

International Cash Conference 2017

War on Cash: Is there a Future for Cash?



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Carl-Ludwig Thiele

Dinner Speech on 25 April 2017



Carl-Ludwig Thiele
Board Member of the Deutsche Bundesbank

Ladies and gentlemen,

It gives me great pleasure to welcome you here to Montfort Castle this evening. I hope you enjoyed today's conference proceedings and the boat trip on Lake Constance. I am particularly honoured to welcome Dr Kurt Pribil, Member of the Governing Board of the Oesterreichische Nationalbank responsible for payment systems.

Our day has been both informative and enlightening, and what better place to end it than in these historic surroundings. Montfort Castle, in its present form, was built in the 19th century by King William I of Württemberg on the site of Count William II of Montfort's castle ruins. The castle is thus named after its first inhabitant, who lived here back in the 14th century. Throughout the years, this Moorish-style building has been a palace, a villa, a guest house, a spa house and even an office building. Among the special features of the castle are the Moorish details, such as the striped effect created by the yellow and red coloured brickwork and the

terracotta relief design on the outside of the building. The building is a significant example of the orientalised architectural art of the 19th century. Montfort Castle now belongs to the municipality of Langenargen, which had the castle thoroughly renovated and remodelled in 1978. This Hall of Mirrors is a rather special setting for the official dinner of our third Cash Conference.

This conference once again brings together central bankers and the academic community of cash researchers. It covers a wide range of current topics with renowned experts discussing interesting aspects. The title this year is: “War on Cash – Is There a Future for Cash?”

Cash is an exciting and important field of research, which has been subject of extensive debate, especially of late. For various reasons, academics, but also other market players, such as commercial banks, card-issuing companies and internet firms, have been speaking out against cash, with the latter hoping to increase the popularity of cashless payment instruments for their own benefit.

Studies show that the payment behaviour of consumers can vary greatly from country to country. Germany is one of those countries that likes to use traditional payment methods. Although a constant – albeit slight – decline in cash as a means of payment can be observed, it is still used for almost 80 percent of all transactions at the point of sale and thus continues to be the medium of choice for spending on everyday necessities. But it is not just the German public’s payment habits that are subject to constant change. Driven by the increasing cost pressure which the banking industry is facing at present, we are currently observing a shift in the way in which consumers obtain and dispose of cash. In the future, cash supply and removal operations could shift from classic bank branches towards the retail industry, predominantly supermarkets. For consumers, especially those that live in rural areas where there are no bank branches and often no ATMs, it will be much easier to obtain and deposit cash. We welcome this new development; however, it sets

us new challenges. If retailers take on traditional banking operations and cash is returned to banks or central banks less frequently, we must, for instance, ensure that counterfeits can still be removed from circulation.

In light of these issues, it is important to forge ahead with our research into the use of cash. Cash is all too often reduced entirely to one supposedly determining factor: cost. However, I believe that it is preferable to give equal consideration to the benefits of cash; in other words, those characteristics that make it unique. The key advantages of cash include anonymity, immediate settlement of a payment contract at the point of sale and the possibility of effecting payment without requiring any other service providers or technical infrastructure. The latter ensures that cash can still be used even if cashless payments are temporarily unavailable.

The Deutsche Bundesbank does not issue any recommendations for or against the use of cash. The driving principle behind our business policy is to support both consumer sovereignty and the principle of contractual freedom, and to let the public decide which method of payment they prefer.

I believe that cash will therefore remain a major component of the payments basket in the foreseeable future. So far, none of the alternative payment forms have been able to fully replicate those properties that have made cash so successful, which is why cash is and remains such a fascinating topic of research. Potential developments and dynamics impacting on the future cash landscape are sure to be the focus of many a conference and research project to come.

On that note, I wish you all a rewarding rest of conference, a lively exchange of ideas and a pleasant evening.

Cheers!



Kurt Pribil

Dinner Speech on 25 April 2017



Kurt Pribil
Board Member of the Oesterreichische Nationalbank

“Research is creating new knowledge”.

Neil Armstrong once stated this and it is a pleasure and privilege for the Austrian National bank to participate as the guest of honour in this year’s International Cash Conference - which is bringing together an impressive panel of cash experts and researchers from all over the world to share and discuss their findings on cash-related subjects - creating new knowledge.

Good Evening Ladies and Gentlemen,

I would like to thank Deutsche Bundesbank for providing us this great opportunity to exchange knowledge and viewpoints on the ever-interesting subject of means of payment. The special surroundings of the beautiful Flower Island of Mainau in Lake Constance are providing additionally an extraordinary cultural experience. Today we are pleased to have our dinner at Montfort castle - the magnificent landmark of Langenargen, built in 1866 in an impressive Moorish style.

Payment behavior is a fundamental basis for the economy. Ensuring that there are sufficient and efficient payment options in all possible transactions is a relevant factor of strengthening the faith not only in the economy but also in the currency. Therefore, it is essential to improve and understand cash payment economics, and to identify possible dynamics and developments that will structure the future cash payments landscape.

Is cash fading away or will there always be cash? With a look into the past: Is there a return of cash across time and across countries? The demand for cash is still growing and Euro cash has quadrupled since the introduction of the Euro. A longer view on cash demand reveals that cash is surprisingly resilient. One reason is that large financial crises lead to a surge in demand for cash and cash serves as a safe asset in times of uncertainty. Cash allows valued characteristics to society as availability to everyone, anonymity, transparent expenditure overview, speed & ease of use or independency of the functioning of electronic networks - just to mention the most important ones.

Are innovative technologies revolutionizing people's life in a way that transactions will only be thinkable in an electronic way? Or might there be a stable component of cash across all business areas and across all countries?

The Eurosystem is neutral with regard to the use of cash and non-cash payment instruments and is making a clear commitment to the future of cash. Lots of alternative payment instruments match some attributes of cash, but none can offer its full range of advantages.

What part does cash cycle optimization play, what is its potential where are the limits?

The Eurosystem monitors the cash cycle in the Euro Area and aims for further increase of its security and efficiency. An important consideration is the permanent enhancement of automation and standardization in the cash cycle.

The program of this conference is a truly stimulating one. Tomorrow 's agenda includes again interesting contributions about cash demand and survey-based studies on the payment behavior, presented by renowned researchers as well as central bank experts. It offers a wealth of subjects relating to cash. Together we can develop ideas and debate in a relaxed atmosphere, free from daily working pressures.

I want to thank once more the Bundesbank for the invitation and this wonderful event and wish us all a pleasant and interesting evening.

Thank you.



Stefan Hardt

Dinner Speech on 26 April 2017



Stefan Hardt

Director General Cash Management
at the Deutsche Bundesbank

Ladies and gentlemen,

I am delighted to welcome you to dinner here at the Schwedenschenke at the end of the second day of conference proceedings. I hope you enjoyed the tour on Island of Mainau, and I'm sure you'll agree that it was pleasant to round off a fascinating day of meetings with a bit of exercise.

The title of this year's conference is "War on Cash: Is there a Future for Cash?" Such a title encompasses various research questions which have been thoroughly examined in the talks we've heard thus far, and will be further investigated in those still to come. This evening I would like to discuss the various operational levels of cash in more detail. I intend to pay particular attention to its haptic, psychological and symbolic aspects.

But before I go into detail, allow me to take you on a short tour through the history of cash. The first money, known as primitive money, came into being in the 6th century BC. Initially this consisted of useful objects which were easy to transport, store and count, such as shells, arrowheads, tea or even salt. Furthermore, the general recognition of the intrinsic value of primitive money was a significant factor.

As goods trading increased, this primitive money came to be replaced by coins with a solely monetary function. These first uniform coins, simple gold nuggets, were manufactured in the 7th century BC by the Lydians, a people in Asia Minor, and minted under Croesus, their king. These coins then gradually spread throughout the Mediterranean region. The advantage of these coins over natural money was that they had a fixed weight. This meant that upon payment, they could simply be counted out rather than having to go through the inconvenient weighing process. The cost and time required for transportation and acquiring information were greatly reduced when money was introduced as an intermediate good and a unit of account.

The advent of paper money in the 10th century represented a further step towards the money of today. In China, their considerable weight meant that the iron coins in use there were deposited with the shops in exchange for a piece of paper upon which the value of the deposit was written. Thus paper money was born. In Europe, paper money was not introduced until much later, in the 14th century, to be precise. Here, valuable items were deposited with bankers. A customer's payment claims upon a bank were noted down and paid out upon request. Depositing customers could transfer these payment claims to other account holders.

Europe's first official banknotes were issued in 1661 by the Bank of Stockholm, a private central bank. However, the new medium soon encountered problems. Money made of paper proved to be both a blessing and a curse. While precious

metals are required to produce currency coins, making production costs comparatively high, this is not the case with paper money. People yielded to the seductively simple production of money and breached the principle of coverage, i.e. the promise by the authority issuing paper money that it would redeem a banknote for coins at any time. The bank ran into difficulties because too many banknotes were printed.

This brief historical summary brings me to the haptic effect of cash. The importance of this aspect appears to have changed continuously throughout history and to have diminished over time – at least at first glance. Although the material value of the medium was of key importance in the beginning of the history of money, it became less significant as time progressed. The introduction of paper money marks the end of the process of dematerialisation. The intrinsic value of the medium became detached from the object itself, and the nominal value by far exceeded the material value. Thus, the actual value of the medium of payment works at a more abstract level. Nevertheless, the haptic of cash continues to play a key role. We do not need to travel too far into the past to find an example that highlights how relevant this aspect is. Let us just take a look at the difference between East and West German coins before reunification; the material coins were made of appears to have played a relevant role. While the 1 Pfennig aluminium coin in East Germany weighed only 0.75 grammes and had a smooth surface without reeding, the 1 Pfennig coin in West Germany was made of non-ferrous metals and, at 2 grammes, weighed more than double as much as the equivalent East German coin. Irrespective of apparently rational considerations, such as that being lighter, the East German coin would be easier to handle, the West German copper coins felt more valuable. People's perceptions are receptive not only to the physical but, above all, the sensory quality of objects. This, in turn, is influenced by visual, haptic and acoustic stimuli. According to what Professor Gabriel said at our 2012 cash symposium, the sensory effect of the aluminium coin was devastating for East Germany. The population saw no aesthetic value in these coins and even ridiculed

them as tin or play money. Given that it is hard to separate economic and aesthetic value, this perception had symbolic repercussions. The perceived aesthetic worthlessness led to a perceived economic worthlessness of the currency, which also entailed a politically symbolic conclusion, the worthlessness of the East German state. The sensory quality of the coins became a metaphor for the entire structure of the state. What we see is that confidence in a currency can be damaged by the material it is made of.

To highlight the relevance of the psychological component of cash, I would like to quote a study conducted last year, which was published in the *Journal of Consumer Research*. The study found that the post-transaction connection with a product or organisation was more pronounced when individuals paid in cash as opposed to debit or credit card. It therefore seems that cash increases an individual's emotional attachment to the purchased product. In addition, it is more likely that individuals will share with others a positive experience with the product or the organisation. The study also found that the likelihood of a repeat purchase increases when individuals pay in cash. As a result, paying in cash appears to have a positive effect on the downstream product and brand connection.

The Dutch central bank also conducted a study on psychological aspects relating to the choice of payment instrument and presented the results at our last cash conference in 2014. The neuroscientific study showed that paying by cash triggers more positive emotions than using cashless means of payment. However, the reasons why paying with cash is associated with positive feelings remain to be explored.

It is very important for the policymakers of a central bank, in particular, to be familiar with the key psychological aspects and effects of its citizen's choice of payment medium. That makes it easier to gauge how the different means of payment will be used in the future. The Bundesbank therefore likewise decided to conduct a

study which would shed light on the psychological motives at play when selecting the means of payment, amongst other things. Most importantly, the study seeks to identify the reasons for the relatively high use of cash in Germany.

As a father of two, let me share a small personal anecdote at this point on the physical and psychological effects of cash. One day, I gave both of my children €10 pocket money. One of them received a €10 banknote, the other two €5 banknotes. And guess what happened? Of course the one who had been given only one banknote was upset because, physically, he had received less money. At a young age, it is hard for children to grasp the abstract value of money. The value they attribute to money is still based on the physical object. Nevertheless, compared with cashless alternatives, cash is easier for children to understand for the simple reason that they can see and touch it.

Finally, I would like to take a look at the third component, the symbolic level of cash. Confidence in a currency is rooted in cash. Euro coins and banknotes have become a symbol inspiring confidence for the entire Eurosystem. As the confidence in a currency depends on the quality and ample supply of cash, amongst other things, it is one of the Bundesbank's core tasks to ensure a high quality and sufficient supply of cash at all times. Quality refers, first and foremost, to making cash counterfeit-proof and durable. However, history has taught us that aesthetic design can also play a decisive role and help promote stability and confidence.

Confidence in a currency is essential to the symbolic component of cash. Without this confidence, the function of money as a means of exchange and store of value would be limited. Money therefore requires acceptance in the sense that it needs to be generally recognised as a means of payment in society. Money is therefore a symbolic medium of exchange in the form of an immaterial value. However, this exchange value is not at all static; what money buys is in constant flux, which means that the relationship between money and services or products is always

changing. It has become absolutely essential for people to have confidence in the stability of a currency, particularly since the nominal value of the means of payment greatly exceeds its material value. Money can therefore be regarded as the mirror image of a global currency area.

As we can see, cash has many facets and levels of impact. This makes cash a multi-faceted and interesting topic of research today and probably also in the future.

At this point I won't test your patience any longer by further delaying dinner. I hope we all continue to gain some interesting insights in what remains of this conference. Here's to a lively exchange of ideas and a pleasant evening.

Cheers!



Peter Sands

The dark side of cash – facilitating crime
and impeding monetary policy



Peter Sands
Harvard Kennedy School,
United States of America

Good morning.

It is a privilege to be talking to a room full of experts on the wonders and mysteries of cash, one of mankind's most brilliant inventions. My thanks to the Deutsche Bundesbank for inviting me to speak.

Yet I confess that as someone who has publically and forcefully argued for the elimination of high denomination bank notes, I feel a bit like Daniel in the lion's den. Almost by definition the people that come to a conference on cash tend to be enthusiasts for cash. So I appreciate that I may seem like an unwelcome interloper.

But first let me declare that I too am an enthusiast for cash. It is, as I said, a brilliant invention. Like the written word and mathematics, the invention of physical money as a medium of exchange and store of value was a huge breakthrough, a massive

step-forward in facilitating human interaction and economic activity. And physical – particularly state-issued paper – cash has stood the test of time. While digital alternatives have swept aside the physical letter, the compact disc and cassette tape, and the videotape, we're using more notes and coins than ever before.

But like many great inventions physical cash has a dark side. It can be used for good or evil. Physical cash is the world's most successful payment mechanism. It's acceptable everywhere. It's incredibly easy to use. It doesn't need electricity, a mobile signal or any kind of merchant device. There's no fee. You don't have to give your name and there's no transaction record so it's completely private. It's no surprise that everyone, everywhere uses cash all the time as they go about their ordinary, law-abiding lives. And on top of that, through seignorage, cash provides a great source of revenue to governments and their central banks – a tax no one complains about (mainly because they don't know it exists).

Yet cash is also the favourite payment mechanism of those who don't abide the law. Amongst drug-traffickers, terrorists, corrupt officials and tax evaders, cash is by far the preferred mechanism for storing money, moving money and making payments. As Europol put it, in the world of the criminal "cash is king".¹ The same attributes that make cash so convenient to those conducting legitimate activities also make it enormously attractive to those who are up to no good.

Of course what criminals really like about cash is the anonymity and the lack of a transaction record. When you're doing something illegal, it's really important you leave no trace. If you're criminal, a tax evader, if you're paying or accepting a bribe, nothing beats cash – not wire transfers, not gold, not bitcoin. Nothing compares.

¹ See, e.g., Europol (2015), *Why is Cash Still King? A Strategic Report on the Use of Cash by Criminal Groups as a Facilitator for Money Laundering*.

Then there's also the fact that the presence of physical cash makes it more difficult for central banks to impose negative interest rates. Since cash offers zero interest rates, it becomes – in relative terms – a high yielding asset when bank account interest rates are negative. Perfectly law-abiding citizens will switch from holding money in a bank account to holding physical cash if interest rates go below zero. In our current ultra-low interest rate environment, central bankers fret that the fact that citizens have the option to hold their savings in cash limits their room for manoeuvre in implementing policy responses to an economic slump. Those central banks that have recently ventured into negative nominal interest rates, have not been willing to go very negative, in part because of the existence of physical cash. It's revealing that in some countries with negative interest rates, such as Switzerland, Denmark, and Sweden, retail savings accounts pay zero, not a negative rate, reflecting the fact that retail savers can so easily switch into cash. Meanwhile corporate and institutional clients do earn negative rates.² So while the existence of cash does not entirely preclude central banks from going below the zero lower bound, it creates a constraint on how negative rates can be and distorts the impact of such a policy.

The impact on the "zero-interest boundary" is a favourite topic of economists and central bankers, since it's intellectually interesting and susceptible to theorising. There's a ton of literature on the topic. I think it is a real issue, but personally I think it's over-egged relative to the issues around the use of cash in financial crime, terrorist finance and tax evasion, about which much less is written. The misuse of cash in financial crime isn't a potential problem, it's a current problem, and a big one.

² James McAndrews (May 2015), "Negative Nominal Central Bank Policy Rates: Where is the Lower Bound?" Speech at the University of Wisconsin. <https://www.newyorkfed.org/newsevents/speeches/2015/mca150508.html>

Don't get me wrong. I am not claiming that cash causes crime, nor that if we got rid of cash that crime would suddenly disappear. All I am saying is that the existence of cash makes being a criminal easier.

Driven in part by increased awareness of the role cash plays in crime and in part by concerns about the impact on monetary policy in a negative interest rate scenario, we have seen much more debate about the role of cash over the last 18 months, not least with the publication of "The Curse of Cash" by my Harvard colleague Ken Rogoff.³ We have witnessed some policy action, such as the decision to stop printing the €500 note and India's "demonetisation" strategy – so much so, that some have declared that's there's a "war on cash". Indeed, that's the title of this conference.

This debate has generated a remarkable level of emotion. Some see every step to curb the illicit use of cash as the thin end of the wedge, first steps towards removing cash altogether, an unacceptable intrusion into people's private lives, a symbol of governmental over-reach. The arch-defenders of cash see a digital dystopia, where the government monitors every transaction you make, where your life savings and identity are vulnerable to cybercrime. Others see cash as a costly relic of an earlier era, the sooner replaced the better. They point to a vision of a totally digital world – more inclusive, more efficient and more accountable.

But it's possible to chart a path between these extremes. To acknowledge the great advantages of cash, the benefits it brings to everyday economic life. Yet also to recognise the dark side, the downsides of cash.

In fact it's not only possible, but it should be an obligation. Cash is a product of the state. It's not as if cash is a natural phenomenon, like wood or oil, or even a prod-

3 Kenneth S. Rogoff (September 2016), "The Curse of Cash", Princeton University Press.

uct of the free market, like bread or cars. The issuance of legal tender is a state monopoly. The choice of denominations, the volumes we print, the rules we make about how cash can be used – these are all policy decisions that should be made with a view to promoting the socially optimal outcome. And this implies understanding both the bright and dark sides of cash, and making trade-offs.

Now the fact that good things can be used in a way that causes harm is not unique to cash. It's also true of:

- wine – delightful with dinner, but damaging to the individual and society when consumed in excess – or if you're under the influence when you drive a car
- pain-killers, from the humble paracetamol to more powerful opiates – essential when you've hurt your back or have a toothache, but also a way to translate a momentary suicidal impulse into suicide itself – and often dangerously addictive.
- the internet – a massively powerful tool for business, education, entertainment and social interaction, but also an enabling mechanism for those with dark desires or malicious intent.
- even planes, trucks and cars. As we have discovered to our horror, these fantastically useful transportation vehicles can also be deployed as weapons of terrorism. More prosaically, we have also determined that driving too fast, or driving while drunk, are types of car useage it is socially beneficial to prohibit.

With all of these examples, researchers and policy-makers have dug deep into analysing the benefits and risks. They've sought to differentiate the good and bad uses. They've looked for ways to protect the benefits, whilst minimising the downside. So for example, with alcohol, we limit the alcohol content, we constrain where you can buy and consume it, we determine who can buy it, and we prohibit drinking and driving. Different societies make different trade-offs, but in most places – and obviously this is different where there are religious constraints on alcohol consumption – the objective is to leave the legitimate use of alcohols

as unfettered as possible, whilst putting in place measures to minimize the downsides.

I'm not claiming that we always get it right in making these trade-offs. In fact it's a constant process of learning and readjustment, balancing the good and the bad. But the point it's that we acknowledge that all these things have a bright and a dark side, we analyse the good and the bad and we seek to devise regulations and mechanisms to maximise the social benefits and minimise the social costs.

One might have thought we would do the same with cash. In fact, you might think that the incentive to devise the optimal trade-off between unfettered use and avoiding abuse would be even higher since, unlike my other examples, cash is solely produced by the state. If the balance is wrong, we can't blame nature or the free market.

Yet there's remarkably little analysis of the benefits and costs of cash. This conference is a great exception – and my plaudits to the Deutsche Bundesbank for holding it – but if you compare the richness of data, array of analyses and number of conferences on other aspects of what central banks do, such as monetary policy and the regulation of banks, the contrast is stark. Decisions on cash are typically made on the basis of scant data and limited analysis. When you think about the data hungry, analytically rigorous approach that central banks take to other aspects of their role, the comparison is striking.

I am sure some central bankers will protest, pointing to their payment surveys or payments diaries as examples of data, and I would agree, these are incredibly valuable. But I would also say that in most countries these are episodic rather than continuous, and perceptual rather than factual. They bear no comparison to the multiple, continuous data feeds of actual prices that inform monetary policy. Or the scale, depth and intensity of bank stress tests. Yet for the most part, these payment

surveys and diaries are our main source of insight into how cash is actually being used.

What is missing is any systematic attempt by central banks to understand how cash is being misused. When a pharmaceutical drug had adverse effects, the pharma company is forced to do extensive research into the prevalence, severity and underlying mechanisms of such effects. Whenever a plane crashes, there's an exhaustive investigation into root causes.

Yet when the most senior law enforcement official on the continent says cash plays a critical role in money laundering and terrorist finance, when tax authorities declare that under-reporting of cash revenues is the biggest source of tax evasion, do we see those who produce of cash rushing to gather data and produce analyses of such problems? There are some honourable exceptions – for example, the Swedish Riksbank – but the honest answer would be, not really. There is some very good work – and much of the latest and best will be presented here – but investigating such abuses is not part of the core data gathering and analytical process of a central bank. This is not something central bank governors spend time thinking about.

When I have said this to central bankers, some replied that it's very difficult to do more than payment surveys because cash is anonymous and leaves no record. But of course that's the point. This is precisely why criminals love using cash.

But there's a lot that could be done to gain a better picture of the illicit use of cash.

If you are a central banker here ask yourself:

- When was the last time you conducted – or requested – an analysis of the denomination mix of law enforcement cash seizures?
- When was the last time you analysed patterns of large value cash deposits and withdrawals to understand what types of customer are withdrawing high denomination notes? Is there a correlation with other indicators of suspicious transactions?
- When was the last time you sat down with law enforcement officials who are experts in, say drug trafficking, to understand the role of cash in the business models of traffickers?
- When was the last time you worked with the tax authorities in your country to conduct analysis of the role of cash in VAT or sales tax evasion? Have you analysed the cash deposit and withdrawal patterns of companies that have been convicted of VAT fraud?

I'm sure some of the people in this room have done these things. But there are not many central bank governors who have spent much time on these issues. When I confront them with such questions some central bankers say that these things are the job of others, of financial intelligence units, law enforcement agencies and tax investigators. Yet that's a cop out. You make the product. You should understand how it is being misused.

And anyway, the message from these agencies is loud and clear.

Law enforcement officials would love to get rid of high denomination notes, put limits on high value cash transactions. For all the effort and money going into AML/KYC, they reckon we're intercepting little more than 1% of illegal financial flows.⁴ And while there are weaknesses elsewhere in the system cash is the gaping hole in anti-money laundering and financial crime control.

Tax collectors would also love to force more transactions away from cash to electronic means. For all the press about big corporate tax evasion and high net worth individuals squirreling away cash in Panama, the biggest source of tax evasion is smaller businesses underreporting income. In Europe alone, VAT evasion amounts to some €160bn per year, and it is believe that most of this is cash-based.⁵

Let me give you an example of analysis that could be done but isn't. If you do a stylised model of the economics of a small retailer, the incentives to use cash to avoid taxes jump out. By not declaring a proportion of cash income, a small retailer can easily improve its profitability by over 50%. Unsurprisingly, that exactly what they do. The IRS has estimated small business in the US only report about half of cash income.⁶ Look at the academic papers on central banking or the working papers from central banks themselves, and you'll see hundreds of papers on how market participants respond to financial incentives in capital and currency markets, to the incentives created by regulatory arbitrage opportunities or to the incentives from compensation schemes. But you'll struggle too much about the incentives created by the most tangible product central banks create, cash.

⁴ United Nations Office on Drugs and Crime (October 2011), "Estimating illicit Financial Flows resulting from Drug Trafficking and other Transnational Organized crimes."

⁵ European Commission, "Study and Reports on the VAT Gap in the EU-28 Member States: 2016 Final Report." TAXUD/2015/CC/131.

⁶ U.S. Internal Revenue Service (August 2007), "Reducing the Federal Tax Gap: A Report on Improving Voluntary Compliance."

To the extent that such work is being done, I suspect it is being done by the people in this room. Which is great. And I am really looking forward to hearing the presentations over the next couple of days. But given the scale of the problems that cash enables and intensifies I would argue it isn't nearly enough.

In fact, I find it hard to think of something so important and ubiquitous produced by the state that is so unscrutinised. While the people in this room are an exception, on the whole central banks seem relatively uninterested in how their most visible product is used, and certainly in how it is misused. To be provocative, I would venture that from outside it looks like a kind of wilful blindness. Many central banks don't seem to want to know about the dark side of cash.

Why is this? I don't want to suggest that it's all self-interest, but I think you have to accept there is a conflict of interest. Central banks make a lot of money issuing cash through seignorage. Having their own income from seignorage buys central banks operational independence from the rest of government. Since in most countries the lion's share of the cash outstanding is in the highest denomination note, most of the seignorage comes from high denomination notes that are rarely used in normal life (but, based on their popularity and the anecdotal evidence that does exist, are used heavily by criminals). In normal times, physical currency constitutes most of the right-hand side of a central bank's balance sheet, yet it is a liability that incurs no interest and is never paid back. Moreover, in some central banks issuing and distributing cash employs more people than other activity. So central banks have a strong vested interest in the status quo. Reducing the role of cash would cut the income of central banks and cut jobs. Institutions facing such threats tends towards defensiveness and denial. It would be remarkable if central banks were immune from such impulses.

A thought experiment. Suppose cash was a commercial product, produced by commercial banks. Wouldn't regulators and policymakers be asking them to justify

Peter Sands: The dark side of cash
– facilitating crime and impeding monetary policy
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why they are facilitating criminal activity? Wouldn't we be putting pressure on them to analyse usage patterns to identify wrongdoers? Wouldn't we be questioning whether profit incentives were encouraging them to issue volumes and denominations that were socially suboptimal?

In fact, this is exactly the stance policymakers and regulators do take towards illicit transactions through the banking system. Banks are under enormous pressure to detect and deter criminal activity through their systems and are fined when they fall short. As a result banks have invested enormous sums in building capabilities and infrastructure to conduct extensive know-your-customer reviews, extensive transaction surveillance and thorough investigation of hundreds of thousands of alerts. It's far from perfect, bad transactions still get through, but the contrast in investment and information versus what we do with cash is astonishing. Moreover, these activities can cause considerable inconvenience to normal, law-abiding customers and have almost certainly driven up the cost of simple banking services. Again the contrast is striking. We are willing to accept considerable inconvenience and cost to make it more difficult for criminals to use the banking system, but often appear reluctant to accept any inconvenience to make it more difficult for criminals to use cash.

At this point, you're probably thinking I'm the devil incarnate, beating up on central bankers and unleashing a war on cash?

But I hope I am not that bad. I acknowledge that central bankers have had a lot of other things to deal with. Rewriting the entire rule book on banking regulation. Catalysing growth in stuttering economies. I also know that a few central banks have been tackling these issues head on. And I applaud the Bundesbank for holding this conference.

And I am not against cash. I am not one of those who think we should push to get rid of cash altogether. There are still some contexts where we don't really have a robust alternative: paying a child some pocket money; giving a donation to someone with a charity bucket; buying food in an emergency when there's no electricity and the mobile phone system is overwhelmed. And, in many of the poorest countries, the infrastructure is still not even close to supporting ubiquitous access to digital alternatives.

Moreover, I accept the argument that privacy matters, that there's a role for being able to make anonymous transactions that leave no record.

But I think we can find a better balance between maximising the benefits of cash and minimising the downside.

The opportunity lies in the different pattern of usage between legitimate uses of cash and socially-damaging illegal use.

In the legal world of everyday life and normal economic activity, the overwhelming majority of cash transactions are for relatively low values, using relatively low value notes and coins.

From payment diaries we see that, across all countries, cash is most popular for transactions of fairly small values. In Europe, cash typically loses its position as most popular payment mechanism in the third quartile of transaction values, in other words, between the median and the 75th percentile. To put this in perspective, in Germany, the 75th percentile transaction value is about €40, so we are not talking about huge sums.⁷ Within the top quartile of transaction values, the use of cash tails off sharply as transaction values increase.

⁷ European Central Bank (2014), Consumer cash usage: A cross-country comparison with payment diary survey data

While the data is far from robust, it seems safe to conclude that only a tiny proportion of cash transactions are for over €200 and only a minute fraction of these are in the thousands of Euro.⁸ That's partly because individuals make far fewer transactions for larger amounts, and partly because we tend not to use cash when we do make these transactions. Of course there are differences between countries, but the general pattern remains the same. Law-abiding citizens make very few large transactions in cash. That is not where there is a massive societal benefit from cash.

Criminals, tax evaders, those paying bribes and terrorists also use cash for small transactions, such as petty theft, avoiding tax on tips, or buying the train ticket to the scene of the terrorist attack. Such crime-facilitating transactions will inevitably happen if cash exists. But I think it is fair to conclude that the social costs of such crimes are massively outweighed by the social benefits of being able to use cash to facilitate the multitude of small transactions that we conduct in everyday life.

But unlike law-abiding people, the bad guys also often use cash for large transactions. While there is no reliable data, it seems likely that a large proportion of large cash transactions – say those over €1000 – involve some form of illegality. There's a reason why people making such large transactions want to keep them secret. And it also seems probable that much, if not most of the usage of the highest denomination bank notes involves some form of illegality. Evidence from investigations into organised crime syndicates and from cash seizures demonstrates that criminals use high denomination bank notes intensively, to move and store money and make payments.

⁸ European Central Bank (2011), The Use of Euro Banknotes: Results of Two Surveys among Households and Firms

So at one level the answer seems simple. Restrict the use of cash for large transactions, by getting rid of high denomination bank notes and imposing cash thresholds, but keep cash for smaller transactions. That way we reduce the dark side of cash, with minimum impact on the bright side.

We don't need to get hung up on precisely where the cut-off between large and small is. If we eliminate the highest denomination notes and prohibit the largest transactions, we can then collect the right data and properly analyse the impact, and go further or not, depending on the results.

To some extent this is what is happening. The ECB decided to stop printing the €500 note last May – a decision I applaud. The catch is that printing will continue until next year, and all outstanding notes will, of course, always remain legal tender. As a result, we have given organised crime syndicates plenty of time to adjust their business models. Countries like Singapore and Canada have already got rid of high denomination notes such as the Sing\$10000 and the CAN\$1000.

India's "demonetization" strategy doesn't quite fit the mould. The underlying objective appears to be roughly the same – to curb organised crime, tax evasion and terrorist finance, and perhaps above all, corruption, but the approach taken is very different. By getting rid of the 500 and 1000 rupee notes (and not just stopping printing, but in a matter of weeks cancelling legal tender status) which aren't high value notes by international standards, since they're worth about \$7 and \$15 respectively the Indian Government risked much greater economic disruption, particularly in poorer, rural areas where the digital infrastructure is limited. India has also started issuing a 2000 rupee note. Others will no doubt go into much greater detail on the India experience, but from my perspective the strategy seem a bit muddled and the execution of the strategy, far from perfect. Yet I have to admire the ambition. Modi is clearly determined to turbocharge the shift to a much more digital payments environment. The logic is compelling. Cash-driven economies like

India cannot raise taxes effectively and are crippled by corruption.

Across Europe and in a few countries elsewhere, countries are introducing cash thresholds, limits on the size of transaction that can be conducted with cash. Colleagues of mine will present on this topic later in this conference, so I don't want to steal their thunder, but I will tell you I think they're a good idea. If someone is buying something with cash for €5000, what's more likely:

- That they have a legitimate reason for using cash, such as concerns about privacy or to avoid credit card fees?
- Or that they got the money illegally or want to avoid VAT?

Maybe I have too little faith in humanity, but I know which option I think is more likely. I'm not convinced by the arguments around privacy or avoiding credit card fees. Most things you buy for €5000 – a car, a motorbike a valuable artwork, a new kitchen – need to be registered, insured or involve a contract. They're not private in the way the cash transaction is private. And you don't need to use a credit card. Debit cards don't have ad valorem fees and neither do bank transfers.

Much more compelling is the utilisation of cash I didn't pay tax on, or obtained through illegal activity. Or if I am – by my own lights – a law-abiding citizen, I might still be tempted by the chance to avoid 20% VAT – on a €5000 purchase, saving a cool €1000. Many citizens – and dare I say it, central bankers – don't see such tax evasion as being really criminal. Certain types of tax evasion – say, the way you buy a second hand car – are normalised.

Yet endemic tax evasion imposes huge costs. Here is an economic study central banks should fund – an investigation into the economic distortions caused by cash-based tax evasion, much as financial economists have conducted hundreds of studies on the distortion of incentives caused by the interest tax deduction. Those

sectors of the economy in which it is easy to use cash to evade tax should in theory receive disproportionate investment relative to those in which it is more difficult, since post tax returns are in effect subsidised. Given the scale of the underground economy in most advanced economies, let alone less developed economies, these distortions are likely to be quite powerful.

Various arguments are made against measures like eliminating high denomination notes or imposing cash thresholds.

Most common is the slippery slope argument: put any restriction on the use of cash and we're on the road to an Orwellian nightmare, where the big brother state watches everything you do with your money.

This is an absurd argument. It's like saying because we put restrictions on the use of opiate pain-killers, we are on the road to depriving everyone of aspirin and paracetamol. Because we don't let people drive when inebriated, we are on the road to banning alcohol. Because we fine people who speed, we are on the way to banning driving cars.

Sensible restrictions on the use of any product to avoid social harm don't represent a path to elimination. In a way they represent the opposite. They allow us to enjoy the benefits of the product whilst minimising the downside.

Another argument against restrictions on the use of cash relate to privacy. If we are forced to use digital alternatives to cash then our bank and the government will know exactly what we are buying and selling, where we are going and so on. I share the concern about unwarranted intrusions into individual liberty. We want the freedom to be able to live our lives – including buying and selling things – without having the sense that our bank or government can always spy on us.

Protecting that privacy in the things we do every day is one reason I am not in hurry to get rid of cash entirely. Whilst there are ways we can protect privacy in the digital world, cash is a simple, proven mechanism for enabling people to conduct everyday transactions anonymously.

But privacy isn't an absolute right. In many areas we accept limits to privacy in the interest of the greater social good. When you fly you don't get to keep your identity – or the contents of your carry-on luggage – entirely private. We work hard to stop paedophiles keeping their grooming activities private. In professional life we have rules to force people to reveal conflicts of interest, not keep them private. While privacy is the starting presumption, there are many instances where policy-makers have decided to impose limits to privacy in the interests of society as a whole.

My instinct is that while there may a good case for enabling people to keep small transactions private, the argument doesn't hold for large transactions. Think about what large transactions – say anything over €2000 – are for. It's things like buying a car or motorbike, buying a house, booking a holiday, buying a work of art, buying furniture, holding a party, repairing a building, or paying for personal services like medical care. In many cases, we already require some form of registration or identity so privacy will be compromised in any case. In others, the purchaser will typically buy insurance, again compromising privacy. In fact in a well-established democracy, it's quite hard to imagine circumstances when we would keep such a large transaction private for legitimate reasons.

By contrast it all too easy to imagine the many illegitimate reasons we might want to keep such a transaction private, or at least, how we paid for it. Keeping it private enables us to launder money, evade taxes, slip in a bribe. It is not difficult to make the argument that while privacy should hold for small transactions, maximising the social good requires transparency for large transactions.

A third argument against reducing the role of cash relates to cyber-risks. Won't we be pleased we held on to cash when the banking system comes crashing down? Not really, because if cyber attacks demolish the banks then society will be in chaos. Having a bit of cash will be helpful in this scenario, but it's not exactly a good fall-back position. Moreover, the wrong people will have the cash – since so much of it sits in the hands of criminals and tax-evaders. I don't underestimate cyber-risks, but I don't think cash is the answer. It's a bit like suggesting candles will be helpful if cyber-terrorists take out the power distribution grid – true to a point. The real answer is to make our digital systems more resilient to cyber threats.

Finally, there is the argument that restricting the use of cash would have minimal impact on criminal activity, so why bother? Why cause inconvenience to people who want to use cash, even for large transactions, when criminals are just going to find other ways to go about their business? Yet in the case of tax evasion, even a modest reduction in underreporting will yield huge gains in revenue collection. And for law-enforcement agencies, so much of what they do is targeted at making it incrementally harder and riskier for criminals to conduct their activities: adding impediments to criminal activity – locks, burglar alarms, fraud detection systems, cash thresholds; removing or controlling things that facilitate criminal activity – guns, knives, high denomination bank notes. Given that the social costs of crime are exceedingly high⁹, then even small reductions in crime – whether through increasing the ability of law enforcement to detect and catch criminals, or through making it more costly or difficult for criminals to act – can yield massive social benefits.

⁹ Hannah Mills, Sara Skodbo, and Peter Blyth (October 2013), "Understanding Organized Crime: estimating the scale and the social and economic costs." United Kingdom Home Office.

When you look forward and think about the dynamics of what is happening, the implications for central bankers that issue cash should raise alarm bells. On the one hand you have technology, which is making electronic alternatives to cash ever more convenient. Take contactless cards. They directly replace cash for a huge number of transactions, whether getting on the bus, buying a coffee, or buying flowers for your partner. On the other hand you have the increasing sophistication of banks KYC/AML systems. Given the billions of dollars banks have been spending on their transaction surveillance systems, any sensible criminal is going to shift more of their activity into cash.

As these trends unfold - with legal activity moving to electronic alternatives and illegal activity shifting out of the banking system towards cash - the share of cash transactions that are connected to illicit activity will inexorably increase, particularly for larger transactions and larger denomination bank notes. There will be a tipping point when so much of the use of cash is for illegal purposes, that it is actively avoided by law-abiding citizens and businesses. In fact we're probably already there in some countries when it comes to the use of high denomination notes. Many retailers across the EU won't accept €500 notes. In the UK, many retailers won't accept the comparatively humble €50 note.

But this is going to get worse. As ever more sophisticated AML techniques force criminals to avoid the banking system, wrongdoers will get their money in cash, keep it in cash and want to spend it in cash. The world of crime will become ever more cash intensive. And the more this happens, the more the rest of the world will shun cash.

Resisting every attempt to curb the illicit use of cash is the wrong way to protect the valuable role cash plays in our societies. It will have the opposite effect. Let cash become the exclusive preserve of the criminal world and you'll find more and more policymakers arguing to get rid of cash. Understand and control the use of

cash by the bad guys and we'll be able to shape the usage patterns to maximise the bright side and minimise the dark.

To do this requires acknowledging that cash is being used for bad purposes and investing in research and analysis to understand these dynamics. It requires central banks to grasp the nettle and take action on high denomination bank notes and high value cash transactions. Normal society does not need a CHF1000 note, €500 notes – or even €200 or €100 notes. The US does not need over 30 US\$100 bills for every man, woman and child living in America. We don't need the freedom to buy things for thousands in cash. We do need the ability to easily pay for daily purchases in cash. And we do need less crime, less corruption, less tax evasion and less terrorism.

Thank you.



Friedrich Schneider¹

Restricting or abolishing cash: an effective instrument for fighting the shadow economy, crime and terrorism?²



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Abstract

This paper has four goals: First, the use of cash as a possible driving factor of the shadow economy is investigated. Second, the use of cash in crime, here especially in corruption, is also econometrically investigated. The influence is somewhat larger than on the shadow economy, but it is certainly not a decisive factor for bribery activities. Some figures about organized crime are also shown; the importance of cash is diminishing. Third, some remarks about terrorism are made and here a cash

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² A first version of this paper was presented at the Bundesbank Conference in Konstanz/ (Germany), April 20–23, 2017, Friedrich Schneider (2013).

limit doesn't prevent terrorism. Fourth, some remarks are made about the restriction or abolishment of cash on civil liberties, with the result that this will extremely limit them. The conclusion of this paper is that cash has a minor influence on the shadow economy, crime and terrorism, but potentially a major influence on civil liberties.

1 Introduction

In recent years intensive discussion has arisen about restricting or even abolishing the use of cash. I am aware that there is a much longer and more extensive debate about the costs and benefits of phasing out paper currency, which is the title of a paper of Rogoff (2014).³ But what is new, all of a sudden, is the suggestion that the restriction or even abolition of cash would more or less do miracles: If cash were to be severely restricted or no longer existed, there would be much less crime and the shadow economy would be drastically reduced, because most shadow economy transactions are usually undertaken in cash. Also if cash were not easily available, terrorist attacks would be severely hampered. This paper tries to shed some light on whether cash has such an important influence on the shadow economy, crime and terrorism, but also on the effect which reduced cash would have on civil liberties.

In most countries the dominant means of transfer in paying legally (but also illegally) for goods and services is cash, which has proved to be an efficient means of handling all economic activities. But there is a growing literature claiming that cash supports the shadow economy, crime and terrorism and is risky, old fashioned and unnecessary, especially if one considers the fast increase in electronic payments.⁴

³ Compare here only some recent references: Sands (2016), Rogoff (2014), Feige (2012), Schneider and Linsbauer (2016), Riccardi and Levi (2017), Imordino and Wussow (2016), Saints (2016) and Rogoff (2014).

⁴ Riccardi and Levi (2017), Levi (2016) and Andersen et al. (2013).

Hence, the goal of this paper is to undertake an empirical econometric investigation about the relations (1) between cash and the shadow economy and (2) between cash and crime, including corruption. Furthermore, some remarks are made about (3) cash and terrorism and (4) cash and civil liberty. To my knowledge a sound econometric investigation has not been undertaken in order to fulfill the *ceteris paribus* condition for evaluating the relation between cash and the shadow economy and the relation between cash and corruption, e.g. as measured by the Transparency Corruption Perception index.

The paper is organized as follows: In chapter 2 some short remarks about the use of cash are made. Chapter 3 deals with cash versus illegal activities; in subchapters 3.1 cash and shadow economy, 3.2 cash and bribery, 3.3 cash and crime and 3.4 cash and terrorism. In the final chapter 4 some considerations about cash versus civil liberties are undertaken and conclusions are drawn.

2 Some remarks about the use of cash

In this chapter, some short remarks about the use of cash are made. The recent data shows that cash is heavily used in the legal economy. Despite the increasing use of alternative payment methods, such as credit cards, electronic payment systems, or virtual currency, banknotes still represent the preferred means of payment, both in Europe and abroad, including the United States. This is particularly true for small-scale purchases in certain sectors.

There are numerous studies which extensively analyze the use of cash.⁵ Bagnall et al. (2014) state that their paper is one of the first that analyzes the cash payment behavior of consumers, using harmonized micro-data from several countries

⁵ Compare e.g. the papers of Bagnall et al. (2014), Riccardi and Levi (2017), Ardizzi (2015), to mention just a few recent studies.

(Australia, Austria, Canada, France, Germany, The Netherlands and the United States). Due to the lack of available data, they argue that relatively little has been known about the use of cash. These authors provide first evidence. They combine data from a regular questionnaire with data from payment diaries, which collect information on individual payments by consumers. This allows them to comprehensively analyze consumers' payment behavior. They come to the surprising result that in spite of what many have predicted so far (that cash is disappearing as a payment instrument), their research paper shows, that in all seven countries considered cash is still used extensively, in particular for lower value transactions. In table 2.1 the results for the use of cash are shown. The table is taken from Bagnall et al. (2014). It clearly shows that cash is mostly used in Austria with 82% payment share by volume, followed by Germany with also 82% and then by Australia with 65%. If we look at payment share by value, in Austria cash is still mostly used with 65% followed by Germany with 53% and then by the Netherlands with 34%. This table clearly shows that cash is still quite heavily used.

Use of Cash, Years 2010–2012 in seven highly developed OECD countries

Table 2.1

Variable	Country						
	AU	AT	CA	FR	DE	NL	US
Payment share by volume							
Cash	0.65	0.82	0.53	0.56	0.82	0.52	0.46
Debit	0.22	0.14	0.25	0.31	0.13	0.41	0.26
Credit	0.09	0.02	0.19	0.01	0.02	0.01	0.19
Total	0.96	0.98	0.97	0.88	0.97	0.95	0.91
<i>Other most important payment instrument (share > 5%)</i>	-	-	-	0.09 ^a	-	-	-
Payment share by value							
Cash	0.32	0.65	0.23	0.15	0.53	0.34	0.23
Debit	0.32	0.25	0.30	0.43	0.28	0.60	0.27
Credit	0.18	0.05	0.41	0.03	0.07	0.04	0.28
Total	0.82	0.95	0.94	0.60	0.89	0.97	0.78
<i>Other most important payment instrument (share > 5%)</i>	0.12 ^b	-	-	0.30 ^a	-	-	0.14 ^a

^a Cheques.

^b Internet/telephone banking.

Notes: Authors' calculation based on questionnaire and diary surveys. Nominal values are expressed in PPP-adjusted USD. PPP exchange rates are taken from the OECD: http://www.oecd.org/std/pricesandpurchasesingpwwerparitiesppp/PPP_OECD.xls.

Source: Bagnall et al. (2014), p. 27.

In table 2.2 the use of Euro banknotes (in circulation estimates) for 2008 and 2014 is shown. One realizes clearly that in 2014 households and non-bank companies used Euro banknotes for 30% of total payments, somewhat less than in 2008 where it was 33%. Also banks' use of cash dropped from 8% to 6%, holdings of cash outside the European monetary union increased from 20% to 23% (2014) and domestic cash hoarding by households and non-bank-companies increased from 39% to 41%.

If we consider other studies, e.g. Drehman et al. (2002), who analyze cash use in several countries, come to the result that it is widespread, especially for low-value transactions, and systematic differences between countries persist. Other related studies include, among others, Amromin and Chakravorti (2009) who find decreasing demand for small denomination currency, even when debit card use increases. Alvarez and Lippi (2009) and Lippi and Secchi (2009), who study the relationship between money demand and innovations in money withdrawal technologies, and Evans, Webster, Colgan, and Murray (2013) show increased cash use in European countries from 2000 to 2012. Of course, one should be clear here that the use of cash is vastly different from country to country and is driven by different payment habits.

Use of euro banknotes in circulation
– estimates in 2008 and 2014

Table 2.2

Purpose/Variable	User	Year 2008		Year 2014	
		Share of total	EUR bn	Share of total	EUR bn
Domestic transaction balance	Households, non-bank companies	33%	250	30% ↓	305
Banks' vault cash	Euro area banks	8%	60	6% ↓	61
Holdings outside the EMU	No sectoral information	20%	150	23% ↑	230
Domestic cash hoarding	Households, non-bank companies	39%	300	41% ↑	420
Total value of euro banknotes in circulation	All users	100%	763	100%	1017

Source: Mai, H. (2016), p.4.

This can also be seen in table 2.3, where the result of an ECB survey about the use of cash is reported for the year 2011. With the exception of Luxembourg and the Netherlands small Euro amounts (< 20€) are dominantly used for purchases; e.g. 91% in Germany, 90% in Spain and 91% in Italy. If one uses the purchase value 30–100 Euro, the use of cash drops but is still 77% in Italy, 69% in Germany and 64% in Spain. If we consider purchases between 200 and 1000 Euro the use of cash drops heavily but is still 30% in Spain, 31% in Italy and 21% in Germany. If one takes purchases of 1000 Euro and more the figure drops down to below around 6% but in Austria is still 10%. This clearly shows that small sums are dominantly paid in cash.

Percentage of respondents always or often using cash by value of purchase; year 2011; 8 EU-countries

Table 2.3

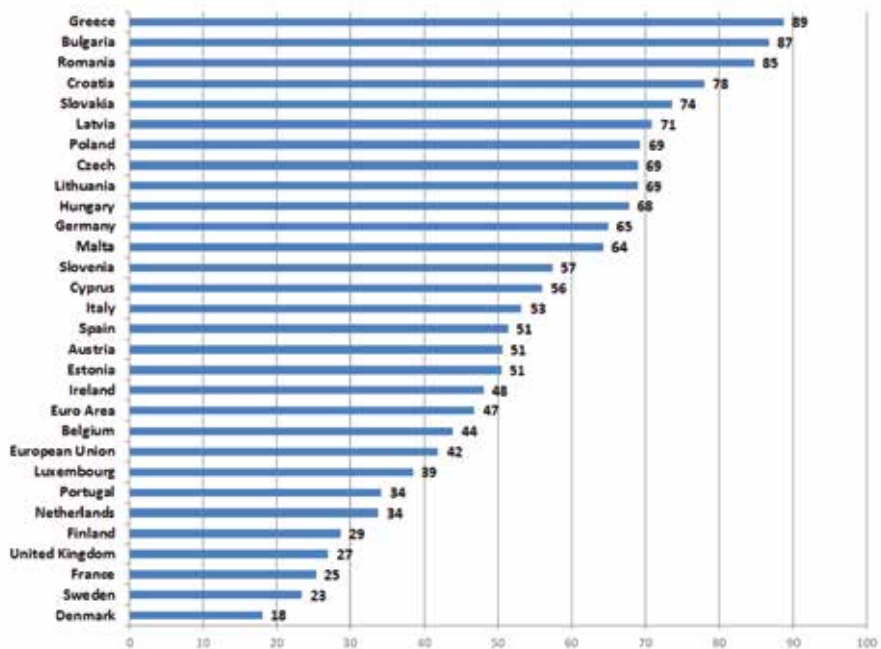
Country	Percent of respondents always or often using cash by value of purchase			
	< 20 euro	30–100 euro	2,000–10,000 euro	> 10,000 euro
Belgium	84%	48%	18%	5%
Germany	91%	69%	21%	4%
Spain	90%	64%	30%	6%
France	80%	15%	3%	0%
Italy	91%	77%	31%	4%
Luxembourg	77%	27%	10%	3%
Netherlands	65%	20%	8%	4%
Austria	82%	60%	29%	10%
AVERAGE (8 EU MS)	87%	55%	20%	4%

Source: ECB, Frankfurt (2011).

Finally, in figure 2.1 the average cash ratio (defined as the ratio between the amount of ATM withdrawals (proxy for cash use) and the sum of total payments) over the period 2011–2015 is shown across European Union countries. For the countries of the Euro area it is 46.8%, for the total European Union it is 41.9%. The highest shares are for Greece, Bulgaria and Romania with 88.8%, 88.6% and 84.8%; the lowest are for the United Kingdom. France and Sweden with 27.0%, 25.3% and 23.4%. Again, huge differences!

**Cash-ratio across 28 European countries;
average 2011 – 2015¹⁾**

Figure 2.1



1) The ratio is defined as the ratio between the amount of ATM withdrawals (proxy of cash use) and the sum of total payments including those through residents' points of sale (POS).

Source: Piccardi and Levi (2017), who draw on ECB data.

To summarize, these tables, figures and remarks clearly show that cash was still dominantly used in Europe and in other highly developed OECD countries over the period 2010 to 2015. The percentage of use is vastly different between countries and it all depends on payment habits. But these tables clearly show that cash is an important element and also that cash hoarding increased significantly.

3 Cash versus illegal activities

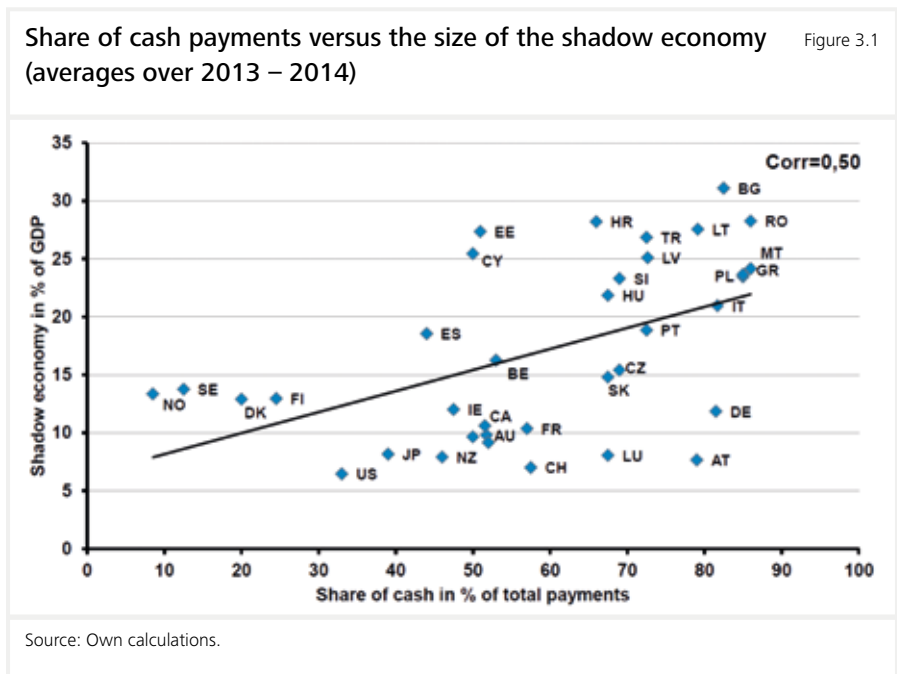
In this chapter the major research question is “How much does cash stimulate illegal activities?”, starting with the shadow economy, then crime and corruption, and finally considering terrorist financing. It is obvious that cash cannot be easily traced, which makes cash attractive for transactions related to the shadow economy, bribery, crime and finance of terrorism. But still an important question is: Is cash a major source of the shadow economy, of crime and of terrorism or just one means?

3.1 Cash and the shadow economy

Shadow economy refers to business/economic activities off the books, which are legally allowed but not recorded in order to avoid tax and social security payments and to avoid labor market and other regulations.⁶ In this subchapter I want to investigate the role cash “plays” as an indicator of the size of the shadow economy. In figure 3.1, the share of cash payments versus the size of the shadow economies of 36 highly developed countries averaged over 2013–2014 are shown. One clearly realizes that the larger the share of cash in total payments the larger the size of the shadow economy. The correlation coefficient between the two variables is 0.50 and is highly statistically significant. Hence, at a first glance, it looks like the

⁶ There is an extensive literature about the definition of a shadow economy also estimating a shadow economy and its interaction with the official economy. Compare for example Feld and Schneider (2010), Gerxhani (2003), Schneider (2015, 2017), Schneider and Williams (2013) and Williams and Schneider (2016) as well as Sauka, Schneider and Williams (2016). Due to this extensive literature a longer discussion about defining and estimating a shadow economy and its interaction with the official one is not undertaken in this paper.

higher the share of cash (as a percentage of total payments) the larger the shadow economy. However, if one also looks at figure 3.1 there are some distinct exceptions, for example Germany and Austria are cash-intensive countries with relatively small shadow economies. In Sweden, where cash payments have become rare, the country still has a medium-sized shadow economy.



Given these inconclusive findings and in order to fulfill the *ceteris paribus* condition an econometric investigation is undertaken. I know that the shadow economy is driven by tax burden, by regulation, by the quality of public institutions, unemployment, tax morale and other factors.⁷ But how is it related to the use of cash

⁷ Compare here for example Feld and Schneider (2010) and Schneider (2015, 2017).

and/ or cash limits?⁸ In this paper I choose three ways of investigation.

First, using a MIMIC estimation, shadow economy is a constructed figure with various causes, such as tax burden, regulation measures, economic freedom, legal system, tax morale, etc. Indicators, like employment and GDP and cash or cash limits are neither used here as indicator nor as cause variables. These “cash free” shadow economy figures are now regressed on the availability of cash approximately by the share of cash in total payments and by cash limits. The results are shown in table 3.1. The size of the shadow economy in 38 highly developed countries as averaged over the years 2013/2014 is regressed on GDP per capita, share of cash payments and cash limits, which exist in a number of European countries. The results clearly show that the share of cash payments has an influence on the size and development of the shadow economy and is statistically significant; the more cash, the larger the shadow economy, *ceteris paribus*. However, the estimate coefficient of cash limits which is in place in various European countries (for example Italy, France) has the theoretically expected negative sign, but is not statistically significant.

In table 3.2 some simulation results are undertaken about the importance of the cash figure on the size of the shadow economy. Table 3.2 clearly shows that when GDP decreases by 10%, the shadow economy increases by 18.4%. When the share of cash payments decreases by 10% the shadow economy decreases just by 2%. If we make the assumption that no cash is available anymore, the shadow economy would decrease by 20%. Cash limits have no significant effects.

⁸ It is obvious, that cash is an important element or indicator of the shadow economy. There is even one method, the currency demand approach, which originally was developed by Vito Tanzi and Gutmann in the 80s, who use the idea that the amount of cash held outside banks is a function of traditional factors like consumption habits, income and interest rates, but also one can include factors which are drivers of the shadow economy, like tax burden and regulation. One can econometrically estimate such a function and can derive value-added figures of the size of the shadow economy. But again, here cash is only an indicator and not the primary reason why people work in the shadow economy.

**OLS-Regression with robust standard errors;
38 highly developed countries; average of the shadow
economy of the years 2013/2014**

Table 3.1

Dependent variable: Shadow Economy in % of GDP (average over 2013/2014)	Coefficients (t/z-value) [beta-value]	Independent variables
	96.490** (6.46)	Constant term
	-7.991** (-6.30) [-0.714]*	log(GDP p.c.) (average over 2013/2014)
	0.075* (2.06) [0.204]	Share of cash payments in % of all payments (average over 2013/2014)
	-1.450 (-1.07)*** [-0.091]	Cash limit (dummy-variable 1=limit, 0=no limit)

*

**

*** Not statist. significant!

Source: Own calculations

**Static simulation results
(no adjustment procedures are assumed!)**

Table 3.2

Simulations of standardized effects		
Variable	Effect on shadow economy	
GDP p.c.	10% decrease	– Shadow economy increases by 18.4%
Share of cash payments	10% decrease	– Shadow economy decreases by 2.01%
No cash payments, at all	Drops to 0!	– Shadow economy decreases by 20.1%
Cash limit	[Introduction of cash limit]	– no significant effect

Source: Own calculations.

The second way to test how important cash is for the shadow economy, or whether a cash limit would reduce the shadow economy as a causal variable, is investigated by undertaking a MIMIC estimation⁹; the results are presented in table 3.3. We clearly see that the cash limit variable has no statistically significant influence as a causal factor on the size of the shadow economy whereas the tax burden, rule of law index and the inflation rate all have the theoretically expected sign and are highly statistically significant; the only exception is unemployment, which has the expected sign, but is not statistically significant. Cash as an indicator of the shadow economy has a statistically significant influence on the size of the shadow economy.

⁹ This estimation procedure is explained in detail in Schneider (2017), Feld and Schneider (2011), and Schneider and Enste (2010).

**MIMIC estimation, latent variables:
shadow economy of 36 highly developed countries;
years 2012 to 2014**

Table 3.3

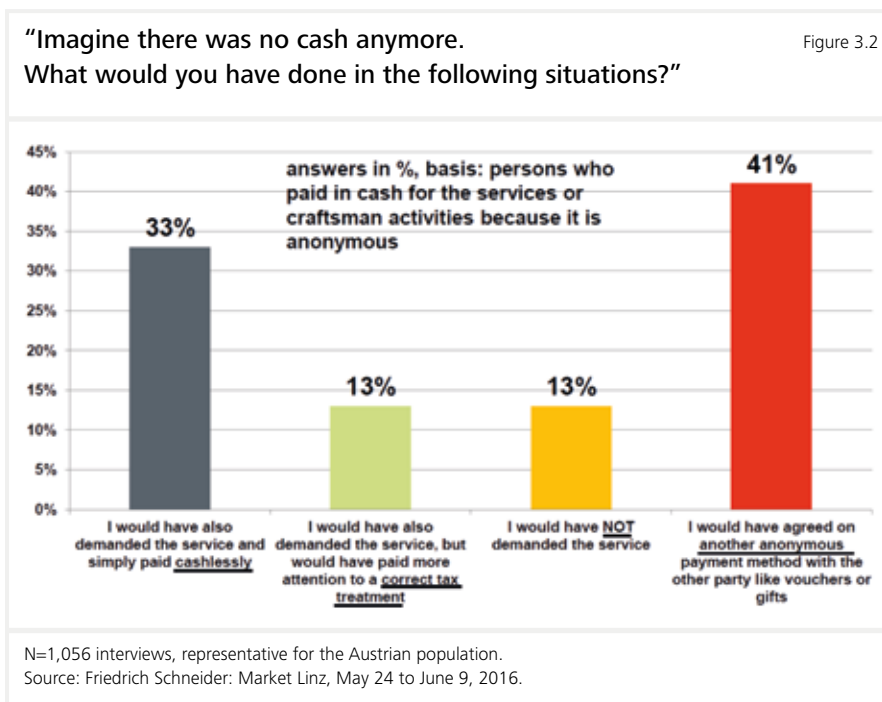
MIMIC Estimates	
Causal variables	Est. Coeff.
Cash limit (dummy-variable: 1=limit, 0=no limit)	1.889 (0.56)
Tax burden in % of GDP	0.174** (2.10)
Rule of law index (the better, the higher)	−2.995*** (−3.28)
Inflation rate	2.824*** (3.50)
Unemployment rate	1.735 (0.60)
Indicator variables	
Cash as share of all payments	1.00 constrained
Labor force participation rate	−0.431*** (−3.44)
Chi-Square	6.14 (0.188)
RMSA	0.122
Coefficient of determination	0.908
Observations	36

**

Source: Own calculations.

The third way is a first attempt at a micro study. In figure 3.2 some first micro results about the following question are shown. "Imagine there was no cash anymore. What would you have done in the following situations?" The answers are in percent of those persons who said that they paid in cash for services or trades activities because it was anonymous. 33% of the Austrians interviewed (interviews were done from May 24 to June 29, 2016 with 1056 interviewed persons) would still demand the service and would pay cashless. 13% said that they would still have demanded the service but would have paid more attention to correct tax treatment. 13% would not have demanded the service anymore and 41% would have negotiated another anonymous payment method with the other party, such as vouchers or gifts. Hence, even under the extreme assumption that no cash is available, 41% of the people who prefer anonymous payment would still seek an anonymous payment method.¹⁰ To summarize, cash is an important element in the shadow economy. But cash is by no means a causal factor and it has quantitatively limited influence on the development of a shadow economy. Without any cash a shadow economy might be reduced between 10 to 20%.

¹⁰ These are first results on a project of a micro-investigation for Austria about the structure of the shadow economy motivation and why people work in the shadow economy.



3.2 Cash versus illegal activities

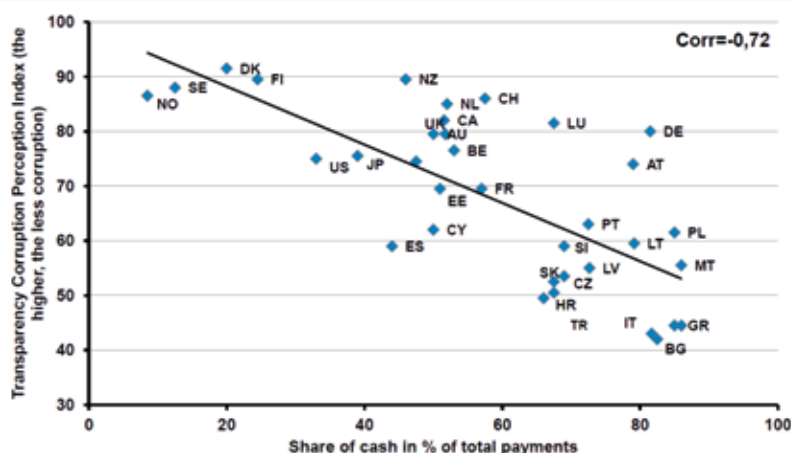
3.2.1 The case of corruption

As in subchapter 3.1, the use of cash is often blamed as the main enabler of bribery, corruption and other crime activities. In many countries the simple equation of much cash, much bribery, seems to hold true in media stories. In countries such as Switzerland and Austria, low levels of perceived public-sector corruption and bribery occur alongside a high share of cash in total payments and/or low number of cashless payments per person. Compare here figure 3.3, in which the share of cash payments and the transparency corruption perception index are plotted. We clearly see in this figure that the higher the corruption the lower the transparency corruption index value, and the higher the cash share. Hence, countries like Greece

and Bulgaria (which have high corruption) also have a high share of cash payments measured as a percentage of total payments; the correlation coefficient is -0.72 and highly statistically significant. But, as already argued, other countries such as Switzerland, Germany and Austria have a high share of cash payments, but quite low corruption. As in the shadow economy case from this figure, we cannot draw the conclusion that cash is responsible for corruption.

Share of cash payments as an indicator of corruption
(averages over 2014 – 2015)

Figure 3.3



Source: Own calculations.

Again, I undertake an econometric investigation, trying to explain corruption. Corruption has considerable impact on economic, political and social factors and is subject to a vast range of institutional, jurisdictional, society and economic conditions. In a survey paper, Dimand and Tosato (2017) provide a comprehensive state of the art survey of the existing literature on corruption and its causal effects. They reach the conclusion that thanks to more convenient and better availability of data,

empirical research on corruption has advanced vastly over the last decade. They conclude that from a scholarly perspective the remaining challenge is how to deal with noisy data and they try to capture hidden behavior. Their survey shed light on the development of empirical corruption research and on the non-robustness of older and newer empirical findings. They show that recent empirical findings on the interrelation between corruption and bureaucracy, press and economic freedom, poverty wages and/or the shadow economy are in line with both theoretical assumptions and older empirical research. They further conclude that the quality of empirical research and corruption is still advancing and needs to settle important issues, such as the right way to measure corruption, before being able to settle debate of conflicting empirical findings. They conclude that more micro-data is required in order to get consistent findings.¹¹

Considering these survey results, an attempt is made here to explain corruption. The transparency corruption index (TCI) is used as dependent variable; and indices of rule of law and economic freedom, GDP per capita, share of cash payments and cash limits are used as independent variables.¹² The TCI of 38 highly developed countries over 2014/2015 is used. The results are reported in table 3.4 (note that for the dependent variable the TCI, the higher the value the lower the corruption!). The regression shows that the better the rule of law and the more economic freedom is granted, the lower is corruption. It also shows, the higher GDP per capita is, the lower is corruption. The result also shows that the higher the share of cash payments, the higher is corruption; the estimated coefficient is statistically significant. Finally, the cash limit dummy variable has the wrong sign and is not statistically significant.

11 A similar conclusion was also reached by Dreher and Schneider (2009), who empirically investigated the interaction between corruption and the shadow economy.

12 Amazingly, in the survey by Dimand and Tosato (2017), cash as a driving force for corruption is not even mentioned.

Regression results: Transparency Corruption Index (the higher the value, the lower corruption); 38 highly developed countries; years 2014/2015

Table 3.4

Dependent variable: Transparency Corruption Index (TCI) (average over 2014/2015) (The higher the value, the lower corruption) Test-Statistics:: R ² =0.924 F-value=124.64(0.000) RMSE=4.67 D.F.=32	Coefficients (t/z-value) [beta-value]	Independent variables
	-44.725* (-2.48)	Constant term
	0.616** (3.18) [0.424]	Rule of Law Index; the higher, the better
	0.507* (2.59) [0.204]	Economic freedom index; the higher, the better
	4.060(*) (1.65) [0.176]	log(GDP p.c.) (average over 2013/2014)
	-0.176** (-3.30) [-0.233]	Share of cash payments in % of all payments (average over 2013/2014)
	-2.192 (-1.23)*** [-0.066]	Cash limit (dummy-variable 1=limit, 0=no limit)
* ** *** Wrong sign! Not significant! Source: Own calculations		

In table 3.5 some simulation results about quantitative importance are presented. One realizes that if the rule of law (economic freedom), increases by 10 percentage points, the TCI increases by 6.1 (5.0%), which means less corruption. If the share of cash payments is decreased by 10 percentage points, the TCI increases only by 1.8%, which means less corruption. I have here a statistically significant effect of the estimated coefficient of the cash variable, but compared to the other two variables, it is only of minor importance.

**Simulation results on TCI Transparency Corruption Index
(the higher the value, the lower corruption)**

Table 3.5

Standardized effects – Simulations

Rule of law	+10 percentage points	– Increase of 6.1 percentage points of the TCI – Less corruption
Economic freedom	+10 percentage points	– Increase of 5.0 percentage points of the TCI – Less corruption
Share of cash payments	–10 percentage points	– Increase of 1.8 percentage points of the TCI – Less corruption
Cash limit=1		Wrong sign! Not significant!

Source: Own calculations.

Finally, in table 3.6 a robustness test for six different specifications is presented, as Dimand and Tosato (2017) argued in their survey about the instability of the regression results explaining corruption. Table 3.6 clearly shows that the estimated coefficient of cash share is in three cases statistically significant and in three cases not. The estimated coefficient of cash limit is not statistically significant in any the six cases. I must confess that the results are not stable. Hence, I cannot conclude that cash is a driver of corruption.

Problem of stability of the estimated coefficients of the variables “cash share” and “cash limit”

Table 3.6

No.	Estimated coefficient of “Cash share”	Estimated coefficient of “Cash limit”	Specification of the regression; depended variable; Transparency Corruption Index
1	−0.176** (−3.30)	−2.191 (−1.23)	Log(GDPAV), ECFI av., LAW av.
2	−0.079 (−1.54)	−0.089 (−0.06)	Log(GDPAV), ECFI av., LAW av., Gov. Eff.
3	−0.083 (−1.13)	0.032 (0.02)	Log(GDPAV), ECFI av., Gov. Eff.
4	−0.195** (−3.38)	−1.915 (−1.05)	LAW av., ECFI av.
5	−0.109(*) (−1.82)	−2.86 (−1.46)	Log(GDPAV), LAW av., BFI av.
6	−0.083 (−1.13)	0.033 (0.02)	Log(GDPAV), ECFI av., Gov. Eff.

GDPAV=GDP average 2013–2014; LAW av.=Rule of Law Index, Gov. Eff.=Gov. Efficiency index, ECFI av.=Economic Freedom Index, BFI av.=Business Freedom Index

*

**

Source: Own calculations

3.2.2 The case of money laundering

It is obvious that “crime” or dirty money is laundered. This has the purpose of making dirty money appear legal (compare Walker, 1999, 2007).¹³ There are many methods of money laundering; table 3.7 briefly explains the 12 most common methods according to Unger (2007) and Schneider (2015). Which of these methods is chosen depends on the type of crime activity and on the institutional arrangements in the country where the criminal money is “earned”. For example,

¹³ Step one is the earning and collection of the crime money. Step two is to become as rich and influential as possible in the underground and legal world.

in the drug business method 8 “business ownership” is quite often used.¹⁴ In big cities quite reasonable amounts of cash are earned by drug dealers in a lot of different places, which they infiltrate into cash-intensive operations such as restaurants, which are especially well suited for money laundering purposes, by adding the criminal proceeds to the “legal” turnover of the business. Table 3.7 also shows that in 8 out of the 12 methods cash is only or mostly used. Quite obviously, when using cash deposits (method 2), cash smuggling (method 4), business ownership (method 8), credit card advance payments (method 11) and ATM operations (12) for money laundering, more or less only cash is involved in these transactions. Only for wire transfers, the purchase of insurance policies, security purchases and the creation of shell corporations is cash of little or no importance. Therefore, cash is quite important for money launderers in traditional criminal activities at the first stage.

Unger (2007) estimates the amount of laundered money for the top 20 destination countries of laundered money. These figures are shown in table 3.8. In this table two estimates are presented, one by Walker (1999, 2007) and one by the IMF. The Walker figure of 2.85 trillion USD is much larger than the IMF figure of 1.50 trillion USD (both figures are for the year 2005). Walker’s figures have been criticized as too high, which was one reason why the IMF estimates are shown too.

Table 3.8 clearly demonstrates that two-thirds of worldwide money laundering is ascribed to these 20 countries listed. One should realize that most of these countries are highly developed and have quite sizeable legal/official economies, which makes them highly attractive for re-investing the laundered proceeds. What is also amazing is that there are only a few small countries, offshore countries (OFCs) and/or tax havens among them (Cayman Islands, Vatican City, Bermuda and Liechten-

¹⁴ Compare Schneider (2004) and Masciandaro (2004).

stein).¹⁵ The majority of countries that attract money laundering flows are economically big players. The United States has the largest share in worldwide money laundering at almost 19.0%, followed by the Cayman Islands (4.9%), Russia (4.2%) and Italy (3.7%). However, smaller countries such as Switzerland (2.1% of worldwide money laundering), Liechtenstein (1.7%) and Austria (1.7%) are also attractive. If one takes the lower IMF values for Austria, Switzerland and the United Kingdom, about 5.5% of the total amount is laundered in these three countries, which comes close to roughly 10% of their official GDP. Yet it needs to be emphasized that it is not clear whether this money is “only” laundered in these countries or whether it also remains there. The money may well leave these countries after the laundering process. In general, table 3.8 demonstrates how substantial the amount of laundered money is and that two-thirds of these funds are concentrated in only 20 countries.

Bagella et al. (2009, p. 881) apply a two-sector dynamic general equilibrium model to measure money laundering for the United States and the EU-15 macro areas over the sample period 2000:01 to 2007:04 on a quarterly basis. Their time series are generated through a fully micro-founded dynamic model, which is appropriately calibrated to replicate selected stochastic properties of the two economies (legal and illegal). Their model has a short run perspective. Bagella et al. get the following results: First their simulations show that money laundering accounts for approximately 19.0% of the measured GDP in the EU-15, while it accounts for 13.0% in the US economy, over the sample 2000:01 to 2007:04. Second, the simulated size of money laundering appears less volatile than the corresponding GDP. As regards the EU-15 macro area, the simulated statistics suggest that money laundering volatility accounts for one-third of GDP volatility. For the US economy, the same statistics produce a figure of two-fifths. Considering these estimates I admit that they

¹⁵ Compare also Masciandaro (2005, 2006), Zdanowicz (2009), Truman and Reuter (2004), and Walker and Unger (2009).

are quite high and I have some doubts about how plausible these large figures are.

In another study Walker and Unger (2009, p. 821) again undertake an attempt to measure global money laundering and/or the proceeds from transnational crime. They criticize the traditional and often used methods such as case studies, proxy variables, or models for measuring the crime economy, arguing that they all tend to overestimate money laundering. They present a theoretically orientated gravity model which makes it possible to estimate flows of illicit funds from and to each jurisdiction in the world. This “Walker Model” was first developed in 1994 and was updated in 2008/2009. The authors elaborate that their model belongs to the group of gravity models which has recently become popular in international trade theory. The authors argue that the original Walker Model estimates are compatible with recent findings on money laundering. Once the scale of money laundering is known, its macroeconomic effects and the impact of crime prevention, regulation and law enforcement as well as the scale of transnational crime can also be measured. Walker and Unger (2009, pp. 849–850) conclude that their model still seems to be the most reliable and robust method to estimate global money laundering, and thereby the important effects of transnational crime on economic, social and political institutions. Rightly they argue that the attractiveness of the distance indicator in the Walker Model is a first approximation, but is still not theoretically satisfactory. A better micro-foundation for the Walker Model is needed. Micro-foundation here means that the behavior of money launderers is analyzed; in particular the reasons that make them send their money to a specific country. Hence, Walker and Unger (2009, p. 850) conclude that an economics of crime micro-foundation for the Walker Model would mean that, similarly to international trade theory, behavioral assumptions about money launderers should be made. Their gravity model can be seen as a reduced form or outcome of a rational calculus of sending money to a certain country and potentially making large profits.

Problem of stability of the estimated coefficients of the variables “cash share” and “cash limit”

Table 3.7

1	Wire transfers (no cash)	Money launderers move funds around in the banking system all over the world. Often these funds go through several banks and different jurisdictions.
2	Cash deposits “Smurfing” (only cash)	Money launderers deposit cash advances in bank accounts. Due to anti-money-laundering regulations they often “structure” the payments, i.e. break down large to smaller amounts (“smurfing”).
3	Informal value transfer systems (IVTS) (mostly cash)	Money launderers on the one side rely on other transfer providers, such as the Hawala or Hindi, and on the other side on IVTS shops (mainly selling groceries, phone cards or other similar items).
4	Cash smuggling (only cash)	Money launderers mail, FedEx or simply carry cash from one region to another.
5	Gambling (mostly cash)	Casinos, horse-races and lotteries are ways of legalizing funds. The money launderer can buy (for “dirty” cash) winning tickets – or in the case of casinos, chips – and redeem the tickets or the chips in a “clean” bank check.
6	Insurance policies (no cash)	Money launderers purchase single premium insurance, redeem early (and pay a penalty) in order to receive clean checks to deposit.
7	Securities (no cash)	Usually used to facilitate fund transfers, where underlying security deals provide cover (and legitimate looking reason) for transfers.
8	Business ownership (only cash)	Money is laundered through legitimate businesses, cash-intensive operations, such as restaurants, are especially well suited for laundering; one of the most often used methods!
9	Shell corporations (little cash)	Money launderers might create “fake” companies exclusively to provide cover for fund moves without legitimate business activities; one of the most often used methods!
10	Purchases (mostly cash)	Real estate or any durable good purchases can be used to launder monies.
11	Credit card advance payment (only cash)	Money launderers pay money in advance with dirty money, and receive clean checks on the balance from the bank.
12	ATM operations (only cash)	Banks might allow other firms to operate their ATMs, i.e. to maintain and fill them with cash. Money launderers fill ATMs with dirty cash, and receive clean checks (for the cash withdrawn) from the bank.
Summary		“no” cash: 4 cases “only” cash: 5 cases “mostly” cash: 3 cases

Source: Unger (2007, pp. 195–196) and own remarks.

The amount of laundered money for the top 20 destinations of laundered money, year 2005

Table 3.8

Rank	Destination	% of world-wide money laundering	Walker estimate 2.85 trillion USD Amount in billion USD	MF estimate of 1.5 trillion USD worldwide Amount in billion USD
1	United States	18.9%	538,145	283,500
2	Cayman Islands	4.9%	138,329	73,500
3	Russia	4.2%	120,493	63,000
4	Italy	3.7%	105,688	55,500
5	China	3.3%	94,726	49,500
6	Romania	3.1%	89,595	46,500
7	Canada	3.0%	85,444	45,000
8	Vatican City	2.8%	80,596	42,000
9	Luxembourg	2.8%	78,468	42,000
10	France	2.4%	68,471	36,000
11	Bahamas	2.3%	66,398	34,500
12	Germany	2.2%	61,315	33,000
13	Switzerland	2.1%	58,993	31,500
14	Bermuda	1.9%	52,887	28,500
15	Netherlands	1.7%	49,591	25,500
16	Liechtenstein	1.7%	48,949	25,500
17	Austria	1.7%	48,376	25,500
18	Hong Kong	1.6%	44,519	24,000
19	United Kingdom	1.6%	44,478	24,000
20	Spain	1.2%	35,461	18,000
Summary		67.1%	1,910,922	1,006,500

Source: Unger (2007, p. 80).

3.2.3 The case of cybercrime

According to Anderson et al. (2013), in the last 10 to 15 years cybercrime has originated from white-collar crimes. In the year 2007 the European Commission defined cybercrime in the following way¹⁶:

1. traditional forms of crime such as fraud or forgery, though committed over electronic communication, networks and information systems;
2. the publication of illegal content over electronic media; and
3. crimes unique to electronic networks.

Today, cybercrime takes on many forms, like online banking fraud (phishing), fake antivirus software, fake computer programs and fake error messages. In a first systematic paper Anderson et al. (2013) try to use a survey to measure the cost of cybercrime and/or the criminal proceeds from some types of cybercrime.¹⁷ Cybercrime is a fairly new development and is certainly becoming more and more important. What type of cybercrime costs can one observe? Anderson et al. (2013, p. 269) state the following four:

1. costs in anticipation of cybercrime, such as antivirus software, insurance and compliance;
2. costs as a consequence of cybercrime in the form of direct losses and indirect costs, such as weakened competitiveness as a result of intellectual property compromise;
3. costs in response to cybercrime, such as compensation payments to victims and fines paid to regulatory bodies; and
4. indirect costs such as reputational damage to firms, loss of confidence in cyber

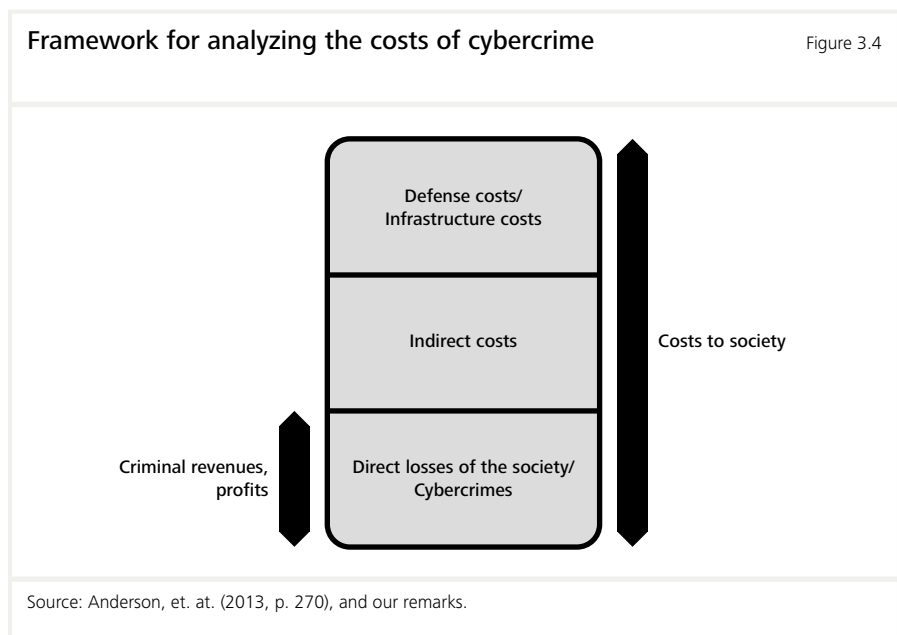
¹⁶ This definition is taken from Anderson et al. (2013, pp. 268); compare also Levi and Suddle (1989) as well as Levi (2009 a,b), and Levi (2017).

¹⁷ Compare also Detica and the Office of Cyber Security and Information Assurance (2011), Kanich et al. (2011), Levi (2011), Levi and Burrows (2008), Taylor (2011), Van Eeten and Bauer (2008).

transactions by individuals and businesses, reduced public-sector revenues and the growth of the underground economy.

These types of costs are shown in figure 3.4, where Anderson et al. try to analyze the costs of cybercrime and also some criminal revenues. From figure 3.4 one clearly realizes that criminal revenues or criminal proceeds can be derived from the direct losses of victims due to cybercrime. Direct losses (or proceeds of national or transnational criminal activities) include:

1. money withdrawn from victims' accounts;
2. stolen software; and
3. faked financial transactions.



What does one know about the costs (and partly proceeds of criminal activities) in the cybercrime area? Anderson et al. (2013, pp. 294–295) provide an interesting table (table 3.9) showing a first estimation of the costs (and partly proceeds) of the category of cybercrime.¹⁸

Considering the four cost (proceeds) components (costs of genuine cybercrime, costs of transitional cybercrime, costs of cybercriminal infrastructure, costs of cybercrime against public institutions) in table 3.9 one clearly realizes that component 4 “Cost of crime against public institutions (welfare and tax fraud)” becoming “cyber” is by far the largest part covering 67.5% of all costs of cybercrime, which amounts to a sum of 150.2 billion USD on a global estimate. Turning to global estimates of other components of cybercrime, one realizes that the costs of “genuine cybercrime” on a worldwide basis are 3.5 billion USD or 1.6% of the total costs of cybercrime. The 3.5 billion USD can also be seen as the largest part of the proceeds of genuine cybercrime activities. If one considers component 2 “Costs of transitional cybercrime” one realizes that it amounts to 44.2 billion USD or 19.8% of the total costs of cybercrime. With 24.8 billion USD the costs of cybercriminal infrastructure are quite sizeable as well; they amount to 11.9% of the total costs. As already said, the costs of traditional crimes becoming cyber are with 150.2 billion USD the largest part of the costs of cybercrime. Again this could at least partly be seen as the criminal proceeds from cybercrime activities in these areas, especially for tax fraud. In general table 3.9 clearly demonstrates that the costs and proceeds of cybercrime activities are sizeable. In future they will certainly rise because the use of electronic networks for crime activities is becoming more and more attractive.

¹⁸ In the following table own calculations are added but it originally comes from Anderson et al. (2013, p. 294–295).

**An estimation of the various cost components
(for the criminal proceeds) of cybercrime; year 2012**

Table 3.9

Type of cybercrime (in % of total cost); year 2010–2012	UK Est. (in bn \$)	Global Est. (in bn \$)	Ref. period
1. Cost of genuine cybercrime (e.g. online banking fraud) in bn \$	0.164 (0.9%)	3.50 (1.6%)	
2. Cost of transitional cybercrime (e.g. online payment card fraud) in bn \$	3.07 (6.7%)	44.20 (19.8%)	2010
3. Cost of cybercriminal infrastructure (e.g. expenditure on antivirus) in bn \$	1.24	24.84 (11.9%)	2012
4. Costs of cybercrime against public institutions			
4.1 Welfare	1.90	20.00	2011
4.2 Tax fraud	12.00	125.00	2011
4.3 Tax filing fraud	–	5.20	2010
SUM of 4 in bn USD (in % of total costs)	13.90 (75.7%)	150.20 (67.5%)	2011
SUM of 1–4 in bn USD (in % of total costs)	18.37 (100%)	222.70 (100%)	2011
In percent of total crime proceeds 1,100 bn worldwide (100%)		20.3%	

Source: Anderson et al. (2013, pp. 294–295)

3.3 Cash versus terrorist financing

There are quite a number of statements and also papers which draw a connection between the financing of terrorism and cash. Some studies also support the view that cash is used also for terrorism financing.¹⁹ In table 3.10 the costs of terrorist attacks are presented. Table 3.10 clearly shows that not much money is needed in order to undertake terrorist attacks. What is also quite often not known that before the attacks terrorists are unknown as terrorists and they can use their bank accounts and other financial means. Hence, even severe bargain restrictions can easily be bypassed if one goes several times to cash (ATM) machines or asks friends to go several times to do this. In figure 3.5 the costs of terrorist attacks in Europe are shown. Most of them cost less than USD 10,000. This figure clearly shows that even a severe legal cash restriction has minor effects on the financing of terrorists and activists. As shown in table 3.11, terrorist organizations such as ISIS or others have quite sizeable annual budgets and need to finance their operations in order to function as an organization. But even here it is doubtful whether this terrorist organization would diminish if there were no cash available worldwide.

¹⁹ Compare e.g. Riccardi and Levi (2017), Halliday, Levi and Reuter (2014).

Cost of terrorism – selected examples

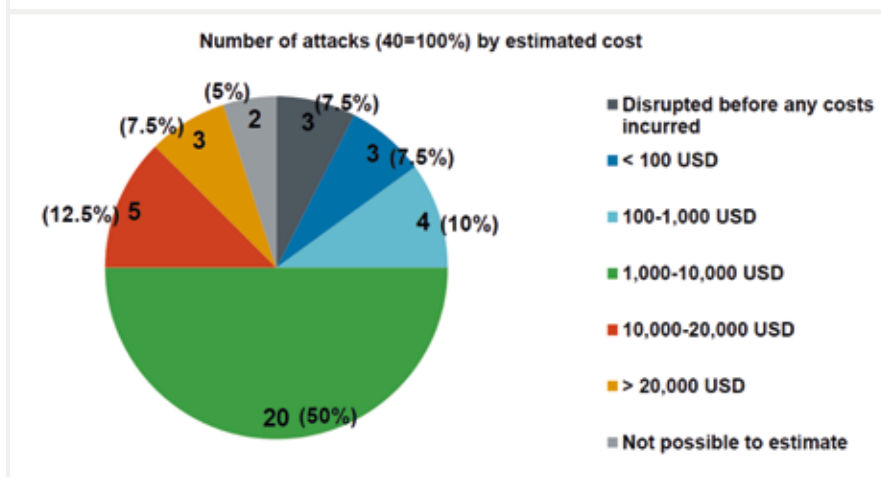
Table 3.10

Date	Incident	Cost
1993	World Trade Center bombing in New York	US\$19,000
2002	Bali bombing	US\$25,000
2004	Madrid train bombing	US\$10,000
2003	Jemaah Islamiyah operatives captured in Cambodia	Carrying US\$50,000
2001	9/11 bombings	13 hijackers received US\$10,000 each
2015	Charlie Hebdo attacks in Paris	€6,000

Source: Sands, P. (2016): Making it Harder for the Bad Guys: The Case for Eliminating High Denomination Notes, Weil Hall, p. 25.

Costs of terrorist attacks in Europe in past 20 years¹⁾

Figure 3.5



¹⁾ An analysis of 40 jihadist attacks in the past 20 years shows that most funding came from delinquents' own funds and 75% of the attacks cost total less than USD 10,000. Source: Mai, H. (2016).

The world's 7 "richest" terrorist organizations

Table 3.11

Organization	Annual turnover	Main sources
ISIS	US\$2bn	Oil trade, kidnapping/ransom, protection, taxes, bank robberies, looting
Hamas	US\$1bn	Taxes/fees, financial aid/donations
FARC	US\$600m	Drug production/trafficking, kidnapping/ransom, mining, fees/taxes
Hezbollah	US\$500m	Financial aid/donations, drug production/trafficking
Taliban	US\$400m	Drug production/trafficking, fees/taxes, financial aid/donations
Al Qaeda	US\$150m	Financial aid/donations, kidnapping/ransom, drug trafficking
Lashkar-e-taiba (Kashmir)	US\$100m	Financial assistance/donations

Source: Sands, P. (2016): Making it Harder for the Bad Guys: The Case for Eliminating High Denomination Notes, Weil Hall, p. 26.

3.4 Summary of the empirical findings

Summarizing subchapters 3.1 to 3.3 I reach the following findings/conclusions:

- (i) Figures on crime and criminal cash usage are rare, often contain large errors (problem of double counting) and are difficult to interpret.
- (ii) The available evidence suggests that restrictions on cash use will probably reduce profits from crime, but will certainly not eliminate them. Due to my empirical investigation, I reach the following figures: Reduction in cash or introduction of a cash limit: Shadow economy reduction between 2 and 20% (extreme case: no cash); corruption reduction between 1.8 and 18 percentage points (extreme case: no cash); crime reduction between 5 and 10%.
- (iii) Other means of storing and transferring illegally obtained assets without leaving many traces are already in use. They include:
 - a. the transport of physical valuables (e.g. prepaid instruments, precious metals, diamonds),
 - b. using false identities and fake firms,
 - c. criminal middlemen and shell companies to facilitate cashless transfers via regulated entities like the banking system, money transmitters or online payment service providers.
- (iv) Also, funds can be moved through traditional or new, alternative transfer systems like hawala or private virtual currency schemes.
- (v) Finally, technical progress, especially cyber money (bitcoin), and other electronic means are rapidly changing payment habits and hence will be heavily used by criminals, too.

4 Conclusions: Cash and civil liberties

For liberal societies the importance of cash has much deeper aspects than “pure” economic ones. Cash reflects the fundamental relation between citizens or taxpayers and state authorities. Using cash means freedom, independence and personal fulfillment for a citizen who doesn’t want a state intervention when using cash. The “voices” calling for the limitation or abolishment of cash argue that tighter and more comprehensive state control over individuals’ financial flows and funds will effectively fight crime, shadow economy and terrorism. But in my opinion we have weak empirical evidence.

Of course, anonymous cash makes tax evasion easier, especially for those who cannot afford to shift funds abroad. However, easy cash is clearly not the main reason for tax evasion, though it does facilitate it. Indeed citizens’ willingness to pay taxes crucially depends on tax morale.²⁰ Tax morale has been found to correlate with the relation between citizens and the government. The better the relation the higher the tax morale. A high degree of trust and of political influence (direct democracy) strengthens tax morale and the willingness of the citizens to pay their taxes, so that the state can provide goods and services. Tax authorities should treat taxpayers or citizens with respect and as clients rather than as suspects or servants. Hence, such a fundamental basic contract (developed by Frey and Feld (2002, 2007)) between the tax payer and the state is crucial for the functioning of society.

The abolishment or strict limitation of cash carries the risk of seriously weakening trust in state authorities. Abolishing cash as a simple tool against citizens to enforce state control can easily prove to be counter-productive. Given the real perceived importance of cash for civil liberties, a limitation or abolition could only be justified by sound reasons and large benefits. Only then may trust between citizens and

²⁰ Compare here the work of Feld and Frey (2002, 2007), and Schneider (2015).

authorities remain intact. As cash is neither the motivation nor the reason for shadow economies, crime or terrorist attacks, its abolition would not lead to large welfare gains. In a democracy the choice between cash and other means of payment should be left to users, who happen to be citizens, taxpayers, consumers and producers at the same time. Hence, my final conclusion is that citizens don't want to be forced by state authorities not to use cash anymore. They should be free to choose which payment instrument they use.

Friedrich Schneider: Restricting or abolishing cash: an effective instrument for fighting the shadow economy, crime and terrorism?

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Emmanuelle Politronacci, Elodie Ninlias, Enda Palazzeschi and Ghjuvanni Torre

The demand for cash in France: review of evidence¹



Emmanuelle Politronacci
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Abstract

Despite the well-known difficulties to measure national euro circulations within the euro area, several methods have been used to estimate the national demand for euro banknotes in France, such as key-based calculations (ECB capital), approaches using average return time of banknotes or extrapolated data from legacy currencies historical trends, methods relying on the replacement indicators of the first euro banknote series.

¹ The analyses presented in this paper are those of the authors alone and do not necessarily reflect the views of the Banque de France. The authors would like to thank their colleagues from the Directorate General Statistics of the Banque de France, in particular Georges-Pierre Baltzinger, Guillaume Cousin, Corinne Devillers, Jeanne Pavot and Yann Wicky for their valuable insights, as well as Jozef Vrana and Harald Deinhammer from the Directorate Banknotes of the European Central Bank for giving us permission to present their works in this study.

This paper proposes an update of these approaches and complements them with two additional methods. First, exportations of banknotes data enable to infer the French national circulation from the difference between banknotes issued by the Banque de France and the banknotes it shipped outside the euro area, directly or via the French wholesale bank. Second, a “bottom-up” approach can be built-up, where the cash holdings of the different institutional sectors (MFIs, households, non-financial corporations) are summed up in order to estimate the use of cash for transactional purpose.

Bearing in mind that those various approaches do not always separate the hoarding from the transactional purposes nor take into account banknotes migrations flows across countries, the analysis of the similarities and differences between those several methods sheds light on the French national demand for cash by giving hints on both the low and the top ends of the range.

Introduction

As at December 31, 2016, more than 20 billion banknotes issued by the 19 national central banks of the Eurosystem circulated worldwide for a total value of 1,126 billion euros. Since the introduction of euro banknotes and coins in 2002, the number of euro banknotes in circulation has grown by 7% each year on average.

However, while the total number of euro banknotes in circulation is known, the number of banknotes circulating in the euro area Member States is not. After being issued by the central bank, the behaviour of banknotes in circulation is unknown. Lightweight, transportable and accepted throughout the euro area and beyond, banknotes often migrate far from their point of emission.

In the absence of a better measure, the euro area Member States use the concept of “net issuance”. Purely statistical, this concept represents the difference between

the notes withdrawn and the notes lodged since 2002 at the national central banks' counters. At the end of 2016, the net issuance of France amounted to nearly 120 billion euros and accounted for 4.8 billion banknotes. However, these aggregate data mask inconsistencies: the net issuance of €5, €200 and €500 notes is negative, which means that for these denominations the number of banknotes lodged at the Banque de France's counters since 2002 is greater than the number of banknotes it has issued.

The actual number of banknotes in circulation in France is estimated through various methods. These estimates have a rather wide margin of uncertainty, especially since banknotes are used for various purposes. Being the only available medium physically representing the holding of central bank money, banknotes are used to carry out transactions, but also to constitute reserves of value.

First, this study finds that the existing estimates of the number of banknotes in circulation in France have usually been based on observed flows or net emissions, sometimes in relation to macroeconomic aggregates, and that they have significant methodological limitations (1).

Second, it proposes to introduce two complementary approaches, both based on estimating the cash holdings of the various institutional sectors within the meaning of the national financial accounts (2).

Third, the comparison of the results reveals very substantial differences, the amplitude of which is however reduced if the comparison focuses on the "active" circulation (banknotes held for transaction purposes). With a lower limit estimated at 12.2 billion euros in 2015, representing about 11% of French net issuance, this study leaves unexplained a significant "residue", even when taking into account the non-observed economy. The wide range of banknote circulation estimates, as well as the gap with the actual national net issuance, highlights the need for

further research, in particular in order to better assess the volumes of hoarded notes in France and the non-resident detention (3).

Definitions and methodological clarifications

In the context of this study:

- “Cash” only refers to banknotes: coins are not included in the analysis;
- “Cash holdings” refers to stocks of banknotes;
- “Active circulation” refers to notes held for transaction purposes. It should be distinguished from the circulation of “transactional” denominations (€5 to €50 banknotes) because it does not include the fraction of €50 notes used for hoarding purposes (which accounts for more than half)²;
- “Banknotes in circulation” includes banknotes held by euro area Monetary and Financial Institutions (MFIs), as well as banknotes circulating outside the euro area;
- Due to the late availability of certain data, the study covers the year 2015;
- Banknotes put into circulation by the overseas departments note-issuing bank (IEDOM) are included in the data.

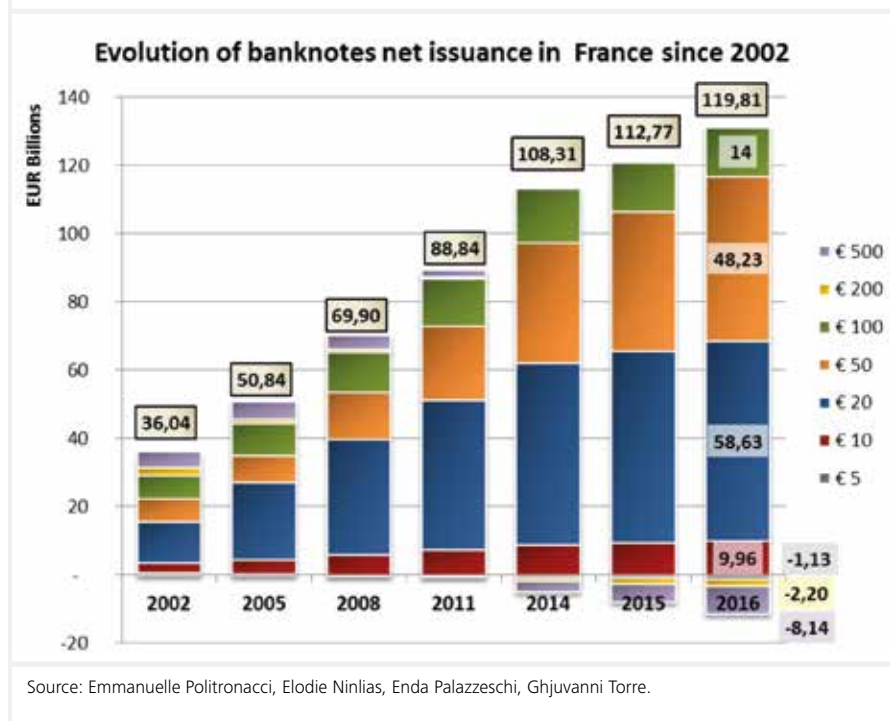
² Since the European return time (expressed in months between the issuance of a banknote and its lodgement at the central bank) of the €50 note is more than twice that of the €10 and €20 notes, it can be estimated that more than half of the European net issuance of €50 would be used for hoarding purposes.

Stylized facts about French net issuance of banknotes

At December 31, 2016, French net issuance amounted to 4.8 billion banknotes, for a total of 119.8 billion euros, representing an increase of 6.7% in volume terms and 6.2% in value terms over 1 year.

Evolution of banknotes net issuance in France since 2002

Figure 1



The breakdown of the French net issuance by denomination highlights disparities in the use of the euro banknotes, with the €20 note representing 48.9% of the value of the French net issuance. On the other hand, the net issuance of €5, €200 and €500 denominations are negative, which means that since 2002, the Banque

de France has registered more lodgements than withdrawals at its counters for these denominations.

I- The banknote circulation of one country is usually estimated from banknotes flows or net issuance

Since the euro introduction, measuring the number of banknotes in circulation has become more complex. Several methods for estimating national circulations have been used at the European level (method 1 based on the capital key), as well as by the Banque de France (method 2 based on the return time and method 3 which extrapolates on the French franc circulation).

More recently, new methods for estimating national banknote circulations have been proposed by the European Central Bank (ECB)³:

- A method based on a stabilisation of the net issuance after the euro introduction, taking into account the growth rate of consumption (method 4) ;
- Two approaches related to the introduction of a new series of euro banknotes (ES2) :
 - One method based on the stability of ES2 lodgements and withdrawals (method 5 a).
 - Another approach based on the stability of the ES1 share in sorting (method 5 b).

Finally, another method based on “adjusted active circulation” has been also recently developed by the Directorate banknotes of the ECB.

³ ECB presentation, “Lessons learnt from the ES2 introduction on the determination of a national circulation and euro banknote needs”, J. Vrana, July 2016

1/ Method 1: Capital key

The simplest method for estimating the French banknote circulation consists in applying the ECB capital key share of a given country to the average monthly circulation of euro banknotes.

Indeed, NCBs' shares in this capital are calculated using a key which reflects the respective country's share in the total population and gross domestic product of the European Union (EU). These two determinants have equal weighting. The ECB adjusts the shares every five years and whenever a new country joins the EU.

Using this key presumes that the circulation of each country is proportional to the size of its population and of its economy.

For France, the capital key is currently 14.18%. As part of the estimation of national banknote circulation, only the paid-up capital by the 19 central banks of the euro area countries is taken into account, i.e. currently 20.14%.

According to this method, French banknotes circulation would amount to EUR 209.6 billion on average in 2015.⁴

⁴ This figure differs from the theoretical share of France in the total value of euro banknotes issued by the Eurosystem, for two reasons: the share allocated to the ECB (8% of the total outstanding amount in circulation) is not deducted here and the figure displays the average circulation value by denomination in the course of 2015 instead of the value at 31 December 2015

**Average estimated French banknote circulation
and average total circulation of euros banknotes in 2015**

Table 1.1

EUR billions	€ 5	€ 10	€ 20	€ 50	€ 100	€ 200	€ 500	Total
France	1.71	4.43	12.94	78.99	41.77	8.30	61.45	209.60
Eurosystem	8.50	22.01	64.23	392.14	207.37	41.19	305.09	1,040.53

Source: CIS

This method assumes a same usage of cash in the euro area. However, in practice, cash payment habits are different from one country to another. For instance, as noted above, France is a major issuer of €20 banknotes, whereas the share of high denomination notes (€100, €200 and €500) is rather limited.

Moreover, the relative place of cash among all means of payment is also variable within the euro area. In some countries, as in Germany or in Italy, the use of cash compared to the other means of payment is more important than in other countries where the use of payment card is more developed, as in France. According to studies based on payment diaries in France⁵ and in Germany⁶, cash payments accounted for 56% of payments in volume and for 18% of payments in value in France (in 2011), compared with 79% of payments in volume and 53% of payments in value in Germany (in 2014).

It should be noted that the large-scale survey conducted by the Eurosystem in 2015-2016 on the use of cash by households (SUCH survey, for “Study on the Use of Cash”), whose results are pending at the date of this writing, could lead to update the respective market share of the card and the cash in the point of sale (POS)

⁵ David Bounie, Abel François, “Towards an Electronic Payment Society?”, *Revue d’économie financière* 2013/1 (N° 109)

⁶ Deutsche Bundesbank, “Payment behaviour in Germany in 2014”, p. 27.

payments of households in France.

2/ Method 2: Return time

Banque de France usually bases its own estimates of cash demand on the return time of euro banknotes. The return time of a denomination is defined as follows in a given geographic area:

$$\text{Return time} = \text{average monthly net issuance} / \text{average monthly lodgements}$$

Assuming a similar return time within the euro area, the national banknotes circulation by denomination can be deducted from the European return time and the lodgements at the given BCN's counters.

According to this method, the French banknote circulation is estimated to be EUR 125.5 billion in average in 2015.

2015								Table 1.2
EUR billions	€ 5	€ 10	€ 20	€ 50	€ 100	€ 200	€ 500	Total
European return time (in month)	5.5	3.1	3.6	8.6	21.0	34.9	43.4	
Monthly average lodgement France (millions of pieces)	25.5	188.3	228.6	106.2	9.1	1.4	1.3	
Estimated circulation in France (millions of pieces)	141.2	579.7	830.9	918.9	190.2	47.5	55.8	2,764.1
“Estimated circulation in France (Eur billions)”	0.7	5.8	16.6	45.9	19.0	9.5	27.9	125.5
Source: CIS								

This approach presents two major biases:

On the one hand, the European return time calculation is based on the total euro banknote circulation, of which a significant part is held abroad.⁷ Thus, the application of these return times at national levels overestimates the banknote circulation of the given country.

On the other hand, it is unlikely that the return times would be the same between euro area Member States, because of the national specificities regarding cash cycle and in particular the development at different speeds from one country to another of the recirculation by private operators.

3/ Method 3: Extrapolation of the French franc circulation

This method extrapolates the French franc banknote circulation observed between 1979 and 2000.

This reference period is justified both by data availability considerations and by the impact of the cash changeover in 2002, which led to a decline in the French franc banknote circulation as of the end of the year 2000.

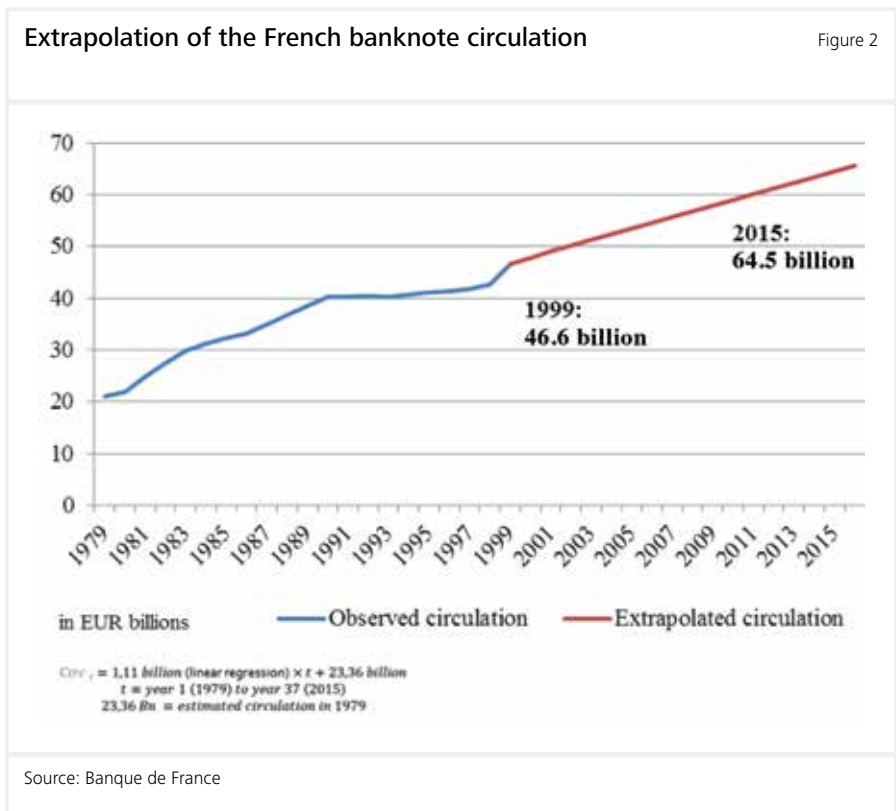
During the period under review, several notes ceased to be legal tender.⁸ These notes were still exchangeable for euro at the Banque de France's counters a long time after the introduction of the euro banknotes (until between 2005 and 2009). During this period, the Banque de France paid advances representing the French Treasury's claims on the Banque de France for the balance of notes issued but not presented for exchange. These advances were deducted from the franc banknote

⁷ According to the ECB, around one-third of the total value of euro banknote circulation is held outside the euro area.

⁸ Four notes from the antepenultimate range of banknotes: 10 francs Voltaire, 10 francs Berlioz, 50 francs Racine and 100 francs Corneille (15 September 1986), as well as the whole penultimate range of banknotes: 500 francs Pascal (1st March 1997), 200 francs Montesquieu (1st April 1998), 100 francs Delacroix (1st February 1999) and 50 francs Quentin de La Tour (1st December 1995).

circulation, so they have been added here to avoid breaks in statistical series.

According to this method, the French euro banknote circulation would reach EUR 64.4 billion at the end of 2015.



To evaluate the breakdown by denomination, the so-called “gap-method”, which models the replacement of the francs by euros, is used. In this method, each denomination in francs is substituted by the euro denominations immediately above and below. The allocation keys for this replacement result from the difference between the franc denomination and the two nearest euro denominations ⁹.

According to this rule, the demand in French franc would switch to euro banknotes and coins as follows:

Table 3.1

	2 €	5 €	10 €	20 €	50 €	100 €	200 €	500 €
20FF	65.0%	35.0%						
50FF		47.6%	52.4%					
100FF			47.6%	52.4%				
200FF				65.0%	35.0%			
500FF					47.6%	52.4%		

⁹ For example, the “gap” between the 50 franc note (i.e. €7.62) and the €5 note is €2.62 and the gap with the €10 note is €2.38. Therefore, $1 - (2.62 / 5)$ of the 50 franc note was transferred to the €5 note (representing 47.6%), and $1 - (2.38 / 5)$ of the 50 franc note was transferred to the €10 note (representing 52.4%)

By denomination, the French euro banknotes circulation would be broken down as follows:

Table 3.2								
EUR billions	€ 2	€ 5	€ 10	€ 20	€ 50	€ 100	€ 200	€ 500
2015	0.1	0.8	5.4	18.4	22.7	17.2		
For the record: French net issuance		-1.0	9.4	56.0	41.1	14.4	-1.7	-5.4
Source: Banque de France								

The limits of this approach:

- This method assumes that the real national banknote circulation followed a growth rate in line with the trend observed over the previous 20 years (1979 – 1999), after the cash changeover. However, several events between 2000 and 2015 may have affected the dynamics of the banknote circulation, in particular with respect to the evolution of the cash cycle, the economic crises in 2001 and in 2008, the development of electronic means of payment, etc. Moreover, between 1979 and 2000, the French franc circulation did not grow at an even pace, with periods of rapid growth (1981-1984) and periods of stagnation (1992-1995).
- The range of French franc notes is difficult to compare with the much wider range of euro notes. Indeed, the French franc notes did not include a note higher than 500FF (i.e. €76). So, it is therefore difficult to define the extent to which the present circulation of higher value denominations, in particular €200 and € 500, corresponds to a changeover of the circulation of 500 franc note or to a growth in circulation in absolute terms due to the introduction of high value notes. The absence of obvious correspondence between the two denomination structures limits their comparability.

- The available data about the French franc circulation includes all the banknotes issued by France, including franc notes which were held outside the country. However, these banknotes should not be taken into account in estimating national banknote circulation. Moreover, given the international role of the euro, the foreign demand for banknotes from France is probably significantly stronger than at the time of the francs.

4/ Method 4: re-optimised circulation after the euro adoption

This method consists in determining the month from which national net issuance adopts a stable and predictable seasonal pattern after 1 January 2002. The net issuance of this month is identified as the actual circulation in the country. This estimated circulation is then extrapolated for the following years by applying the growth rate of final consumption expenditure of households and associations (NPISHs, Non-profit Institutions Serving Households).

There are two assumptions underlying this method:

- There is a point in time where the national net issuance and the actual national circulation matched: when, for each denomination, the holdings of the various stakeholders did stabilise.
- From that date, the evolution of net issuance would be mainly due to banknote migrations, while national circulation would increase at the rate of final consumption by households and associations.

This approach is limited to low and medium denominations, for which there is little or no hoarding. Indeed, the application of this method to the high denominations would imply to take into account an additional time required to rebuild hoarded cash. In addition, the extrapolation of the circulation from the growth rate of final consumption do not suit denominations of high value, as they are not usually used for transaction purposes in France. For the €50, this method is not fully relevant

since a large part of its circulation is presumably hoarded. Nevertheless, for the sake of comparability with other methods, we hereafter provide an estimate of the €50 circulation based on method 4.

Estimated circulation of €5 to €50 denominations at the end of 2015				Table 4.1
	€ 5	€ 10	€ 20	€ 50
Stabilisation date	Jul-02	Apr-02	Feb-02	Jun-02
Estimated circulation (EUR billions)	0.6	3.8	12.4	9.0
For the record: French net issuance	-1.0	9.4	56.0	41.1
Source: ECB				

In total, € 25.8 billion would be the value of the circulation of low and medium denominations (€5 to €50) at the end of 2015.

This method presents several limits, all the more pronounced as we move away from the date of the euro introduction.

Firstly, it assumes that, after 2002, real circulation increased at the rate of the final consumption. However, this is not necessarily the case, in particular because of the substitution of other means of payment and changes in the cash cycle which may have impacted the demand for cash. Actually, the sum of the estimated national banknote circulation does not correspond to the net issuance of the whole Eurosystem, because the latter increased much faster than the rate of final consumption, as can be seen in the table below (ECB estimates) ¹⁰:

Difference between the sum of estimated national banknote circulations and the actual euro banknote circulation by the end of 2015

Table 4.2

EUR billions	€ 5	€ 10	€ 20	€ 50
Sum of estimated national circulation	7.5	21.2	52.0	128.5
Eurosystem circulation	8.8	23.3	68.8	419.9

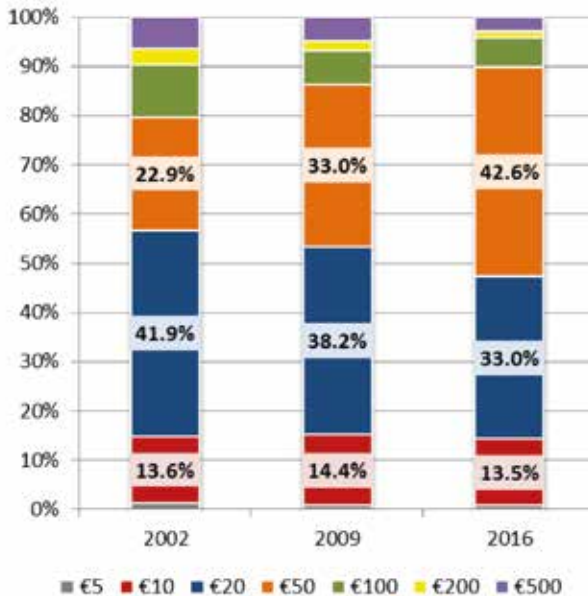
Source: ECB

¹⁰ ECB presentation, “Lessons learnt from the ES2 introduction on the determination of a national circulation and euro banknote needs”, J. Vrana, July 2016

Secondly, applied to each denomination, this method assumes that the composition of the banknote circulation has not changed since 2002. For France, evidence suggest an increasing use of the €50 banknote, gradually bringing the structure of French net issuance closer to the trends observed at the European level:

Share of each denomination in the total value of the withdrawals in France (Banque de France and Iedom)

Figure 3



Source: Own calculations.

5/ Method 5: approaches based on the ES2 introduction

In the context of the on-going replacement of the first series of euro banknotes (ES1) by the new “Europa” series, the ECB proposed two new approaches to determine national circulations:

- a. An approach based on stable volumes of ES2 net issuance;
- b. An approach based on stable volumes of the ES2 sorting data within NCBs.

These two methods are based on a stabilisation of ES2 net issuance when most of the ES1 national circulation has been replaced by the ES2 series (a share of the ES1 banknotes will never come back to the NCBs’ counters). At that time, the net issuance is deemed to represent the actual euro banknote circulation.

- a. The first method (5-a) is based on the identification of the stabilisation period of ES2 lodgements and withdrawals at central bank’s counters, as well as ES1 lodgements.
- b. The second method (5-b) determines the month from which the share of the ES2 in the banknotes sorted by the NCB (ES2 saturation rate in sorting) is stable, that is to say when change in the share of ES2 notes in sorting data is less than 1% for three consecutive months.

Then, the estimated circulation by denomination is adjusted in order to take into account the impact of banknote cross-border migrations.

For a given country, the average of the annual increase of the net issuance for the last 5 years (2011 - 2015) is proportionally subtracted from the estimated circulation:

$$\text{Estimated circulation} = NI_a - (ANI_a \times T)$$

With NI_a = ES2 net issuance stabilised at a given date

ANI_a = average of the annual increase of the net issuance for the last 5 years (2011 - 2015)

T = time between the date of the ES2 introduction and the stabilisation date of the net issuance, in years

The two methods lead to similar results with an estimated circulation of EUR 0.6 billion for the €5 note and around EUR 3.0 billion for the €10 note.

Table 5.1

		€ 5	€ 10
Method 5 a	Stabilisation date	May-15	Sept-15
	Estimated circulation (EUR billions)	0.6	3.1
Method 5 b	Stabilisation date	Jul-15	Jan-16
	Estimated circulation (EUR billions)	0.6	3.0

Source: ECB

These two approaches have also some limits:

- At this stage, they can only be used for the ES2 notes that have been put into circulation for a sufficient period of time to observe a stabilisation of the net issuance. For the moment, this approach cannot be applied to the ES2 €20 note, issued in November 2015. For France, where the share of this note is important, the results will be particularly interesting to analyse.
- The adjustment used to neutralise the migration impact assumes that the full variation of the net issuance is attributed to cross-border migrations. However, at national levels, changes in net issuance may be linked to other factors (changes in payment or hoarding behaviours, macroeconomic developments: GDP, savings rate, inflation, etc.).
- For the method 5-a: in France, the banknotes lodged by the customers are mixed without distinction between series. As a result, the ES1 and ES2 distribution can only be estimated based on the share of each series after sorting.
- For the method 5-b : the existence of a stock of unprocessed banknotes entails a gap between the moment when the ES2 notes become dominant in the circulation and the moment when this saturation is apparent in the sorting data.

6/ Method 6: Active circulation allocated according to the capital key and adjusted with the unfits ratio

This method, recently developed by the ECB, is based on the estimation of an European active circulation. The European return time of €10 note (ie 3.1 months in 2015) is applied to the average monthly logdements of low and medium value banknotes.

Then, the estimated European active circulation is allocated among the euro area countries in proportion to their capital key and then corrected by applying the ratio between the share of the denomination in national unfits and the share of that denomination in European unfits.

Finally, a last adjustment is applied to make equal the sum of estimated national circulations and the European active circulation.

There are two assumptions underlying this approach:

- The €10 note is only used for transaction purposes, whereas the changes in the other denominations return time result from hoarding patterns.
- The difference between the share of a denomination in the unfits of a given country and the share of that denomination in the European unfits is representative of the over- or under-representation of this denomination in the national circulation compared to the European circulation.

Estimated active circulation in France					Table 6.1
EUR billions	€ 5	€ 10	€ 20	€ 50	
2015	0.9	5.2	11.5	22.4	
Source: ECB					

Two limits can be underlined:

- The use of the €10 note return time is relevant for the denominations of €20 and €50 because they share with the €10 note a similar cycle, at least in France (these three denominations are dispensed by ATMs). However, this method cannot be used for high value denominations and its application to the €5 note is questionable: indeed, this denomination has a specific return time, higher than that of the €10 note, because it is widely used for change purposes in stores.

- It is likely that the sorting criteria are not completely homogeneous in the various European countries depending on the denomination. As in consequence, a denomination can be overrepresented in a given country unfits compared to its share in the European unfits, not because of a proportionally higher circulation, but due to various national sorting priorities.

To sum up, each method has some limits and they are not immediately comparable:

Table 6.2

2015	€ 5	€ 10	€ 20	€ 50	€ 100	€ 200	€ 500	Total
Method 1 : Capital key	1.7	4.4	12.9	79.0	41.8	8.3	61.5	209.6
Method 2 : Return time	0.7	5.8	16.6	45.9	19.0	9.5	27.9	125.5
Method 3 : circulation of francs banknotes	0.8	5.4	18.4	22.7	17.2			64.4
Method 4 : re-optimised circu- lation after the euro adoption	0.6	3.8	12.4	9.0	detail not available			
Méthode 5 a: stable Europa series net issuance	0.6	3.1	detail not available					
Méthode 5 b: stable level of the Europa series banknotes sorted by NCBs	0.6	3.0	detail not available					
Method 6: ajusted active circulation	0.9	5.2	11.5	22.4	detail not available			

Three of them provide an estimated total value of the banknote in circulation in one country (methods 1, 2 and 3) and their results vary up to threefold: from EUR 64.4 billion to EUR 209.6 billion in 2015.

The three other approaches (methods 4, 5 and 6) focus on the low and medium denominations and provide insight into the “active” circulation (or transactional circulation). It may be noted that, all methods considered, the largest differences in the estimates are related to the €50 banknote.

This present study propose to complete the comparison by including additional approaches based on an evaluation of the cash holdings detained in the various institutional sectors of the national economy and abroad.

II- Estimation of the euro banknote circulation based on banknote holdings

This study attempts to evaluate the national circulation of banknotes in France by estimating the cash holdings of the various institutional sectors in the national financial accounts meaning. Two methods are detailed below:

- A subtractive approach based on an assessment of the stock of cash issued in France held by non-residents outside the euro area,
- A “bottom-up” approach based on the addition of the cash holdings stored at the various points of cash cycle: among banks and fund carriers, in commercial and service firms and by households.

1/ Method 7: Approach based on the assessment of the non-resident circulation

The actual share of euro banknotes held outside the euro area can only be estimated because of the anonymity of banknote flows across borders.¹¹ However, the use of official statistics on cross-border banknote shipments gives an indication of the bottom of the range of banknotes circulating outside the euro area.

At the Eurosystem level, cash held “officially” abroad is calculated on the basis of net shipments of banknotes outside the euro area by banknote wholesale banks active in the currency market.¹² At end-2015, the cumulated value of these net shipments since 2002 amounted to nearly €180 billion, i.e. 16.4% of the total euro banknote in circulation in terms of value.¹³ As an estimation of banknotes circulating outside the euro-area, this figure is a lower limit since it doesn’t take into account other outflow channels such as tourism, remittances from migrant workers or the “unobserved” economy. From this figure, the ECB estimates that the value of euro banknotes circulating outside the euro area represents around one-third of the total value of euro banknotes in circulation.¹⁴

For France, according to the balance of payments and international investment position statistics, the cumulative imports and exports of euro banknotes outside France from 2002 to end-2015 amounts to 32,9 billions of euros. This figure is based on data collected from banknote wholesalers involved in the euro import / export market.

11 Subject to the obligation for physical persons to declare all sums of cash in excess of EUR 10 000 when entering or exiting the European Union external borders; in France, as in some other European countries, this requirement also applies when moving across the national borders, within the EU

12 European Central Bank (2016), the international role of the euro, Interim report, June 2016

13 The recent methodological revision by ECB of its method for estimating the euro circulation outside the euro area (6 April 2017) is not taken into account in the present paper

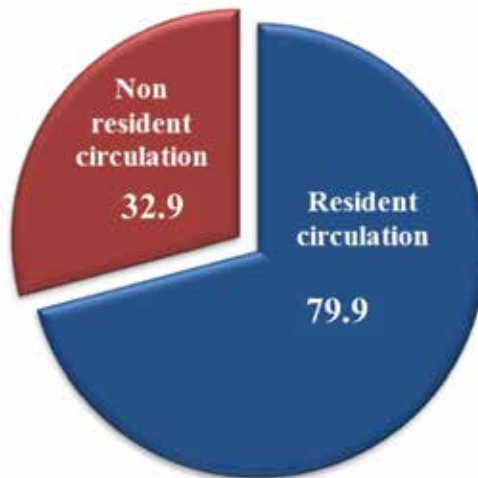
14 European Central Bank (2017), Annual report 2016, April 2017

The Bank of Central African States and the Central Bank of West African States as well as Algeria were the main recipients of banknotes exports in 2015, while Switzerland, Cuba and Tunisia were the main countries of origin of imports.

Circulation of euro banknotes in France in 2015

Figure 4

in EUR billions



Source: Own calculations.

This foreign demand for banknotes, either by foreign central banks or intended to cover the needs of non-euro area business clients (banks, exchange offices, etc.), makes it possible to approximate the non-resident holding of cash. Indeed, by subtraction, we can deduce the share of French net issuance that might be held in France by residents.

Thus, using the French net issuance (€ 112.8 billion at the end-2015), the resident circulation in France can be estimated at **€ 79.9 billion in 2015**.

There are two limits to this approach:

- Due to the lack of data on cross-border migrations inside the euro area, the share of French net issuance circulating in other countries of the euro area as well as the share of net issuance of partner countries circulating in France cannot be taken into account. These migrations, however, are likely to be significant, as illustrated by the fact that at end-2015, all euro area countries but two had negative net issuance for at least one denomination. In France, the €5 note has negative net issuance, which can be linked at least partly to the Deutsche Bundesbank's net issuance volumes of this denomination. By contrast, at the end of 2015, the €20 note represents 62.5% of the volume of the French net issuance, compared with only 4.4% of the net issuance of the Eurosystem outside France. It is therefore likely that France is a net exporter of €20 banknotes in the euro area, even if this denomination is more commonly used in France than elsewhere in the euro area.
- Banknotes issued in France leave the euro area by unofficial channels that are not monitored, such as tourism spending (see Box 1) and remittances, and thus are not taken into account. The figure of € 32.9 billion of non-resident circulation is therefore likely to be a lower limit.

Tourism spending in cash

Box 1

One way to improve this estimate would be to assess expenditure in cash by tourists in 2015 using the data sources used for the compilation of the travel item of the balance of payments (source: Banque de France). Nevertheless, according to this data, it appears that tourism spending would have a very low, or even, no impact.

Expenditure by foreign tourists in France in 2015:

- Tourists from euro area Member States: they spent a total of €20.9 billion in 2015; we subtract from this figure the amount of transactions paid by card and cash withdrawn directly in France at ATMs (11.4 billion + 1.8 billion, giving a total of 13.2 billion euros): thus, euro area tourists would have brought 7.6 billion in cash to France in 2015.*
- Tourists from non-euro area Member States: they spent a total of € 20.5 billion in France in 2015. By subtracting the amount of transactions paid by card and cash withdrawn from ATMs (13.3 billion + 3.9 billion, giving a total of 17.2 billion), these tourists would have brought 3.3 billion in cash to France in 2015.*

Expenditure in foreign countries by French tourists in 2015:

- *In the euro area: French tourists spent 17.9 billion euros in 2015 in the euro area, of which about 10.1 billion were paid by card and 2.8 billion withdrawn on the spot. Therefore, French tourists would have spent in the euro area about 5.1 billion euros in cash withdrawn in France.*
- *Outside the euro area: French tourists spent 16.7 billion euros in 2015 outside the euro area, of which about 7.5 billion were paid by card and 3.7 billion were withdrawn on the spot. Thus, they would have spent outside the euro area about 5.4 billion euros in cash withdrawn in France.¹⁵*

Overall, it can be estimated that 11.0 billion euros in cash entered in France and 10.5 billion euros in cash exited France in 2015, i.e. a close-to-zero balance. According to this result, inflows and outflows of banknotes related to tourists' expenses would have a very limited impact on the value of cash in circulation in France. It should be noted that, regardless of the payment methods used (i.e. including card payments), expenses by foreign tourists in France exceeded French tourists expenses abroad by 7 billion euros.

¹⁵ The totals are rounded from each exact value and will not therefore necessarily represent the sum of the rounded figures

Furthermore, these estimates must be taken cautiously as they suffer several biases:

- They are obtained using data from different sources: surveys of foreign visitors, surveys of French households, collection of data on card payments from French credit institutions.*
- Different methods are used to estimate inflows and outflows of banknotes. Expenses paid by cards come from a survey carried out among foreign visitors. This figure must be taken cautiously as the response rates to the survey are not always significant (e.g. in the survey, card spending is supposed to be nil in case of a non-response). Regarding outflows of banknotes (French visitors in foreign countries), the figure for payments by card comes from the collection of data on card payments from credit institutions.*
- All transactions not settled by card are assumed to be settled by cash. Alternative payment methods, such as electronic currency, are not taken into account.*
- Estimates of cash in wallet held by tourists from outside the euro area seem low: EUR 3 billion (especially since this figure includes foreign currency exchanged in France upon arrival).*

Despite these limitations, the impact of expenses by tourists is an idea to explore. Indeed, if the balance were not close to zero, its extrapolation over the last fifteen years would make it possible to estimate a cumulative stock of cash from tourism expenses, which could be potentially important.

2/ Method 8: Estimation of banknote holdings for transaction purposes

This method is based on an analysis of the cash cycle in France as well as on an identification of cash holdings outside the central bank (Banque de France and IE-DOM).

As a first step, we focus on the domestic transaction cycle in order to estimate the average daily cash held for transaction purposes in 2015 by three main institutional sectors: banks, including Cash-In-Transit (CIT) companies (CH_{fc}), retailers (CH_{nfc}) and households (CH_{hh}).

$$CC = CH_{fc} + CH_{nfc} + CH_{hh}$$

As a second step, the informal economy is included in order to refine this estimate (for a more detailed description of the underlying methodology, see the methodological annex).

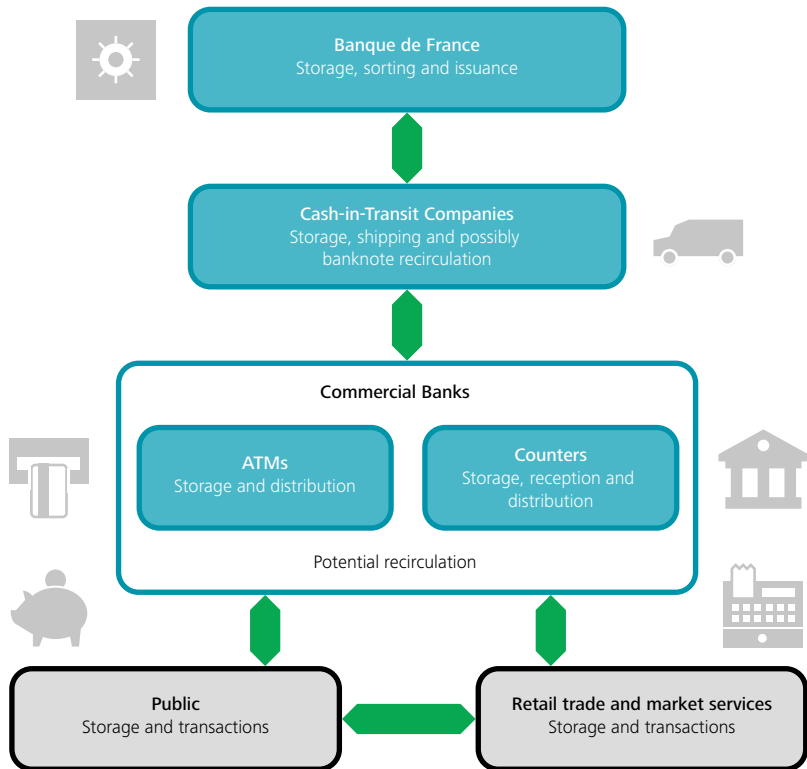
It should be noted that this approach does not distinguish notes from coins, since the relative share of coins in the total cash circulation is very low.¹⁶

To estimate the cash holdings held by the various stakeholders, two sources of information have been combined:

- The modeling of statistical data;
- The results of a qualitative survey (see Box 2).

¹⁶ At the end of December 2015, coins accounted for 2.3% of the total value of the euro cash circulation

Figure 5



Methodology of the qualitative survey

Box 2

For the purpose of this study, interviews have been conducted with various stakeholders of the French cash cycle:

- Credit institutions: seven banking networks participated, representing more than 60% of the withdrawals and lodgements of banknotes at Banque de France counters.*
- Merchant sector: two trade federations and four large-scale retailers (supermarkets and independent franchisees);*
- One Cash-In-Transit company and one tax refund service provider.*

The interviews took place between January and March 2017.

The main topics covered were:

- The average and minimum cash holdings at the end of a typical month in 2015 and their distribution (automats, bank branches, etc.);*
- The impact of the development of recirculation of banknotes on the level of cash holdings;*
- The standards and the frequency of cash collecting in stores;*
- Seasonal variations;*
- The share of high value banknotes in cash holdings;*
- The respective share of transactions settled by cash, card and cheques;*
- The average amount of transactions settled by cash.*

**A/ Banknote holdings for transaction purpose in banks
(including CIT Companies)**

Transactional cash held by the banks was estimated on the basis of the monetary statistics collected by the Banque de France.¹⁷ The estimated figure was then checked against the results of the qualitative survey.

- According to the monetary statistics, banknotes and coins held by monetary and financial institutions amounted to 9.8 billion of euros at the end of 2015. As we want to estimate the transactional cash of banks, it is necessary to deduct the share of high value banknotes to retain only the value of €5 - €50 banknotes. Since the €100, €200 and €500 represented 10.2% of the total value of banknotes withdrawn at Banque de France's counters in 2015, we estimate that the transactional cash holdings of banks amount to 8.8 billion euros. This figure corresponds to the average value of €5 to €50 banknotes held by banks to meet the transaction needs of their clients.
- In addition to this approach, the interviews carried out during the qualitative survey shed light on the organisation of this cash holding.

For security reasons, banks try to keep their stock of banknotes and coins at the minimum required to meet customer demand. This cash is stored in automated teller machines (ATMs), branches vaults, and possibly central cash offices, including cash held by banks at CIT companies.

In the context of our survey, the participating banks reported an average of €2.8 billion held in cash (excluding cash at CITs). The cash holdings of resident banks that did *not* participate in the survey can be assessed by calculating their

¹⁷ Amounts declared in France to the Banque de France by by resident MFIs under the item "Treasury operations – notes and coins"

average share in the total value of withdrawals and lodgements of banknotes at the Banque de France and the IEDOM counters in 2015, i.e. 43%. On this basis, we estimate the total cash holdings of resident banks at 4.9 billion euros.

Furthermore, to estimate the average daily value of cash held by banks at CITs, we assume, on the basis of the qualitative survey, that CITs hold two days of inflows (cash collected from clients) and two days of outflows (cash ordered by clients). On the basis of the following calculation, **the average cash holding of CITs is estimated at 2.3 billion euros:**

Daily average flows:

$$\frac{\text{Annual withdrawals and lodgements at} \\ \text{Banque de France's counters} \\ \text{(excluding €100, €200 and €500 notes)}}{\text{Number of working days in 2015}} \times 2 \text{ days}$$

Withdrawals:

$$\frac{151.9 \text{ billion euros}}{252 \text{ working days}} \times 2 \text{ days} = 1,205 \text{ billion euros}$$

Lodgements:

$$\frac{142.7 \text{ billion euros}}{252 \text{ working days}} \times 2 \text{ days} = 1,133 \text{ billion euros}$$

→ **Estimated average value of banknote holdings of CITs on a given day:**
2.3 billion euros

It is therefore possible to assess the total cash holding of credit institutions, including cash held by banks at CITs: 4.9 + 2.3 billion, giving **a total of 7.2 billion euros, 2.3 billion euros of which are held at CITs.**

This figure derived from a bottom-up approach is consistent with the global figure available in the monetary statistics. For the purpose of this study, we therefore retain the figure available in the monetary statistics, **i.e. 8.8 billion euros.**

B/ Transactional banknotes held by retailers

In order to evaluate the average value of transactional cash held by non-financial companies in France, we use the turnover of retail and market-related services to households in 2015 (source: the French National Institute for Statistics and Economic Research - INSEE).

In accordance with the 2011 ECB study on the use of euro banknotes by households and firms ¹⁸, we consider that other businesses do not hold significant amounts of cash. In addition, wholesale trade, real estate services and services to firms and governments were excluded from this study in order to focus on households spending. E-commerce was also removed from the calculation owing to the

¹⁸ BCE, "The use of euro banknote – results of two surveys among households and firms" – ECB Monthly Bulletin April 2011

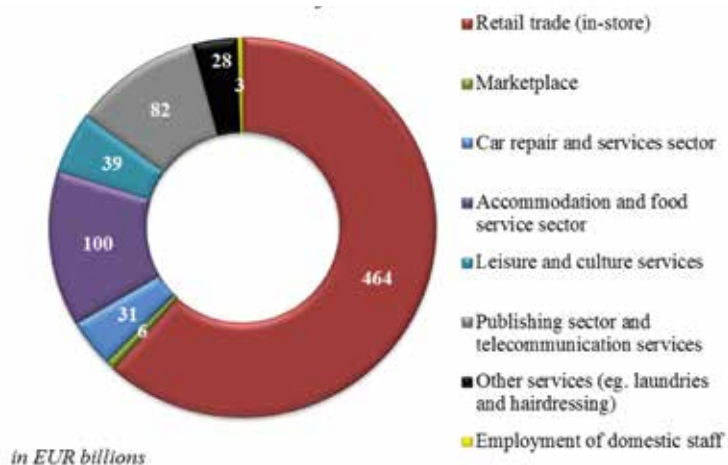
very marginal use of cash in this type of spending.

On the basis of a restatement of the total turnover of retail and market-related services to households in 2015, we estimate that households' expenditure amounted to **753 billion euros** in 2015.

Households expenditure in 2015

Retail trade and market services out of e-commerce

Figure 6



Source: Own calculations.

Under the assumption that cash represents 18% of the value of payments at the point of sale (POS) ¹⁹, annual expenditure paid by cash would amount to **136 billion euros**. Hence, daily spending in cash in 2015 would be equal to 0.43 billion

¹⁹ D. Bounie, A. François, "Towards an Electronic Payment Society?", Revue d'économie financière 2013

euros on the basis of 6 days of spending per week, over 52 weeks.

Besides, assuming that cash is collected by CITs at the POS or brought to the banks by retailers every 3 days, implying an average of two off-loadings per week ²⁰, cash spent by consumers stays at the POS 1.5 day on average. On this basis, we assess that $0.43 * 1.5 = \mathbf{0.7 \text{ billion euros}}$ is held in the retail sector on any given day in 2015.

Moreover, the amount of cash held by retailers for change purposes should be added to this estimate. On the basis of the information gathered during the qualitative survey, we consider that cash held for change at the beginning of the day can be estimated by multiplying the value of a standard cash float (€60) by the number of cash registers. The number of electronic payment terminals (around 1.5 billion in France) is used as a proxy of the number of cash registers. Given the trend towards the individualisation of cash floats by cashier, we apply a ratio to take into account the rotation of several cash floats for one cash register during a standard day. On this basis, the total value of cash floats at the beginning of a day can be estimated at $1.5 \text{ million} * €60 * 1.1 \text{ ratio} = 100 \text{ million euros}$.

Overall, **the value of transactional cash held in the trade sector is estimated at 0.8 billion euros.**

It is important to underline that this result is sensitive to the assumed share of cash payments at the points of sale (18%). However, even if this assumption were revised upwards, the result would be relatively close: 1.2 billion with a 30% share for instance.

Note: the annual expenses paid by cash are estimated at 136 billion euros in this study, which is close to the value of cash withdrawn at ATMs and over the banks'

²⁰ This working assumption is commonly retained within the French financial community

counters in 2015 (190.5 billion euros). The difference may be explained by withdrawals by merchants for cash floats, withdrawals by private individuals for hoarding purposes (in particular, withdrawals of high value banknotes), or payments between individuals (person-to-person payments).

C/ Transactional banknotes held by households

Pending the results of the SUCH study, we use an approach based on the value of withdrawals of €5 to €50 banknotes at ATMs and over-the-counter (OTC) in 2015:

$$\text{Average value of cash withdrawals for transactional purposes} = \frac{\text{Total value of ATMs and OTC withdrawals of €5 to €50 banknotes over one year}}{\text{Total number of withdrawals of banknotes at ATMs and OTC over one year}}$$

We estimate the total value of ATMs and OTC withdrawals for transaction purposes as follows:

$$\text{Withdrawals at BDF counters (€5 to €50 notes) – net shipments by BDF + recirculated banknotes}$$

Besides, the number of ATM and OTC withdrawals in France in 2015 accounts for 1.8 billion.²¹

21 Source: ECB Statistical Data Warehouse, Banque de France calculations

This results in:

$$\begin{array}{l} \text{Average amount} \\ \text{withdrawn} \\ \text{for transaction} \\ \text{purposes} \end{array} = \frac{151.9 \text{ billion} - 0.1 \text{ billion} + 25.7 \text{ billion}}{1\,809 \text{ million of ATM and} \\ \text{OTC withdrawals}} = 98.4 \text{ euros}$$

Assuming a linear decrease of the cash in wallet between two withdrawals, and that the totality of the cash withdrawn is spent before each new withdrawal, **we evaluate the average amount of cash in wallet by inhabitant (aged 16+) at 98.4 / 2 = €49.2.**

The total amount of transactional cash held by households can therefore be estimated at:

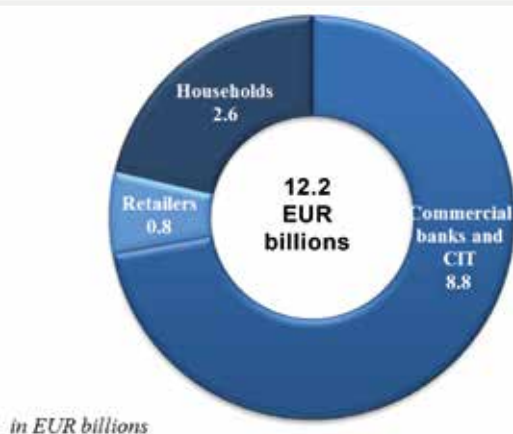
$$€49.2 \times 53 \text{ millions of inhabitants (aged 16+)} = \mathbf{2.6 \text{ billion of euros.}}$$

This estimate seems robust, even if it is probably a lower limit since payments between private individuals are not taken into account. It is possible to compare it to the result of a survey carried out in 2015 for Brink's that estimated the average value of cash in wallet held by private individuals at €45 (using that figure would result in an estimated value of transactional cash held by households of 2.4 billion).

Overall, the total stock of transactional cash held by households, retailers, banks (including CIT companies) is estimated at 12.2 billion euros in France in 2015.²²

Active circulation of euro banknotes in France in 2015

Figure 7



Source: Own calculations.

Thus, only a limited portion of the French net issuance at the end of 2015 would be used for transaction purposes: around 11%.

This result is similar to the findings of other studies carried out elsewhere in the euro area, such as the one conducted in Germany in 2009 (10% share) or by the ECB in 2011 (30% share).²³

²² Holdings detained by Central government are not presented here because of their negligible amount (EUR 45 million at end 2015)

²³ BCE, "The use of euro banknote – results of two surveys among households and firms" – ECB Monthly Bulletin April 2011

D/ Transactional banknotes in the non-observed economy

It is possible to refine the result by including an estimation of the cash used in the transactions in the non-observed economy. In accordance with the typology established by the OECD, this concept refers to three types of activities:

- The underground economy (activities that are legal but deliberately concealed from public authorities or under-estimated);
- The informal economy (clandestine activities by unregistered entities; employment of clandestine workers by households);
- The illegal economy (illegal activities, forbidden by law or carried out by unauthorised persons: trade in illegal drugs or stolen goods for instance).

In 2015, the INSEE estimated at 68.1 billion of euros the value of the underground economy and the informal economy in France.

By comparing the estimated circulation used to settle transactions in the observed economy (12.2 billion) to the estimated annual expenditure in cash in 2015 (136 billion euros, or 18% of 753 billion euros), it can be deduced that with 1 euro in circulation in the economy, consumers pay about 11 euros of purchases. If this ratio of 1/11 is relevant for the non-observed economy, **the estimated value of the non-observed economy (68.1 billion of euros) would mobilise 6.2 billion of euros in cash.**

Due to the lack of data, the assessment of the cash in used in the *illegal* economy is difficult. We therefore suggest that it be excluded at this stage. Moreover, the above-mentioned figure probably partly overlaps with the figure regarding the observed economy (for instance, a part of the cash withdrawals is probably used indiscriminately in observed and non-observed transactions).

The aggregation of the estimated transactional cash holdings in the observed economy (12.2 billion) with the estimated cash in circulation in the underground and the informal economy (6.2 billion) gives **an average active resident circulation of 18.4 billion euros in France in 2015.**

Active circulation of euro banknotes France in 2015
- including non-observed economy

Figure 8



Source: Own calculations.

To fully estimate the total resident banknote circulation, hoarding by households should also be taken into account.

According to studies carried out by the Banque de France at the time of the cash euro changeover in 2002, 45% of the franc circulation was hoarded in 2000 (domestic hoarding accounting for the largest part of the total). However, due to the lack of reliable data on the actual volume of cash in circulation in France, the share of hoarded cash cannot be estimated.

Moreover, there are other avenues for further research works, in order to complete the analysis on:

- Non-observed economy: illicit activities (eg : drug trafficking) is not estimated;
- Households: the exploitation of the results of the SUCH study on the use of cash should give an estimation of the cash carried in wallet in the various euro area countries; it should then be possible to allocate the euro banknote circulation according to cash carried in wallet, which should contribute to remove the bias stemming from the heterogeneous use of cash within the euro area.

III- Comparison of the various methods

Despite their methodological limits, the comparison of the results of the various approaches is highly instructive.

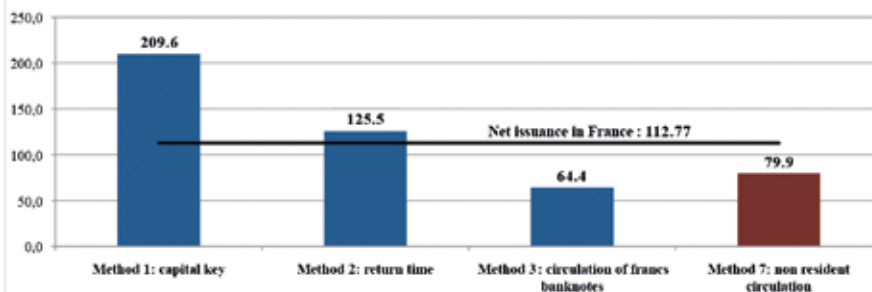
1/ Comparison of the results regarding the total French banknote circulation

Based on the different methods described in the study, the French banknote circulation would stand between EUR 64.4 billion and EUR 209.6 billion.

Estimation of the circulation of euro banknotes in France in 2015

Figure 9

in EUR billions



Source: Own calculations.

The relatively wide range of results gives rise to several comments:

- The methods 1 and 2, which split the European net issuance between countries, seems to lead to an overestimation of the French banknote circulation. Indeed, a large part of euro banknotes in circulation is held abroad and should not be included in the allocation.

Their results are both at the top of the range. This reinforces the view that large volumes of euro banknotes are in circulation outside the euro area.

- Between the methods 1 and 2, the results of the method 2 are logically the lowest. Indeed, the value of banknotes returned at the Banque de France's counters is lower than the expected value using the capital key (15.20 % versus 20%). This confirms both a relatively lower use of cash in France than in the rest of the euro area, and a greater use of low denomination notes.
- The extrapolation of the French franc banknote circulation, whose legal tender ended 15 years ago, have to be regarded cautiously (method 3). Indeed, many factors could have changed the dynamics of the banknotes demand in France since 2002. In this respect, it is somewhat paradoxical that method 3 gives the lowest result. Unlike the other ones, this method does not take into account the development of non-cash means of payment and in particular the significant increase of payments by card. Thus, a higher result compared to the other methods would have seemed logical. This result may be an indicator of the importance of the cash hoarded in France, or "moved" outside France across borders.
- The method 7 is based on a robust evaluation of non-resident banknote holdings. Its result is logically lower than in methods 1 and 2 as the banknotes held outside the euro area are excluded. However, this method does not take into account the banknotes migration between the euro area Member States whereas these flows are probably significant in France.

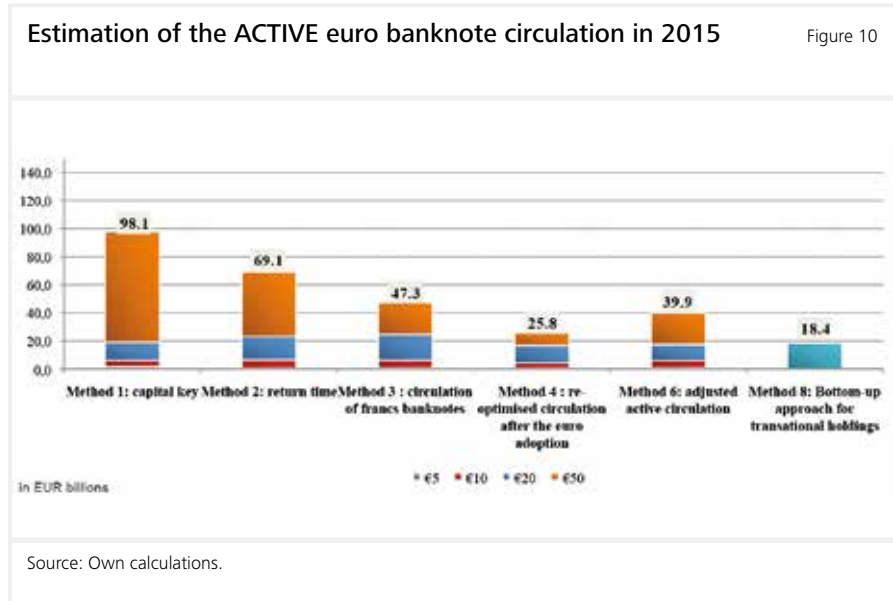
2/ Comparison focused on the active banknote circulation

Given the importance of the use of low and medium denominations in France (the average value of lodged banknotes amounts to €24.2 in France in 2015), an analysis focusing on the active circulation would help to refine the comparison by reducing the gap between the different approaches.

For most of the methods of the total national circulation, it is possible to extract the portion of the banknotes used for transaction purposes assuming that only denominations of €5 to €50 are concerned:

- Method 1: Capital key
- Method 2: Return time
- Method 3: Extrapolation of the French franc circulation
- Method 4: Re-optimised circulation after the euro adoption
- Method 6: Active circulation allocated according to the capital key and adjusted with the unfits ratio

However, at this stage, methods 5 and 7 do not allow for an estimation of the transactional circulation.



The active banknote circulation in France would stand between EUR 18.4 and 98.1 billion. There are several possible explanations for this wide range:

- The hoarded share of €50 banknote is taken into account differently among the methods. Methods 1, 2 and 3 include hoarded €50 notes, while methods 4 and 6 exclude them (since 2002 for method 4). Method 8 includes a very small share of them (the fraction of €50 notes hoarded for one single year). From this point of view, the comparison between the 6 methods should be done with caution.
- The use of the capital key in method 1 and the return time in method 2 lead to an overestimation of the national active banknote circulation because of the integration of the non-resident circulation in the estimation.

- The active banknote circulation stemming from method 1 is also overestimated given the breakdown by denomination based on the assumption of an identical use of cash in euro area countries. Indeed, according to this method, the €50 note would represent 80.5% of the circulation of transaction banknotes (€5 to €50). Despite a strong growth in the use of this denomination in France, this result is inconsistent with the breakdown by denomination of the flows recorded at the Banque de France's counters.
- In method 3, the breakdown per denomination of the banknote circulation relies on a hypothetical calculation as the banknote denomination structures in French franc and in euro are very different. By extension, the estimation of active banknote circulation is also hypothetical.
- The three latter methods provide more homogeneous results, which fluctuate between 18.4 and 40 EUR billion. Their convergence tends to support the robustness of the result of our qualitative survey, which will nevertheless have to be extended over time.

Conclusion

This study aims to stimulate reflexion and improve the statistical processing and modeling of banknote demand in France.

It proposes a new evaluation of the active cash circulation in France in 2015 (on average and on a daily basis): EUR 12.2 billion (without the unobserved economy), or 11% of French net issuance. This result is consistent with the findings of comparable studies conducted in other countries or for the euro area. Adding an assessment of the cash use in underground and informal activities leads to a total active banknote circulation of around EUR 20 billion in France.

The comparison of the results of the different methods analysed in this paper already highlights interesting characteristics of the cash demand in France. Regular updating of these results will be necessary to get comparable benchmarks. Moreover, as soon as there is a sufficient lapse of time, the inclusion of the €20 banknote in the method based on the lessons learnt from the ES2 will be very interesting given the share of this denomination in France.

This study has methodological limitations and some weaknesses due to partial information, for example regarding households' hoardings in France. Further avenues thus need to be further explored, such as:

- Estimation of hoarded cash;
- Analysis of tourists' expenditure in cash;
- Estimation of the share of cash in the remittances of workers;
- Impact of the development of cashless payments and of current regulatory and technological developments in the payments industry;
- Use of the data collected by the new sorting machines (BPS M7), which are equipped with an optical sensor for tracking banknote serial numbers.

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Methodological Annex

Method based on banknote holdings

In this study, we use a bottom-up approach to estimate the cash in circulation (CC), by considering it as the sum of the cash holdings (CH) of the institutional sectors: households (hh), non-financial corporations (nfc), financial corporations (fc), the government sector (gs) and non-profit institutions serving households (npish).

$$CC = CH_{hh} + CH_{nfc} + CH_{fc} + CH_{gs} + CH_{npish}$$

Since the government sector and the NPISHs use relatively limited amounts of cash compared to the other institutional sectors, we focus on the cash held by households, financial and non-financial corporations.

We assume that the institutional sectors, particularly the households, hold cash for two main reasons: transaction (t) and hoarding (h). Due to the absence of data on hoarding, we limit the field of our study to the so-called “active” circulation, used to settle transactions, as opposed to hoarded cash.

By distinguishing between cash held for trading and hoarded cash, the cash held by households can be expressed as follows:

$$CC_{hh} = CH_{hh}^t + CH_{hh}^h$$

Financial institutions hold cash as a result of their customers’ operations, i.e. withdrawals and deposits, mainly undertaken by households and non-financial companies. Their cash holdings are therefore a logistical stock, held either in the ATMs, in the vaults of bank branches, or in the centres of Cash-In-Transit (CIT) companies. A portion of the cash held by financial corporations is intended to be hoarded by

households, or corresponds to holdings de-hoarded by households, and therefore should not be included in the active circulation.

$$CC_{fc} = CH_{fc}^t + CH_{fc}^h$$

Finally, the cash held by non-financial corporations (businesses) corresponds to their turnover in cash awaiting pick-up by CIT companies, as well as cash funds. It can therefore be entirely assimilated to the “active” circulation.

The “active circulation” (AC) can be expressed as follows:

$$AC = CH_{hh}^t + CH_{nfc} + CH_{fc}^t$$

The use of cash for transactions in the non-observed economy by households and non-financial corporations represents an additional difficulty when estimating the active circulation. Cash held by these two sectors can be expressed as the sum of cash held for transactions in the observed economy (ot) and cash held for transactions in the non-observed economy (nt).

$$CH_{hh}^t = CH_{hh}^{ot} + CH_{hh}^{nt}$$

$$CH_{nfc} = CH_{nfc}^{ot} + CH_{nfc}^{nt}$$

The use of cash in the non-observed economy is only partly captured by the data used to estimate the cash holdings of households and non-financial corporations.

Assuming that the ratio between the amount of transactions paid by cash and the currency in circulation is the same in the observed economy and in the non-observed economy, it is possible to estimate the cash in circulation used for transactions in the non-observed economy on the basis of the estimated amount of transactions in the observed (AOT) and non-observed (ANT) economy:

$$CH_{hh}^{nt} + CH_{nfc}^{nt} = \frac{AOT}{CH_{hh}^{ot} + CH_{nfc}^{ot} + CH_{fc}} \times ANT$$





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Jörn Tenhofen¹, Katrin Assenmacher (ECB), Franz Seitz (Weiden Technical University of Applied Sciences)

The use of large denomination banknotes in Switzerland²



Jörn Tenhofen
Swiss National Bank

Abstract

We study the demand for Swiss banknotes over the period from 1956 to 2015 and present stylized facts on different banknote denominations since the inception of the Swiss National Bank (SNB) in 1907. Employing the so-called seasonal method, we focus on the demand for banknotes used as a store of value (“hoarding”), which can be expected to be particularly relevant for Switzerland against the backdrop of its status as a safe-haven country, its currently and historically low level of

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interest rates, and a banknote denomination with the largest value among advanced countries. Due to the pronounced seasonal pattern of CHF 1000 banknotes, which might not be related to transactions, we cannot rely on seasonal ranges including the December peak. Instead, we employ other peak dates as well as a method to correct for the excess seasonality, using institutional features of the tax system. The latter approach is not sufficient to eliminate the excess seasonality and thus does not lead to plausible estimates for the hoarding share of CHF 1000 banknotes. Employing other peak dates, however, indicates that since the turn of the millennium the share of CHF 1000 banknotes that is hoarded increased steadily from around 30% in the mid-1990s to over 70% in recent years.

1 Introduction

During the recent financial crisis, many countries experienced a noticeable increase in banknote demand. In particular, after the bankruptcy of Lehman Brothers in September 2008, which triggered concerns about the solidity of the banking system, large denomination banknotes were in high demand to protect financial wealth against bank failures.³ This is just one example of many, where banknotes are not only demanded as a medium of exchange but – being money – perform their function as a store of value, next to being the unit of account. Central banks have an interest in knowing the share of currency in circulation used for transaction and for store-of-value purposes, respectively. This is relevant both for managing the supply of those banknotes, but also for monetary policy. An estimate of the share of currency in circulation not used for transaction purposes, for instance, helps when interpreting monetary aggregates and thereby when assessing the

³ For instance, circulation of EUR 500 banknotes increased by over 10% from September to October 2008 in the euro area. In the US, where only quarterly data are available for the denominations, circulation of USD 100 banknotes increased by an extraordinary 7% over the last quarter of 2008. In Switzerland, circulation of the CHF 1000 banknote increased by over 12% from September to October 2008.

stance of monetary policy.⁴ Moreover, the demand elasticity for cash being used as a store of value might affect the implementation of monetary policy in a low interest rate environment. Additionally, to perform its day-to-day task of supplying and handling the economy's cash in circulation, the central bank needs to have an idea of important features of the demand side. For example, a larger share of cash used as a store of value might imply a lower variability in the demand for cash. Finally, overall central bank profits will be affected if wealth is permanently held in high denomination banknotes rather than bank deposits, generating seigniorage

The case of Switzerland seems to be particularly interesting when estimating the share of banknotes held as a store of value, both domestically and abroad.⁵ Switzerland issues banknote denominations with one of the largest values in the world.⁶ Moreover, the level of interest rates is among the lowest worldwide, both currently and historically, implying a low opportunity cost of holding cash. This fact, together with Switzerland's reputation as a safe haven that attracts investors especially in times of crisis, would lead one to expect a sizeable amount of cash which is held as a store of value for different motives. While the introduction of the euro has given rise to several cash studies for euro-area countries, papers on the demand for Swiss banknotes are scarce. The most comprehensive study by Andrist (1997) is now 20 years old and therefore covers neither the recent financial crisis

4 Currency in circulation still constitutes a sizeable share of monetary aggregates. While in Switzerland the share of total currency in circulation in M1 decreased from over 20% at the beginning of the 1990s to around 14% recently, the share in M3 actually increased from less than 7% to over 8%.

5 Typically, the methods employed in this paper lead to an estimate of the share of cash used for domestic transaction purposes. The residual would be the share of currency used for all other purposes, i.e., domestic hoarding and non-resident demand. The latter could be further separated into the share used abroad as a medium of exchange and store of value. As the Swiss franc does not seem to be used for transaction purposes in other countries (Andrist 1997), we interpret the residual as encompassing both foreign and domestic hoarding, or hoarding in short. We do not have any evidence on the respective shares nor do we try to estimate them within this study.

6 Printing of the 10'000 Singapore-dollar banknote stopped in October 2014 and it is being withdrawn from circulation. Thus, there seems to be only one banknote denomination still in circulation, which is larger than the CHF 1000 banknote: the 10'000 Brunei-dollar note, which is pegged one to one to the Singapore dollar and is currently worth around CHF 7'100.

nor the phase of low interest rates.

Against this backdrop of only a few studies on the demand for Swiss franc currency, we investigate the demand for Swiss banknotes over the period from the inception of the Swiss National Bank (SNB) in 1907 to 2015. We start by providing a survey of the literature on the demand for Swiss currency and continue with stylized facts on the evolution of total banknotes as well as on the different denominations and put them into relation internationally. We then go on to estimate the potential amount of banknotes used as a store of value, or “hoarding” in short, focusing on the so-called seasonal method and emphasize specific issues when working with Swiss data. The seasonal method approximates non-transactions-related demand by relating the seasonal pattern of the banknotes of interest to the seasonal pattern of some reference series. This reference series can either be a smaller denomination banknote, banknote circulation in another country or other time series related to domestic transaction demand for cash. As hoarding should dampen seasonal variation, the seasonal method requires that the reference series shows a more pronounced seasonal pattern than the series of interest.

In the Swiss case, however, the denomination most likely used for hoarding purposes – the CHF 1000 banknote – shows a large, pronounced seasonal peak in December which exceeds the corresponding seasonal peaks for the smaller denominations and presumably occurs for other reasons than seasonal transaction demand. We try different methods to correct for this peculiarity. First, we try to estimate the “excess seasonality” of the CHF 1000 banknote, using institutional features of the Swiss tax system following Ettlin and Fluri (1986). The resulting corrected seasonal ranges, on which the seasonal method is based, do not lead to plausible estimates for the hoarding share of the CHF 1000 banknote, however. Second, we use different months to compute the seasonal ranges. The corresponding results indicate that since the turn of the millennium the share of CHF 1000 banknotes that is hoarded increased steadily from around 30% in the mid-

1990s to over 70% in recent years.

The paper is structured as follows. Section 2 reviews the existing literature on Switzerland, which reveals a wide range of estimates for the hoarding share of banknotes. Section 3 presents some stylized facts on the evolution of Swiss banknotes over time as well as for the different denominations. Section 4 introduces the seasonal method, describes and rationalizes the pronounced seasonal pattern of the CHF 1000 banknote and explores different ways to apply the approach to the Swiss case. Section 5 summarizes and concludes.

2 Studies on the demand for Swiss franc currency

As indicated in the introduction, it is surprising that Swiss franc currency hoarding has not been much investigated, in contrast to other currencies like the US dollar or the euro (or its precursors). In the following, we survey the literature on the demand for Swiss franc currency, with a particular focus on results related to hoarding.

In general, one strand of the literature on currency demand starts with observations on the share of outstanding currency that is needed for transactions by using either payments data or conducting surveys. We are not aware of any such survey for Switzerland so that we have to resort to evidence collected for countries that might be similar to Switzerland in terms of currency demand. Based on payment diary data, Bagnall et al. (2016) conduct a comprehensive study on cash usage in seven developed countries.⁷ According to this data, the mean respondent carries

⁷ Studies based on surveys and related diary data are often criticized for an inherent sample selection bias and a bias caused by participants responding strategically. In the case of surveys among consumers, also effects of the survey's design on the results have to be taken into account. Particularly evident in this regard is a high sensitivity or resistance among consumers to having to answer questions about their cash holdings (see, e.g., Jonker and Kosse 2009).

cash balances of USD 123 in Germany and USD 148 in Austria in his wallet. Arguing that these countries have similar habits concerning cash as Switzerland, we could take them as a reference to extrapolate the currency stock needed for transactions. With a population of 8 million, this would result in a currency stock of roughly CHF 1.2-1.5 billion, i.e., only 2% of the banknotes that were actually in circulation at the end of 2015.⁸ It is common, however, that households' transaction demand constitutes only a minor share of outstanding currency. Based on evidence from a 1986 currency holding survey, Sprenkle (1993) obtains a value of around 10% for the US. Deutsche Bundesbank (2016, p. 42) estimates that the share of euro banknotes held for transaction purposes in Germany is less than 10%.

However, it seems that Switzerland exhibits some idiosyncrasies in payment patterns that are not shared by its neighbors. While in Switzerland the number of debit terminals per 1000 inhabitants exceeds that in Austria and Germany, the number of non-cash transactions is significantly lower. Moreover, automatic teller machines (ATMs) in Switzerland typically distribute denominations up to the CHF 200 banknote,⁹ which significantly exceeds the value of the denominations that are typically available at ATMs in other countries. There the largest denomination available is generally worth only about one half or one third of that available in Switzerland.¹⁰ This indicates that Swiss consumers might carry significantly larger amounts of cash than consumers in Austria and Germany. Finally, about two thirds of the CHF 1000 notes that were in circulation in 2013 flowed back to the SNB during that year, indicating that large banknotes are actually used in transactions

⁸ Values are converted into Swiss franc using the OECD's purchasing power parity rate for 2015 at http://stats.oecd.org/Index.aspx?datasetcode=SNA_TABLE4, thereby controlling for the different price levels.

⁹ Recently, also CHF 1000 notes are becoming available at ATMs.

¹⁰ See Amromin and Chakravorty (2009), Figure 2, Table 1, and Table 4.

(see SNB Annual Report 2013, p. 55).¹¹ Even when allowing for these differences and doubling or tripling the amount of cash needed for transactions, we are still left with a large share of outstanding currency that is not explained by transaction demand. This implies that sizeable amounts are hoarded and used as a store of value for different reasons (see, e.g., Bartzsch et al., 2013b; Deutsche Bundesbank, 2016).¹²

Coming to studies which feature Switzerland and explicitly investigate hoarding demand, the majority of studies obtains a hoarding share of around 40% for the Swiss franc for the 1980s and the 1990s. An early study is Boeschoten (1992). He finds that in countries with large denomination banknotes hoarding demand accounts for a significant share. For Switzerland, he estimates that at the end of the 1980s, 45% of currency in circulation was hoarded.¹³ From 1970 until 1989, hoarding contributed 1% to the annual growth in cash.¹⁴ Andrist (1997) comprehensively studies money demand in Switzerland, while dedicating a chapter to the demand for cash. He uses different methods to discern the demand for transactions as well as hoarding, both domestic and foreign. Using a method based on the life span of different banknote denominations, he obtains a share of hoarding and non-resident demand in 1995 of 40%. Moreover, following Seitz (1995), he concludes that non-residents do not hold Swiss franc for transaction purposes but exclusively for hoarding. An internal SNB study (SNB 1998) uses the seasonal method with Sweden as a reference country. For the period from 1985 to 1997, the share of the demand for hoarding and non-resident demand of the Swiss franc is

11 Please note in this regard that the same banknote can flow back to the SNB several times in a year. Moreover, anecdotal evidence points to the use of large banknotes, in particular, in the market for cars, cattle trade, and for cash payment of bank transfers at post offices to pay rents and insurance premiums, for example.

12 Based on survey evidence, Stix (2013) found that in ten Central, Eastern, and Southeastern European countries 44% of respondents with savings report that cash has a higher weight in their financial portfolio than bank products (in particular savings accounts).

13 In 1970, this share was 35%.

14 The average annual growth rate of banknotes in Switzerland over that period is 4.3%.

estimated to be about 40% on average.

Some studies, however, obtain much larger estimates of 70% or even more for the hoarding share of the Swiss franc. Based on an analysis of the seasonal patterns, Andrist (1997) calculates a share of 70% for domestic and foreign hoarding demand. Since he uses retail sales as reference series and the results are quite sensitive to the coefficient relating currency in circulation and retail trade, we would not put too much emphasis on these results. Moreover, Doyle (2000) estimates the foreign holdings of US, German, and Swiss currency over the time period from 1960 to 1996. Within a cointegration framework, he uses estimated currency demand functions of a reference country to obtain the predicted (domestic) currency demand of the particular country of interest and thereby an estimate for the foreign holdings. For the Swiss franc, he obtains non-resident holdings of 77% in 1996. However, as the author himself notes, the choice of Austria as a reference country for Switzerland is not fully convincing. Consequently, his results for Switzerland should be interpreted with caution.¹⁵

Moreover, some studies explicitly investigate the demand for certain denominations. Kohli (1988) estimates a system of demand equations for the different banknote denominations in Switzerland for the period from 1950 to 1984.¹⁶ The model is used to predict the demand for a banknote, which had not been issued at the time: the CHF 200 bill. That denomination was actually issued in 1997 and with hindsight, Kohli's estimate for the share of CHF 200 banknotes was quite accurate. He predicted a share of 14.3% (given the CHF 500 banknote would be abolished), when it actually has been 14.5% on average since 1997. Ettlin (1989) investigates

¹⁵ In their study of the euro area, Fischer, Köhler, and Seitz (2004) present stylized facts on Swiss cash demand and its seasonal pattern for comparison without providing estimates of a hoarding share.

¹⁶ Among the potential explanatory variables are a variable measuring the distance of the value of a denomination to its neighboring denominations, the physical size, the price level, income per capita, velocity, and an interest rate.

the demand for small (up to CHF 100) and large (CHF 500 and 1000) banknotes, respectively, within a cointegration framework. He takes particular account of the biannual tax effects and the hoarding demand resulting from measures to bypass capital controls imposed during the breakdown of the Bretton Woods system.¹⁷ Based on just the latter effect, he obtains a hoarding demand of 23% of the large banknotes in circulation for the first quarter of 1980; a corresponding hoarding demand is not apparent for the small denominations.

Finally, Fischer (2014) investigates the effect of immigration on the demand for large banknotes in Switzerland using micro data. He finds that natives hoard more CHF 1000 banknotes than immigrants. While this is inconsistent with the hypothesis that immigrants use cash for remittances or have less access to banking services, it is consistent with tax avoidance or a particular distribution of characteristics that are relevant for precautionary money demand (e.g., immigrants on average being of lower age or having lower wealth than natives). However, the results do not allow for a discrimination between these effects.

¹⁷ Capital controls, e.g. in the form of negative interest rates on deposits of non-residents of up to –10% per quarter were imposed as well as a ban on the acquisition of domestic financial assets by non-residents to address strong capital inflows. These measures were gradually phased out from 1979 onwards, after an exchange-rate target had been introduced at the end of the preceding year; see also SNB (1982, pp. 290f) and SNB (2007, pp. 195-198).

3 Stylized facts on the demand for banknotes in Switzerland

In order to get an overview of the different characteristics of cash demand in Switzerland, we present some stylized facts on the demand for Swiss franc banknotes, both for the total and the different denominations. This allows us to get a sense of the relevance of banknote hoarding over time and of the importance of different denominations in this context.

3.1 Demand for total banknotes

When the SNB started to operate on 20 June 1907, it issued its first own banknotes.¹⁸ On that day, SNB banknotes of a total value of CHF 44.2 million were in circulation.¹⁹ This amounted to 23.3% of the total value of banknotes in circulation (SNB 1932, p. 56), while the remainder was made up of notes of the banks of issue. Over the next three years, these two sets of banknotes circulated in parallel, with an increasing share of SNB banknotes. When the transition was completed in June 1910, the value of total (SNB) banknotes in circulation had increased to CHF 254.9 million.

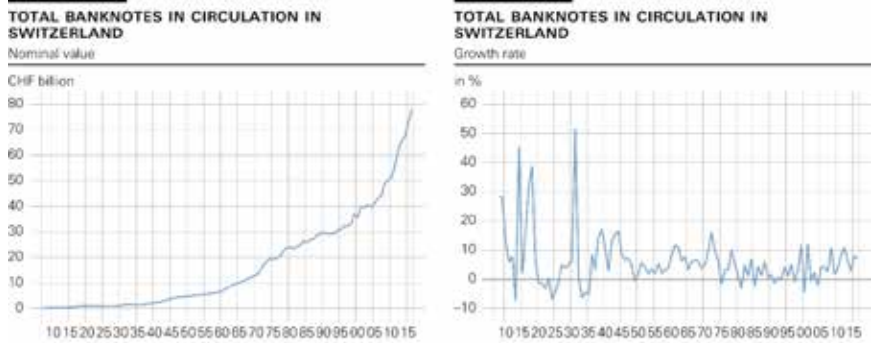
Figure 1 shows annual data for the nominal value of total banknotes in circulation in Switzerland from the inception of the SNB in 1907 to 2015. The left-hand panel indicates that it increased steadily from around CHF 0.16 billion at the end of 1907 to CHF 72.88 billion at the end of 2015. From the end of the transition period in

18 During that time, Switzerland was part of the Latin Monetary Union (de facto on a gold standard from the early 1870s), which regulated issuance and acceptance of coins among participating countries, but not of banknotes. Before 1907, Switzerland had no central bank but operated within a system of free banking, where private banks (“banks of issue”) issued banknotes and competed with each other. Until 1881, the issuance of banknotes was not even regulated by the Swiss government. See SNB (2007, pp 29–35).

19 As the time to develop and produce the SNB’s first own banknote series (called “interim banknotes”) was limited, it built on the banknotes issued by the private banks of issue: it used the same paper and printing plates, where the number of the bank of issue on each denomination was replaced by a rosette with Swiss cross. Also the denominations were the same as regulated and standardized by the Swiss law on banknotes from 1881 (cf. Section 3.2).

Nominal value of total banknotes in circulation in Switzerland

Figure 1



(left panel: in CHF billion, right panel: growth rate in percent)
Source: SNB

1910 to 2015, the average annual growth rate of banknotes in circulation was 5.4%. This is larger than the average annual increase in nominal GDP over that time period, which was 4.8%. Given technological progress in payment technologies and cash management practices, a smaller average growth rate of banknotes than of nominal GDP would be expected. Thus, other factors also seem to have played a role. In particular, as the right-hand panel of Figure 1 shows, the growth rates have been quite different over the years. The first 30 years saw a large volatility in banknote circulation. During four years, banknote circulation even increased by more than 30%, namely during World War I (1914, 1917, and 1918) and when the Great Depression intensified in 1931.²⁰ In all of these instances, hoarding de-

²⁰ That year saw a sharp deterioration of the economic situation particularly in neighboring Austria and Germany, following the failures of Creditanstalt and Darmstädter und Nationalbank (Danat), respectively.

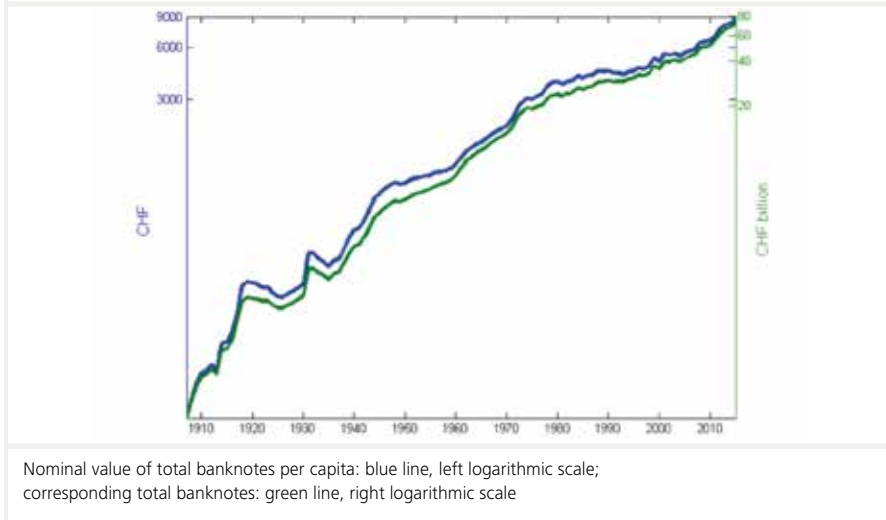
mand for Swiss franc also from non-residents was an issue, so that from May 1918 to June 1921 a ban on Swiss franc shipments abroad was imposed. Between these large peaks, banknote circulation decreased in several years, in particular in the first half of the 1920s and again from 1933 to 1935. There were different reasons for this. In the former period, banknotes that were hoarded abroad flowed back when the German hyperinflation had been stopped (SNB 1932, p. 137). Moreover, gold coins and banknotes circulated in parallel, which made the demand for banknotes dependent on the availability of gold coins (SNB 1932, p. 142), which itself was volatile and affected by global shocks.

The years of World War II saw again a strong increase in the demand for Swiss franc banknotes. It flattened in the 1950s but returned to higher growth rates during the years of higher inflation in the 1960s and particularly in the 1970s. Towards the end of the Bretton Woods system, and again during the late 1970s, Switzerland experienced large capital inflows and in response resorted to capital controls, in particular negative interest rates on deposits held by non-residents. As banknotes were used to circumvent those capital controls, these periods of increased appreciation pressures are visible in the two peaks during the 1970s in the right-hand panel of Figure 1. The 1980s and most of the 1990s featured slower banknote growth, which then accelerated with the uncertainties and crises since the end of the 1990s, namely the fear of a possible millennium bug 2000, the bursting of the dot-com bubble around 2000, the 9/11 terrorist attacks in 2001, the introduction of euro banknotes and coins in 2002, the financial crisis in 2008, and the euro area debt crisis starting 2010.

The (nominal) demand for banknotes increased strongly over time also in per capita terms. Figure 2 shows that banknotes per capita and total banknotes increased in lockstep, so that population growth does not seem to be an important factor driving banknote demand. Total (nominal) banknote holdings per capita increased

Nominal value of total banknotes per capita and corresponding total banknotes in Switzerland

Figure 2



from CHF 80 in 1910 to almost CHF 8800 in 2015. This translates into an average annual increase of 4.6%, whereas population growth was only 0.8% p.a. on average over that time period. A similar picture emerges when considering banknote holdings per capita in real terms.²¹ Real per capita banknote holdings, in prices of 2015, increased from CHF 1430 in 1921 to almost CHF 8800 in 2015, i.e., by 1.9% p.a. on average, whereas real total banknote holdings increased by 2.8% p.a. on average (cf. Figure 3).

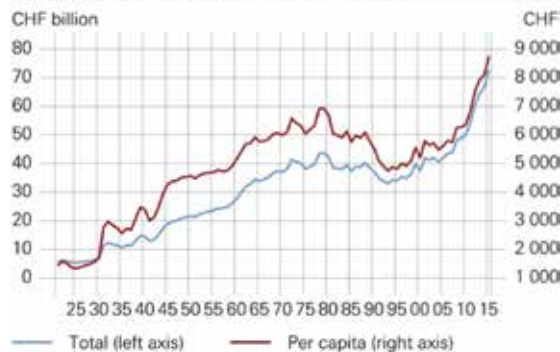
²¹ This series is only available from 1921 onwards due to lacking price data.

Real value of total banknotes per capita in circulation and corresponding total banknotes in Switzerland

Figure 3

TOTAL BANKNOTES IN CIRCULATION IN SWITZERLAND

Real value, in prices of 2015, total and per capita



Real value of total banknotes per capita in circulation: red line, right scale;
corresponding total banknotes: blue line, left scale

Source: SNB

Also in international comparison, banknote holdings per capita in Switzerland are high, as Table 1 documents. The only country coming close is Japan. In Swiss franc, Japan's per capita holdings are 27% lower than Switzerland's, but in PPP terms, they are around 7% larger.²² The US and the euro area, both being large currency areas for which the literature has estimated a sizeable share of banknotes circulating abroad,²³ have holdings at around 60% of the Swiss ones in PPP terms. Whereas the UK and Canada are in a range of 20-25% of Swiss banknote holdings, Sweden is at the lower end with only about one tenth of that of Switzerland's.

²² Following the strong appreciation of the Swiss franc since 2008, total banknotes per capita in Swiss franc tend to overstate holdings in Switzerland relative to other countries.

²³ See, for example, Fischer et al. (2004), Porter and Judson (1996), or Seitz (1995).

International holdings of total banknotes per capita and relative to GDP in 2015

Table 1

	Total banknotes per capita		Total banknotes to GDP in %
	in CHF	in PPP	
Canada	1522.76	1678.12	3.80
Euro Area	3471.46	4179.16	10.36
Japan	6351.29	7370.47	18.55
Sweden	815.55	761.78	1.63
Switzerland	8754.38	6866.18	11.29
UK	1492.73	1443.22	3.48
USA	4275.43	4293.46	7.65

Note: End-of-year values of banknotes in circulation, converted with end-2015 current exchange rates. PPP-calculation based on purchasing power parities computed by the OECD.

Relative to GDP, the position of Switzerland remains basically the same as in per capita PPP terms, confirming that the choice of normalization does not affect the conclusion that Swiss banknote holdings are high.

Standard monetary theory implies that the demand for banknotes should depend on the volume of transactions, the price level, and the opportunity cost of holding cash. We therefore plot the ratio of total banknotes to (nominal) GDP, i.e., the inverse of the velocity of banknotes in circulation, in the left-hand panel of Figure 4, together with the interest rate on savings deposits as a measure of the opportunity cost. Compared with banknote holdings per capita (Figure 2), the ratio of banknotes to GDP shows a different pattern. From the establishment of the SNB until 1945, the ratio of banknotes to GDP increased with a brief fallback in the 1920s. This matches with the evidence reported above that political uncertainty and demand from abroad led to increased hoarding. After reaching a peak of over

25% in 1945, the ratio of banknotes to GDP fell steadily – with only a brief interruption in the early 1970s – until the beginning of the 1990s when it reached a level of about 7.5%. Such a downward trend would be expected if advances in payment technologies lead to a larger share of non-cash payments and if cash management improved. Until the beginning of the recent financial crisis, the ratio of banknotes to GDP moved sideways whereas, since 2008, it started to increase again. Initially, both a fall in GDP in the course of the crisis and an increased demand for banknotes due to doubts about the solidity of banks contributed to this increase. However, even after GDP started to grow again and the most severe banking problems had abated, the ratio continued to increase and reached over 11% in 2015.

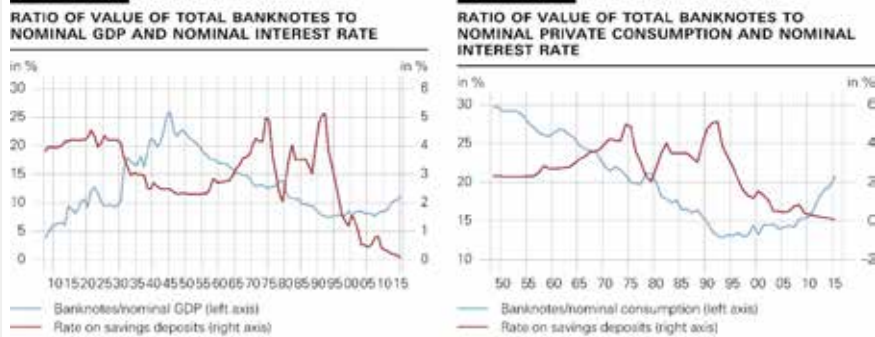
A qualitatively similar picture for the post-war years emerges when relating total banknotes to private consumption, as indicated in the right-hand panel of Figure 4.²⁴ This transactions-related variable is presumably more relevant for banknote demand, compared to the more broadly defined concept of GDP. Nevertheless, also for the ratio to private consumption, a downward trend up to the early 1990s is observed, which was briefly interrupted in the late 1970s. From the early 1990s to the recent financial crisis the ratio bottomed out, but passed over to a strong increase, particularly since 2012. In 2015, the ratio stood at 21%, a level last seen in the late 1970s.

Barring secular trends that are driven by advances in payment technology or other low-frequency developments, we would expect a negative relation between the ratio of banknotes to consumption or GDP and the opportunity cost of holding cash. To some extent, this is indeed the case. The increase in the banknote-to-GDP ratio in the late 1970s coincides with a downward spike in interest rates. Moreover, the sharp increases in interest rates in the late 1980s to the early 1990s led to an

²⁴ Unfortunately, annual data on private consumption for Switzerland is only available since 1948.

Ratio of value of total banknotes in circulation to nominal GDP / to nominal private consumption and nominal interest rate in Switzerland

Figure 4



Ratio of value of total banknotes in circulation to nominal GDP / to nominal private consumption:
blue line, left scale;
nominal interest rate (rate on savings deposits), red line, right scale
Source: SNB

acceleration of the decrease in the banknote-to-GDP ratio. However, much of the decrease in interest rates took place in the late 1990s whereas the banknote-to-GDP ratio picked up strongly only after the financial crisis in 2008. This is reflected in the correlation of the interest rate with the deviation of these ratios from trend.²⁵ Considering the banknote-to-GDP ratio, the correlation is indeed negative at -0.12 for the whole period from 1907 until 2015. Over the post-war period starting 1948, the correlation is more strongly negative at -0.26 . However, as indicated

²⁵ As a first approximation, we try to capture the aforementioned secular movements, which might include advances in payment technology but also long-run trends in hoarding demand, by the trend resulting from an application of the Hodrick-Prescott filter to those ratios. For the banknote-to-GDP ratio, this trend first increases from the beginning of the sample in 1907 until the end of World War II, then decreases again until the mid-1990s. Subsequently, it is stable until the beginning of the recent financial crisis, when it increases again.

above, when considering the sample from the second half of the 1990s until 2015, it turns positive with 0.07.²⁶ Obviously, there have been other factors besides interest rates which have influenced this ratio in the course of time.

In sum, demand for Swiss franc banknotes has increased steadily since the establishment of the SNB in 1907. Until the end of World War II, hoarding demand, also from abroad, has recurrently played a role. With the Bretton Woods agreement, the US dollar became the dominant currency and motives for hoarding Swiss francs apparently receded. Nevertheless, Switzerland's stability, low inflation, and the existence of a large value banknote presumably make Swiss franc banknotes still attractive for hoarding. The strong increase in banknote demand in the wake of the financial crisis supports this conjecture. We now turn to the different denominations in order to uncover more evidence.

3.2 Evolution of different banknote denominations

The first banknote series issued by the SNB contained only denominations of CHF 50, 100, 500, and 1000. The value of the banknote denominations in real terms in the early 1900s was high, in particular when considering that the price level has increased about fivefold from 1920 until 2015. Banknotes were mainly employed in commercial transactions, which explains their relatively large value.²⁷ Typically, (gold and silver) coins were used in day-to-day transactions. In conjunction with the beginning of World War I and a resulting drop in the circulation of coins, banknote denominations of CHF 5 and CHF 20 were added in 1914 to provide sufficient means of payment for day-to-day operations.

²⁶ Similar correlations are obtained when using the banknote-to-consumption ratio.

²⁷ During the first ten years of the SNB, changes in payment technology, namely the replacement of trade bills by settlement in banknotes, led to an increase particularly in the demand for CHF 1000 banknotes, see SNB (1932, p. 136).

About 40 years later, i.e., in 1956, the CHF 10 banknote was issued as the next new denomination. Issuance of the CHF 5 banknote was suspended subsequently in 1958 and its circulation became negligible shortly afterwards. In 1997, the CHF 500 banknote was replaced by a CHF 200 banknote, so that the current set includes the following six denominations: CHF 10, 20, 50, 100, 200, and 1000.²⁸ As a result, the replacement of the CHF 500 by the CHF 200 banknote takes place during our sample period and has the potential to affect the demand also for the other denominations.

Figure 5 shows that the increase in the nominal value of banknotes in circulation since 1956 is mostly driven by the large denominations, predominantly the CHF 1000 and CHF 500 bills up to 1980 and only the CHF 1000 bill thereafter. Their value shares increased particularly over the 1970s, when they were used to bypass measures to limit appreciation pressure on the Swiss franc in the course of the breakdown of the Bretton Woods system.²⁹ The popularity of the CHF 500 banknote declined from the end of the 1970s onwards. This coincides with the introduction of banking accounts related to wage payments over the course of the 1970s, so that fewer and fewer wages were paid in cash,³⁰ where the CHF 500 bill had been a popular denomination. This change in the payment technology also affected the CHF 100 banknote. It was the most important bill up to the early 1970s, but exhibited a sharp drop in its share over the following decade. The CHF

28 The SNB reviews the set of denominations regularly. Against the backdrop of weak demand for CHF 500 banknotes, i.e., the demand for the CHF 500 banknote basically stagnated since the mid-1970s and its share in the total value of banknotes had been declining since 1975, the SNB in 1985 considered two possible future sets of denominations: one with both a CHF 200 and 500 bill and another with either a CHF 200 and 500 bill. Banks and business representatives had a preference for the latter solution and also experiences abroad pointed in that direction. Moreover, printing an additional denomination is costly. As a result, in 1987 the SNB decided to replace the CHF 500 banknote by a CHF 200 bill. See SNB (2007, p. 346).

29 See footnote 21.

30 The number of postal checking accounts more than doubled between 1970 and 1980, mainly due to accounts related to wage payments. See SNB (1982, pp. 290 and 295). The average (gross) monthly wage in 1970 was about CHF 1500.

1000 banknote, in contrast, continued its upward trend – even despite an increased popularity of payments by check (Swiss-Check) – and reached a value share of 62% in 2015. The introduction of the CHF 200 banknote in 1997 led to some modifications in the distribution among the different denominations. First, the CHF 500 banknote quickly dropped out of circulation and the demand was picked up by the new CHF 200 banknote, but also by the CHF 1000 bill. Second, some of the demand for CHF 100 banknotes also switched to the new denomination and the share of CHF 100 banknotes has been on a declining trend since then.

The fact that the noticeable increase in the demand for total banknotes is driven by the largest denomination and that its share dominates those of the other denominations is a first indication that a non-negligible part of the increased demand for the CHF 1000 bill might result from hoarding, domestically or abroad.³¹

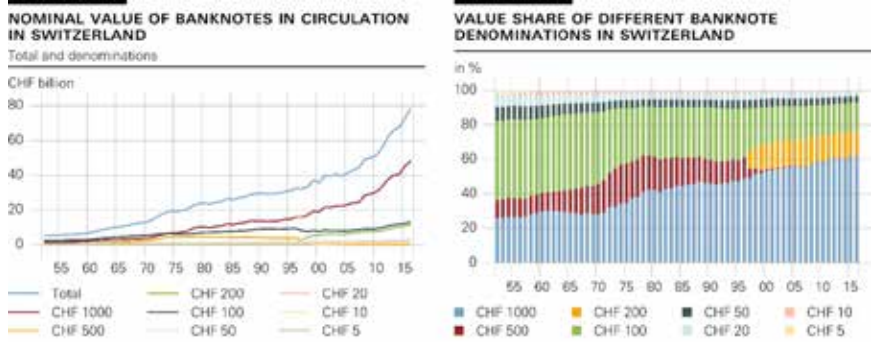
In addition, Figure 6 illustrates that only the CHF 1000 banknote shows an unambiguous increase in its ratio to consumption over the sample period.³² By contrast, for the CHF 100 bill this ratio fell continuously from over 13% in 1956 to less than 3% at the end of the 1990s. The CHF 500 banknote and the smaller denominations also fell strongly in importance until the end of the 1990s, after which they flattened out. By contrast, since the recent financial crisis, the ratios to consumption for the CHF 100 and the CHF 200 banknotes increased slightly, which might indicate some hoarding demand also for these denominations.

31 Fischer et al. (2004, p. 14f) refer to the high share of large denomination banknotes in Germany, the Netherlands, Belgium, and Austria as an indication of hoarding. However, they do not quantify this observation. Van Hove and Vuchelen (1999) show for the case of Belgium that the introduction of a new highest denomination leads to a substitution of hoarding away from the lower denominations.

32 A similar picture emerges for the banknote-to-GDP ratio as presented in Figure 7.

Nominal value and corresponding share of different banknote denominations in circulation in Switzerland

Figure 5

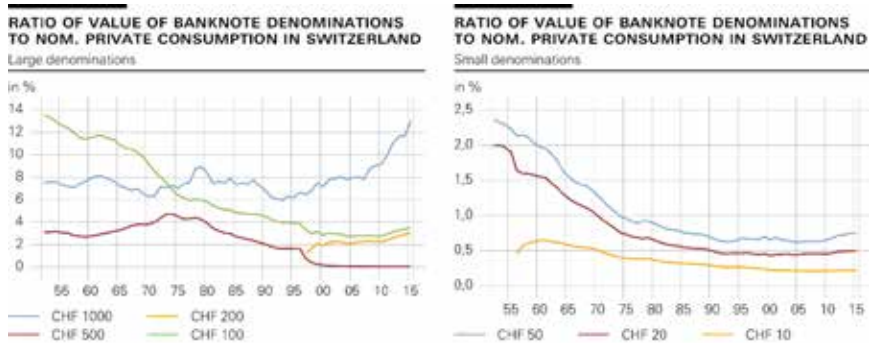


Source: SNB

In general, the developments of the different banknote denominations relative to consumption are consistent with advances in payment technologies, more efficient cash management practices, as well as changes in payment habits (e.g., wages are no longer paid in cash but instead in a bank account, increased payments by credit and debit cards, etc.) and indicate that denominations up to CHF 50 are primarily used for transaction purposes. The CHF 1000 bill, in particular, plays a different role. From 1956 until the late 1990s, the ratio to consumption for the CHF 1000 banknote fluctuated in a band between 6% and 9%. From the mid-1990s on, this ratio embarked on a rising trend and stood at 13% in 2015. Again, these figures illustrate that the main vehicle for banknote hoarding seems to be the CHF 1000 banknote (and to a smaller extent the CHF 200 and potentially the CHF 100 banknote), so that in the following we will focus on this denomination.

The ratio of banknotes to nominal private consumption in Switzerland: denominational breakdown (left panel: large denominations, right panel: small denominations)

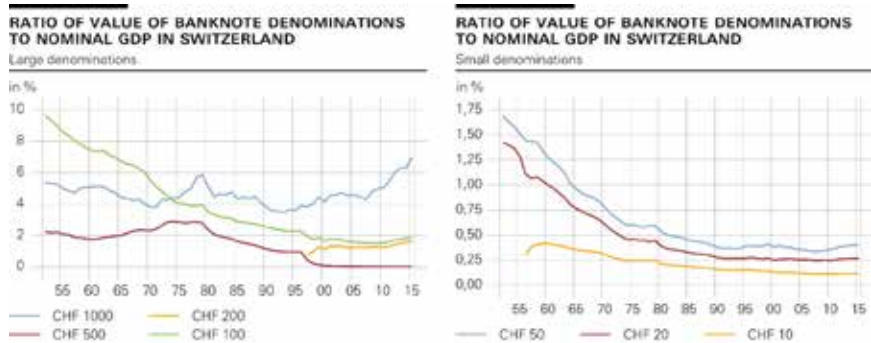
Figure 6



Source: SNB

The ratio of banknotes to nominal GDP in Switzerland:
denominational breakdown (left panel: large denominations,
right panel: small denominations)

Figure 7



Source: SNB

4 The seasonal pattern of CHF 1000 banknotes and hoarding demand

In this section, we study the seasonal pattern of different banknote denominations with the aim to determine the demand for hoarding, following Sumner (1990) and Porter (1993).³³ The basic idea behind the method based on seasonal patterns is that banknote demand for (domestic) transactions is influenced by events that occur regularly over the year like Christmas shopping or summer holidays. By contrast, banknote demand for hoarding (or foreign demand) is typically not affected by such seasonal factors. As a result, the seasonal variation of banknote demand will decrease with an increasing share of banknotes that are hoarded or held by non-residents.³⁴

4.1 Seasonal method

More formally, total banknote demand can be modeled as the product of a trend-cycle component, T_t , and a seasonal component, S_t . This decomposition also holds for the domestic-transactions (T_t^{tr}) and non-domestic-transactions (T_t^{ntr}) related demand, respectively³⁵:

$$T_t S_t = T_t^{tr} S_t^{tr} + T_t^{ntr} S_t^{ntr}. \quad (1)$$

³³ There are different methods to estimate hoarding of a given currency, see Fischer et al. (2004) as well as Bartzsch et al. (2011a, 2011b) for an overview.

³⁴ Nevertheless, seasonal influences are possible in the case of small denominations used for foreign travel. However, the share of foreign demand affected by this is likely to be fairly limited in relation to the total volume of banknotes circulating outside Switzerland or being held for hoarding purposes.

³⁵ Of course, a seasonal adjustment decomposition also entails the irregular component. For the purpose of this investigation, we fold the irregular component into the trend-cycle component. Having a separate irregular component does not alter the results.

Next, let β_t be the share of the overall trend-cycle component demanded for domestic transaction purposes, and $(1 - \beta_t)$ be the share demanded for hoarding or by non-residents. This leads to

$$T_t S_t = \beta_t T_t S_t^{tr} + (1 - \beta_t) T_t S_t^{ntr}. \quad (2)$$

This equation can be further simplified by cancelling T_t from both sides of the equation and assuming that the demand for hoarding and by non-residents does not exhibit seasonal variation, i.e., $S_t^{ntr} = 1 \forall t$:

$$S_t = \beta_t S_t^{tr} + (1 - \beta_t). \quad (3)$$

When solving for β_t , this equation would – based on estimated seasonal factors from standard seasonal-adjustment packages – in principle yield a time-series for the hoarding share.

$$\beta_t = \frac{S_t - 1}{S_t^{tr} - 1}. \quad (4)$$

As can be seen from equation (4), β_t will be close to zero when the seasonal factor for a certain month is close to unity, whereas it might be very large (or undefined) whenever the seasonal factor of the reference series approaches one. To make these estimates more robust, a range (e.g., the maximum) of seasonal factors within one year is therefore usually used.³⁶ Inserting, for instance, the highest and lowest seasonal factors into equation (3) gives:

36 See, for instance, Porter and Judson (1996) and Bartzsch et al. (2013b). Also, seasonal patterns at different frequencies could be used, for instance the intra-weekly, intra-monthly, or intra-yearly seasonal component. See, for example, Cabrero et al. (2002). In line with the literature, we employ the intra-yearly component.

$$S_{max,t} = \beta_t S_{max,t}^{tr} + (1 - \beta_t)$$

$$S_{min,t} = \beta_t S_{min,t}^{tr} + (1 - \beta_t). \quad (5)$$

When subtracting the two equations from each other and solving for β_t , we obtain an estimate of the share of banknotes held for domestic transaction purposes in year t :

$$\beta_t = \frac{S_{max,t} - S_{min,t}}{S_{max,t}^{tr} - S_{min,t}^{tr}} \quad (6)$$

However, the seasonal factors for the purely transactions-related series, S_t^{tr} , are unknown and have to be approximated through the use of a benchmark series. The challenge is to find a suitable benchmark series to determine the range of seasonal factors related to domestic transactions, which cannot be observed directly. Possible choices are the demand for banknotes in a reference country, which does not feature hoarding and demand by non-residents or a variable like retail trade or private consumption expenditures that is solely related to domestic transactions.³⁷ Alternatively, the seasonal factors across different denominations can be compared, assuming that small denominations are mainly used for transactions, whereas large banknotes are more prone to hoarding and non-resident demand.³⁸

In the case of Switzerland, however, finding a suitable reference series is difficult. When using banknote data from another country, ideally, this reference country should feature a similar pattern for banknote demand except that there is no

³⁷ In principle, domestic hoarding and non-resident demand could be separated if a reference country could be found with a similar hoarding demand but no demand by non-residents or vice versa. In practice, it is hardly possible to distinguish the two components. However, Bartzsch et al. (2013b) present one possibility relying on different seasonal patterns for the case of Germany.

³⁸ For an overview of other alternatives like coins or vault cash, see Bartzsch et al. (2013b) and Seitz (1995).

hoarding and foreign demand. In the past, Sweden was considered a reasonable reference country for Switzerland but this does not seem to be the case for more recent data. Fischer et al. (2004, p. 54) calculate the seasonal factors for Sweden and Switzerland from 1980 to 2000. Both countries showed a pronounced seasonal peak in December and no visible peak in the summer months. More recent data for Sweden, however, exhibit noticeable seasonal movements in the summer months, which does not conform with the Swiss pattern anymore. Alternative potential candidates (e.g., Denmark or the UK) exhibit similar problems, while other countries which are more similar with respect to banknote use, like Germany or Austria, also feature demand for hoarding and by non-residents, thereby making them ineligible as a reference country.³⁹

Using private consumption or retail sales as reference series, however, also entails problems. First, private consumption data is available at quarterly frequency only, starting 1980. Moreover, its seasonal pattern is less pronounced than the one for banknotes, which rules out using the seasonal method to estimate hoarding and foreign demand. Second, retail sales are available on a monthly basis, but only since 2002. This would shorten our sample period considerably.

Therefore, we focus on the comparison of different banknote denominations. We concentrate on those denominations which are present over the entire sample under consideration, i.e., from 1956 to 2015.⁴⁰ This eliminates the CHF 200 and 500 banknotes, which were either introduced only later or abolished earlier, respectively. We also abstract from the CHF 10 banknote, introduced in 1956, to limit the boundary problem related to the seasonal filter. As a result, we are left with the CHF 20, 50, 100, and 1000 banknotes, which account for around 83% of

³⁹ The introduction of the euro presents an additional complication for these countries.

⁴⁰ The sample size basically results from the program limitations of the seasonal adjustment package X-13ARIMA-SEATS.

banknotes in circulation on average over the sample period (in value terms). Figure 8 to Figure 11 show their seasonal patterns. On the left-hand panel, the seasonal factors are plotted as time series whereas the right-hand panel shows the same seasonal factors, just in a different ordering, i.e., for a given month over the entire sample period, in order to get an impression of the typical seasonal range in the series.

What immediately becomes apparent from these figures is the pronounced seasonal pattern of the largest banknote denomination compared to the smaller denominations. As indicated in the previous chapter, we would expect hoarding demand to be concentrated in the demand for CHF 1000 banknotes, which would imply that the seasonal variation is dampened compared to those bills which are typically used for transactions. However, this is not the case here. The CHF 1000 banknote is characterized by the largest seasonal factors, particularly in December, though the December peaks have decreased visibly since the mid-1990s and again after the financial crisis. By contrast, the smaller denominations show an increase in the December peak around the early 2000s, which for the CHF 100 banknote has reversed since the financial crisis as well. In the earlier part of the sample, a continuous increase in the seasonal lows at the start of each year is visible for the CHF 100, 50, and 20 denominations. While the cause for the less pronounced troughs is unclear, this development came to an end in the late 1970s when ATMs started to appear and may have led to a smoother demand for precautionary as well as transaction balances.

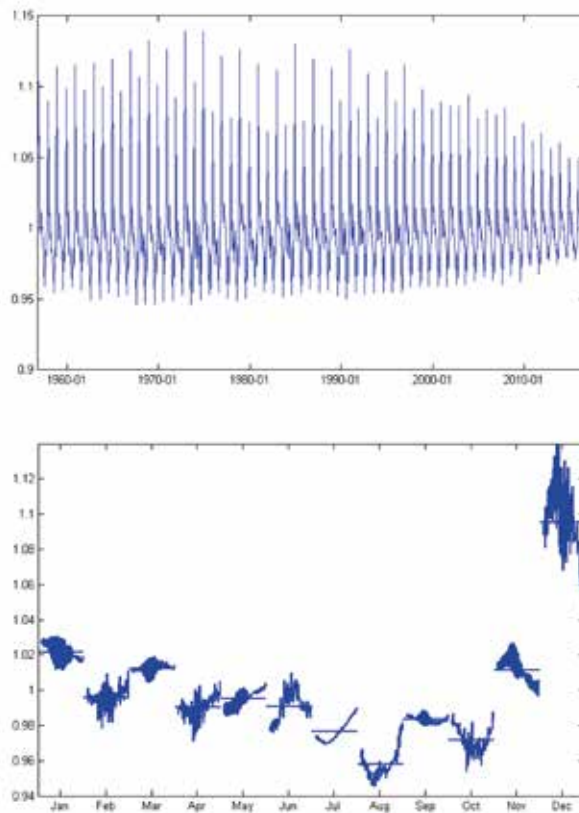
Overall, comparing Figure 8 with those of the smaller denominations illustrates that the CHF 1000 banknote features a maximum seasonal range, which is larger than that of all the other denominations.⁴¹ This basically renders the standard

⁴¹ For the CHF 1000 banknote, the seasonal high is reached in December, whereas the seasonal low is in August.

seasonal approach to estimate hoarding and non-resident demand, as described above, inapplicable.

Seasonal pattern of CHF 1000 banknotes

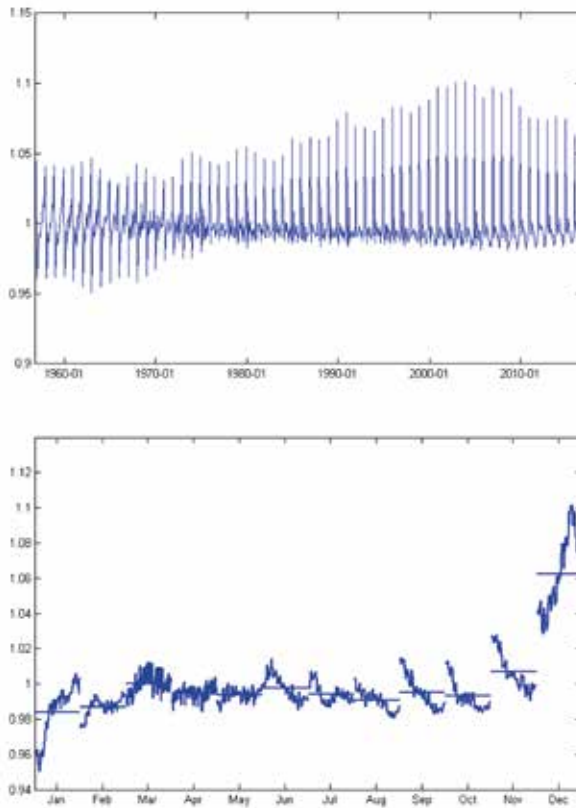
Figure 8



Upper panel: seasonal factors as time series;
lower panel: seasonal factors of respective month over entire sample period)

Seasonal pattern of CHF 100 banknotes

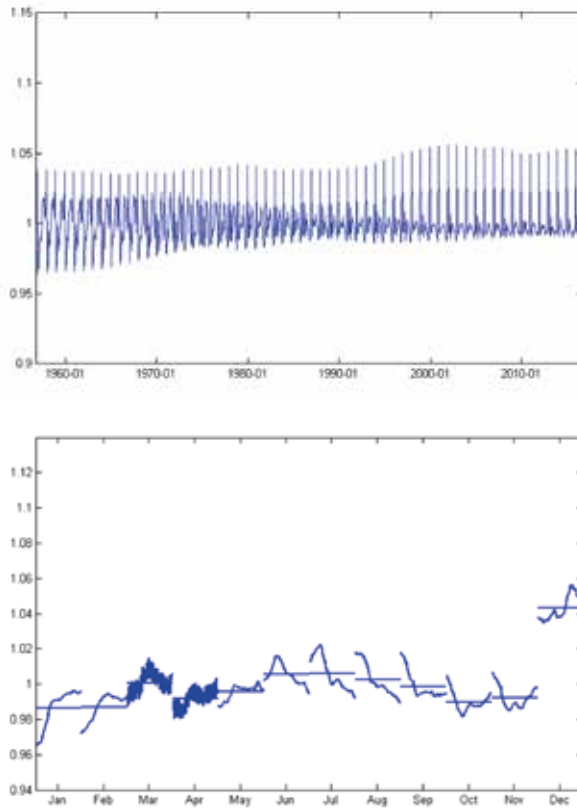
Figure 9



Panels: cf. Figure 8

Seasonal pattern of CHF 50 banknotes

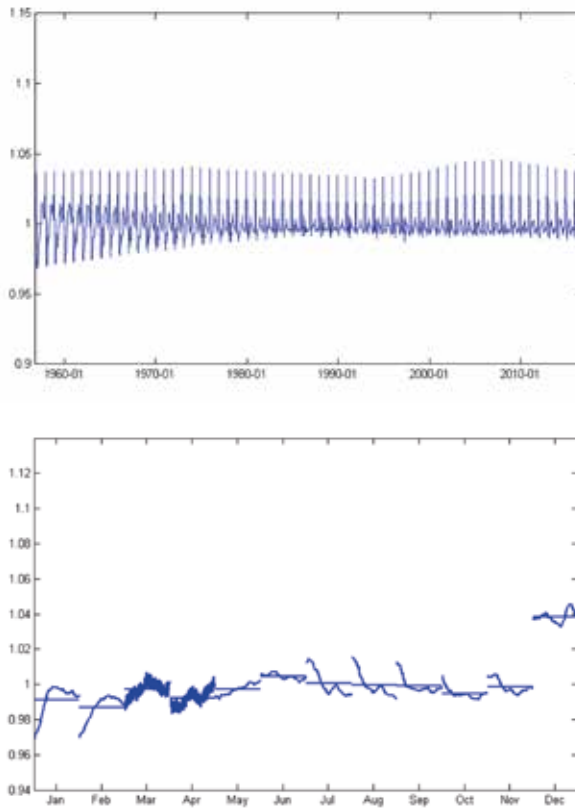
Figure 10



Panels: cf. Figure 8

Seasonal pattern of CHF 20 banknotes

Figure 11



Panels: cf. Figure 8

4.2 Correction for tax effects

As indicated above, the main cause for the extreme seasonal variation of the CHF 1000 banknote is the very large peak in December. Even though one would expect a seasonal peak at the end of the year because of Christmas shopping and gifts in terms of money, also other influences seem to be at work, especially end-of-year tax considerations. Switzerland is one of only a few countries in Europe that taxes wealth, which includes deposits held in bank accounts.⁴² Taxable wealth can easily be reduced by withdrawing deposits prior to the end of the year and re-depositing them at the beginning of the next year, as bank statements issued for tax purposes show only the balance on December 31st.⁴³ Such a behavior would result in a pronounced seasonal peak in the demand for large banknotes in December. Consequently, the maximum seasonal range for the CHF 1000 banknote including December would be biased upward due to a temporary non-transactions-related component from which we want to abstract.

Ettlin and Fluri (1986) present evidence that tax effects indeed play a role for the pronounced December peak in the demand for CHF 1000 banknotes. They document a biannual regularity in the December peak, which they attribute to the biannual tax period that was common in most cantons until 2000.⁴⁴ More specifically, up to that year, the relevant time period for tax statements was two years (instead of one), beginning with an odd-numbered year. As a result, every two years a related increase in the demand for banknotes could be observed, i.e., at the turn of

⁴² Currently, there is a wealth tax at the level of the cantons and the municipalities, but not at the federal level; the federal tax on wealth was abolished in 1959. Though the wealth tax does not range among the most important taxes, its proceeds accounted for 8.5% of the tax income of cantons and municipalities in 2013, see Eidgenössische Steuerverwaltung (2016).

⁴³ Strictly speaking, also cash holdings are part of the taxable wealth and have to be declared. However, they are difficult to verify for the tax authorities.

⁴⁴ The Swiss parliament issued a law in 1993 that required the cantons to harmonize the methodology according to which the wealth tax is collected. Thus, in the years until 2000, the cantons with a biannual tax collection period had to phase out this scheme. The variation of tax rates and exemption amounts among different cantons and municipalities remains nevertheless high, see Eidgenössische Steuerverwaltung (2016).

the year from an even- to an odd-numbered year. Therefore, until around 2000, two subsequent December peaks are of considerably different size and the difference varies over time as the tax legislations of the cantons changed.

We follow the methodology suggested by Ettlin and Fluri (1986) to take these bi-annual effects into account in the seasonal adjustment procedure for the CHF 1000 banknote series. The idea is to split the time series into two series: one containing only the odd-numbered months and one containing the even-numbered months. Standard seasonal filters are then applied separately to these two series. As the seasonal adjustment procedure still filters out seasonal variation over twelve time periods, this means that in effect both series are adjusted for biannual seasonal variation. Subsequently, they are recombined (and re-normalized) to obtain one series. With this methodology, a given month in two subsequent years (e.g., the December in year t and the December in year $t+1$) is treated differently, in contrast to standard approaches. This allows us, in particular, to capture the large seasonal December peak every two years due to tax reasons. The corresponding effect is also visible in the seasonal factors presented in Figure 8.

Following this approach, the average difference between the December peak of an odd-numbered year and the subsequent even-numbered year is 2.9% from the beginning of the sample until 2000, when the last cantons phased out biannual tax collection. The largest (absolute and percentage) difference between subsequent December peaks occurred in 1983/84: The seasonal factor for December 1983 is 1.0725, whereas it is 1.1300 for December 1984, an increase of 5.4% from the odd- to the even-numbered year.⁴⁵ This gives us an estimate of the tax-induced increase in the demand for CHF 1000 banknotes. However, given that not all cantons applied a biannual tax-collection period and that the tax legislation changed over time, these estimates constitute only a lower bound for the true seasonal

⁴⁵ This is after re-normalization to ensure an average seasonal factor of one over each year.

increase in the demand for CHF 1000 banknotes due to tax reasons.

Nevertheless, we try to estimate the magnitude of the tax-related bias in the demand for CHF 1000 banknotes from the difference in subsequent December peaks. Since this difference varies over time, we take this into account in our correction procedure. In particular, until 1998, we replace the (excessive) seasonal factor for December in an even-numbered year by the average of the seasonal factors for December in the two adjacent odd-numbered years, i.e., by the average of the seasonal factors of the preceding and subsequent year. This leads to an average reduction in the seasonal factor for December of 2.9%. Since the biannual tax pattern ended in 2000, we cannot use the aforementioned procedure to correct the December peaks from that year onwards.⁴⁶ The resulting series of seasonal factors can be found in the left-hand panel of Figure 12, whereas the original series already presented in Figure 8 is reproduced here in the right-hand panel for comparison.

Whereas the seasonal peaks in December are reduced, sometimes considerably, the maximum seasonal range is still large when compared to those of the smaller denominations presented in Figure 9 to Figure 11. According to the hypothesis underlying the seasonal method, this would imply that CHF 1000 banknotes are predominantly used for transactions whereas the smaller denominations are hoarded, which obviously does not conform with observed payment patterns.⁴⁷ One problem with our correction for tax avoidance, for instance, is that we only capture tax avoidance in cantons with biannual tax periods, whereas we do not correct for cash withdrawals in cantons with annual tax periods. We therefore

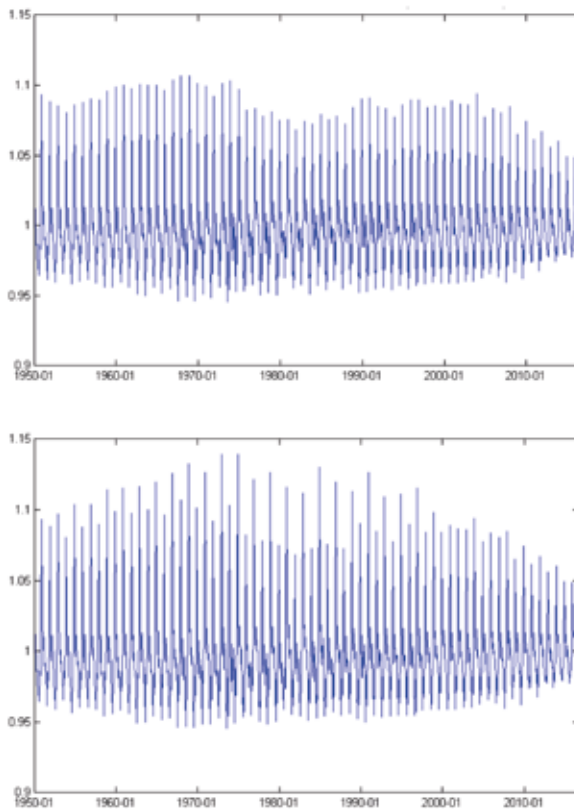
⁴⁶ Please note that after 2000, there is now an annual tax period (instead of biannual), so that one should expect the additional, tax-related banknote demand in December to occur every year (instead of every two years).

⁴⁷ When applying the seasonal method, in this subsection we use the maximum seasonal range of the reference series as well as of the series of interest to compute the hoarding shares. Using other ranges, but still including December, does not fundamentally alter the results.

resort to another approach and employ different seasonal ranges that leave out the December peak.

Seasonal factors of CHF 1000 banknotes

Figure 12



Upper panel: corrected for tax effects; lower panel: original series

4.3 Using alternative seasonal ranges

In the spirit of Porter and Judson (1996), we start from the seasonal range observed over the time period which best corresponds to the maximum seasonality in a transactions-related variable, e.g., retail sales. For this variable, the seasonal high is reached in December and the seasonal low in February, in line with international evidence on the seasonality of transactions. Since we want to abstract from the excessive seasonal peak of the CHF 1000 banknote in December, we take the January as a proxy. This month features the second-largest seasonal factors and, since these are end-of-month figures, presumably the tax-related withdrawals have already been deposited again. As a reference series, we take the CHF 20 banknote. It is one of the smaller denominations less suitable for hoarding purposes. We take the CHF 20 banknote and not the CHF 10, since the latter was only introduced in 1956 whereas the CHF 20 banknote already appeared in 1914. As a result, we can study a longer time period and, moreover, reduce the boundary problem related to the seasonal filter.⁴⁸ Moreover, the maximum seasonal range of the CHF 20 banknote perfectly corresponds to that of retail sales, i.e., the peak is in December, whereas the low is in February. This is a further indication that the CHF 20 banknote is primarily used for transaction purposes. The seasonal factors for these two denominations can be found in Figure 8 and Figure 11.

The main results of this analysis are presented in Figure 13. It shows the share of hoarding demand for the CHF 1000 banknote, i.e., formally $(1 - \beta_t)$. More specifically, we focus on longer-run movements and average the respective seasonal ranges of the target and reference series over a five-year horizon and plot the resulting estimated hoarding shares for the CHF 1000 banknote. After moving around 50% at the beginning of the sample, the hoarding share decreased to 45% at the end of the 1960s. Over the following two five-year periods, coinciding with

⁴⁸ Using a shorter sample period, results based on the CHF 10 banknote do not differ much from those using the CHF 20 banknote as a reference series.

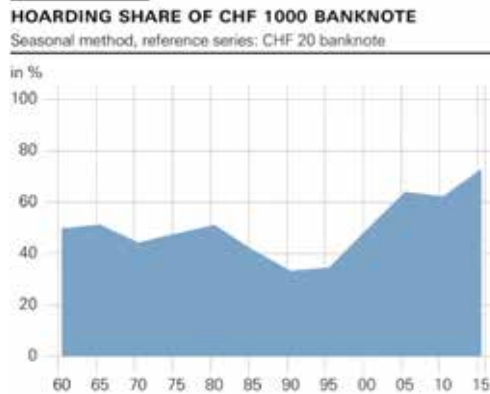
the breakdown of the Bretton Woods system and related pressure on the Swiss franc, the estimated share increased again to 50%. More tranquil times followed, so that a low was reached from the mid-1980s to the mid-1990s with a hoarding share of 33% to 35%. In the course of the increased uncertainty due to the events since the turn of the millennium (millennium bug, 9/11, introduction of the euro), the hoarding share almost doubled to 64%, after which it stabilized until the beginning of the financial and euro area crises. The latter events led to a further increase in the share of hoarding to 73% in the last five-year period up to 2015.

The resulting nominal values, based on the average value of CHF 1000 banknotes in circulation over the respective five-year period, are presented in Table 2. In the first three five-year periods, even though the relative hoarding share fell, the absolute value of CHF 1000 banknotes hoarded almost doubled to around CHF 1.5 billion on the back of an increase in overall demand for CHF 1000 banknotes. During the breakdown of the Bretton Woods system, included in the following two five-year periods, this value further tripled to CHF 4.6 billion, after which it basically stagnated over the following 15 years until 1995. Since then, it increased sixfold to reach almost CHF 29 billion in the period from 2011 to 2015. The first large increase in this latter episode occurred around the turn of the millennium (CHF 5.6 bn, 64%), while the second increase coincided with the period of the financial and euro area crises (CHF 11.7 bn, 69%). Considering the entire sample period from 1956 to 2015, the estimated value of CHF 1000 banknotes held for transaction purposes grew broadly in line with private consumption expenditures.

Overall, the hoarding shares obtained for the CHF 1000 banknote are within the range typically obtained for other large denomination banknotes. For example, estimates for the USD 100 note by Judson (2017) indicate that 60–75% of that denomination were held abroad at the end of 2016. Porter and Judson (1996) obtained a corresponding share of 66–75% for December 1995. For Japan, Otani and Suzuki (2008) found that just 40% of the JPY 10'000 banknotes were hoarded

Share of hoarding of CHF 1000 banknote using
CHF 20 banknote as reference series

Figure 13



Source: SNB

in 2007. Bartzsch et al. (2013b) analyze the net issuance of the Deutsche Bundesbank within the Eurosystem to get an idea of the proportions used for domestic transactions, hoarding, and foreign demand. They found that the EUR 500 banknote, which is especially prone to hoarding, is the denomination most frequently held outside the euro area, i.e., EUR 95 billion out of an estimated total of German banknotes abroad of EUR 175 billion. Before the introduction of the euro, the Netherlands had a NLG 1000 banknote⁴⁹ for which Boeschoten and Fase (1992) obtained a hoarding share of 60–80% for the second half of the 1980s, depending on the method employed.

⁴⁹ This corresponds to more than EUR 450 at the official exchange rate irrevocably fixed at the end of 1998.

**Nominal value of CHF 1000 banknotes held for
hoarding and transaction purposes (CHF billion)**

Table 2

	Total	Hoarding	Transactions
1956 – 1960	1.75	0.87	0.88
1961 – 1965	2.68	1.38	1.30
1966 – 1970	3.41	1.51	1.90
1971 – 1975	5.80	2.77	3.02
1976 – 1980	8.93	4.58	4.35
1981 – 1985	10.81	4.50	6.32
1986 – 1990	13.12	4.38	8.74
1991 – 1995	13.88	4.81	9.08
1996 – 2000	17.46	8.67	8.80
2001 – 2005	22.16	14.22	7.94
2006 – 2010	27.29	17.02	10.27
2011 – 2015	39.30	28.70	10.60

Notes: Numbers are based on the estimated hoarding shares and average nominal values of CHF 1000 banknotes in circulation in the respective time period.

5 Summary and conclusion

In this study, we use the seasonal method to estimate the share of Swiss banknotes in circulation that is hoarded, both domestically and abroad. Compared to other countries, the application of this methodology to the Swiss case faces the problem that the largest denomination, the CHF 1000 banknote, exhibits very pronounced seasonal peaks that exceed those of other transactions-related time series, like small-denomination banknotes or private consumption expenditure, that are commonly used to proxy transactions-related banknote demand.

We present evidence that the large seasonal peak at the end of the year is related to tax effects, in particular, the wealth tax that is levied – among other things – on the end-of-year bank-account balances. For the time when this tax was levied bi-annually, we can estimate a correction for this tax effect. Applying this correction, however, is not sufficient to reduce the seasonal peaks in the CHF 1000 banknote series to levels below those of the references series.

To obtain a meaningful hoarding share, we therefore proxy the December peak of the CHF 1000 banknote and calculate the seasonal range based on the subsequent month, i.e., January. In this way, we obtain hoarding shares of around 50% until the early 1980s that then fall continuously to about 30% in the late 1990s. Subsequently, following the increased uncertainty since 2000 and, in particular, since the financial crisis in 2008, the share of hoarding for the CHF 1000 note has significantly increased to over 70%. These figures are within the range typically obtained for other large denomination banknotes.

In line with other countries and studies, our results show that only a small part of currency in circulation in Switzerland is used for transaction purposes. As this purpose is the most important one for economic and monetary policy reasons, the different motives and their magnitudes should be taken into account when inter-

preting monetary data. This should help to improve the indicator properties of monetary data for price and business cycle developments (see Aksoy and Piskorski, 2005, 2006, for the US).



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DEUTSCHE
BUNDESBANK
EUROSYSTEM

Ruth Judson¹

The future of cash in crisis and calm: demand for US dollar banknotes



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Federal Reserve Board

Abstract

It would seem that physical currency should be fading out as the world of payments is increasingly electronic, with new technologies emerging at a rapid pace, and as governments look to restrictions on large-denomination notes as a way to reduce crime and tax evasion. Nonetheless, demand for U.S. dollar banknotes continues to grow, and consistently increases at times of crisis both within and outside the United States because it remains a desirable store of value and medium of exchange in times and places where local currency or bank deposits are inferior.

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After allowing for the effect of crises, demand for U.S. banknotes appears to be driven by the same factors as demand for other types of money, with no discernible downward trend.

In this work, I review developments in demand for U.S. currency since the collapse of Lehman Brothers in late 2008 with a focus on some new questions. First, what are the factors driving demand for lower denominations, especially \$20s, which are the most commonly used in domestic transactions? To what extent can the recent strength in demand be attributed to the long spell of very low interest rates?

Finally, for the larger denominations, I revisit the question of international demand: I present the raw data available for measuring international banknote flows and presents updates on indirect methods of estimating the stock of currency held abroad. These methods continue to indicate that a large share of U.S. currency is held abroad, especially in the \$100 denomination.

As shown in an earlier paper, once a country or region begins using dollars, subsequent crises result in additional inflows: the dominant sources of international demand over the past two decades are the countries and regions that were known to be heavy dollar users in the early to mid-1990s. While international demand for U.S. currency eased during the early 2000s as financial conditions improved, the abrupt return to strong international demand that began nearly a decade ago with the collapse of Lehman Brothers in 2008 has shown only limited signs of slowing. In contrast, the growth rate of demand for smaller denominations is slowing, perhaps indicating the first signs of declining domestic cash demand.

The Death of Cash? Not So Fast: Demand for U.S. Currency at Home and Abroad, 1990-2016²

Unlike the banknotes of most other countries, the U.S. dollar is used far beyond its borders as a medium of exchange and store of value. This international aspect of dollar usage has important implications for a wide range of Federal Reserve operational considerations, including its currency production, processing, and planning, the interpretation of currency figures as part of monetary analysis, daily open market operations, management of the Federal Reserve's portfolio, and analysis and forecasting of the Federal Reserve's income.³ In addition, currency exports, like other exports, figure in the U.S. balance of payments and international investment position. Finally, the role of cash in the underground economy and other illicit activities has been an increasing focus of discussion, and some countries have adjusted the mix of notes they issue based on these concerns.⁴ This paper shows that the post-2008 resurgence in demand for U.S. banknotes has hardly abated. In addition to updating data and methods presented in Judson (2012), this paper takes a closer look at trends by denomination and poses some additional questions about the future of cash. In particular, I note that demand for smaller denominations appears to be slowing even though interest rates are still near zero and GDP growth has been solid.

² This work would have been impossible without the generous assistance of, and thought-provoking discussions over many years with, Dick Porter (FRB-Chicago); Joann Freddo, Eileen Goodman, Jeff Pruiksmá, Elliot Shuke, and Charles Sims (FRB-New York); Carol Bertaut, Neil Ericsson, Jaime Marquez, John Roberts, Charlie Thomas, Shaun Ferrari, Michael Lambert, and Lorelei Pagano (Board of Governors); and Edgar Feige (University of Wisconsin, Emeritus). All errors and omissions are mine.

³ Until late 2008, Federal Reserve notes, the dominant form of currency, were the primary liability on the Federal Reserve's balance sheet. As a result, currency demand was thus a primary consideration in the conduct of daily open market operations as well as in longer-range planning related to the Federal Reserve's System Open Market Account portfolio. After late 2008, deposits of depository institutions (of which reserve balances are the vast majority) increased significantly and now exceed currency as a liability on the Federal Reserve's balance sheet. Appendix Figure 3 illustrates the major components of the Federal Reserve's balance sheet since 2003.

⁴ For example, India had a surprise recall of its highest-denomination notes in late 2016. The 500 euro note will be phased out after 2018.

Despite the disparate methods and data sources, the data consistently indicate several trends. First, international demand for U.S. currency increased steadily over the 1990s and into the early 2000s, a period that coincided with the fall of the Berlin Wall, the collapse of the Soviet Union, and periodic economic and political crises in several Latin American countries. Second, international demand for dollars began to stabilize or decline around the time of the introduction of the cash euro in 2002.⁵ This decline coincided with economic and political stabilization and financial modernization in many economies in and around the euro zone and the former Soviet Union and continued until late 2008, when the global financial crisis sparked renewed demand for U.S. banknotes that has shown no sign of abating.

In this paper, I present estimates of the stocks and flows of U.S. currency abroad from the early 1990s through the end of 2016. Section 1 reviews the available data sources, with a focus on their strengths and weaknesses for use in answering questions about the shares of banknotes held in the United States and abroad. Section 2 presents an overview of currency demand over the past several decades and some stylized facts about the composition of U.S. currency levels and changes over time. Section 3 builds on these stylized facts and presents simple and direct estimates of stocks and flows of U.S. currency abroad. Section 4 presents updated indirect estimates of stocks and flows of U.S. currency held abroad; these estimates are based on the data sources from Section 1 as well as additional information.⁶ Section 5 presents estimates of a very simple currency demand equation for the United States, from which estimates of the impact of international demand on currency growth can be derived. Section 7 reviews developments in denominations other than \$100s. Section 7 summarizes these findings and concludes with some general observations and directions for further work.

⁵ The euro currency was introduced as a unit of account in 1999; the physical currency was introduced in 2002.

⁶ It is not possible to apply the “biometric” or “fish” method to the most recent design of U.S. banknotes because of a change in the way the notes are introduced.

I Data: An Overview

I.A Total Currency in Circulation

I.A.1 Public Data

In general, the aggregate quantity of genuine currency in circulation is relatively easy to measure: it is physical, and it is produced, transported, and issued under very secure conditions.⁷ Official currency statistics for the United States are reported by the Treasury and Federal Reserve, which collaborate to produce data on currency in circulation, generally defined as Federal Reserve notes, Treasury currency, and coin held outside of the vaults of the Federal Reserve and the Treasury.⁸ Figures on total currency in circulation are reported weekly on the Federal Reserve's H.4.1 and H.6 Statistical Releases; the quarterly Treasury Bulletin provides additional detail on denominations of banknotes and coin in circulation.

I.A.2 Internal Data

The Federal Reserve's internal accounting and production processes require close monitoring of currency production, processing, and movements; as a result, more frequent and detailed data are available internally for Federal Reserve notes, which constitute the vast majority of currency in circulation (\$1.46 trillion of the \$1.51 trillion total as of the end of 2016).⁹ In particular, accounting data provide daily updates by denomination on the quantity of Federal Reserve notes outstanding (that is, carried on the books of each Federal Reserve Bank), and in the custody of each Federal Reserve Bank. In addition, processing data provide monthly totals of Federal Reserve note movements between each Federal Reserve office and

⁷ The quantity of counterfeit currency in circulation at any point is not known, but estimates suggest that circulating counterfeits are extremely small relative to genuine currency, on the order of one to three in 10, 000 (Judson and Porter (2010)).

⁸ Appendix table 1 in Judson (2012) provides a list of sources of currency data along with a description of the different definitions of currency.

⁹ H.4.1 Statistical Release, tables 1 and 6. <http://www.federalreserve.gov/releases/h41/20161229/>.

circulation by denomination.¹⁰ As shown in section 3, these data and simplifying assumptions about domestic and international movements of banknotes can be exploited to obtain estimates of stocks and flows of U.S. currency abroad.

I.B Data on Cross-Border Flows of U.S. Currency

Movements of currency across U.S. borders cannot be precisely measured for several reasons. First, there is no legal requirement or mechanism to monitor movements of \$10,000 or less, and many individuals cross U.S. borders each year.¹¹ The net movements of currency across U.S. borders through such nonbanking channels are potentially significant. Indeed, as noted in U.S. Treasury (2006), customs reporting for Mexico indicates substantial cash flows from the United States to Mexico in the hands of tourists and migrants; such flows, since they typically occur in amounts of less than \$10,000 and through nonbanking channels, are not captured in U.S. data. Second, even when there is a legal requirement to report currency flows, mechanisms are not always in place to capture the data and reporters might not comply with requirements. Despite these challenges, informative measurements do exist.

The Federal Reserve provides currency on demand to all account holders, including those who provide banknotes to international customers. Many of these institutions, including most of the largest wholesale banknote dealers, report monthly, on a voluntary and confidential basis, the value and ultimate source or destination country of their receipts and payments of U.S. currency. While not all banks that deal in the international shipment of banknotes provide these reports, the bank-

10 The locations and boundaries of the twelve Federal Reserve districts were set when the Federal Reserve was established in 1913. Within each district, cash processing occurs at one or more cash offices. The number and location of these offices varies over time. Processing data are reported separately for each office.

11 In 2016, about 160 million passengers arrived and departed on international flights at U.S. airports and about 190 million border crossings occurred by land (Bureau of Transportation Statistics, 2017).

note shipping business is highly concentrated and this dataset currently captures the vast majority of banknote shipments that cross U.S. borders through commercial banking channels.

This dataset begins in the late 1980s and covers virtually every country in the world. The quality of the data varies across time as the set of reporting dealers has evolved; for all practical purposes, the dataset begins in the early 1990s. For example, consider a shipment bound for Russia via Germany. The immediate source or destination of the shipment can be identified by the location of the counterparty. Thus, for a nonreporting dealer, the dataset would only indicate a shipment to Germany, but a reporting dealer would provide the ultimate destination, Russia. Conversely, consider a shipment from Cambodia back to the United States via Hong Kong. Data from a nonreporting dealer would indicate an inflow of dollars to the United States from Hong Kong, but data from reporting dealer would indicate the ultimate source of shipment as Cambodia. The level of detail in the reporting has generally improved over time as more dealers have begun to report. However, this trend has reversed in some cases in recent years as reporting banknote dealers have left the market and as other nonreporting dealers begin providing banknote shipment services to the departing reporter's customers.

Two additional shortcomings of this dataset are that it covers only banknote flows to and from the United States, and that it only covers flows through the banking system. First, the dataset does not cover U.S. banknote flows among other countries, which can be substantial, especially in areas where large volumes of cross-border trade are conducted in cash.¹² The absence of such information complicates any estimation of regional or country-level holdings outside the United States, but does not affect aggregate measurements of commercial bank currency shipment flows into and out of the United States. However, banknote flows through

¹² Refer to U.S. Treasury (2006) for examples of such flows.

nonbank channels can also be significant, and observations gathered in the course of the joint U.S. Treasury – Federal Reserve International Currency Awareness Program indicate that several countries receive dollar inflows through nonbank channels such as tourists or migrant workers but return the currency to the United States through banking channels.¹³ As a result of these shortcomings and complications, the country-level data must be interpreted with care and with an understanding of the institutional arrangements in place through time.¹⁴

II Stylized Facts about U.S. Currency in Circulation

II.A Overall Currency Growth Has Been Strong

The death of cash has often been predicted, and it would seem that demand for currency should grow somewhat more slowly than income given the general increase in the variety of payment media as well as increasing use noncash means of payment.¹⁵ However, U.S. currency in circulation has grown at an average rate of about 7 percent annually over the past few decades, one to two percentage points more rapidly than U.S. nominal GDP. Since 2008, the gap has been greater: annual currency growth has remained around 7 percent even though GDP growth has averaged less than 3 percent.¹⁶

13 This phenomenon is addressed in more detail in the discussion of the flow data.

14 In principle, the most obvious direct source of information on U.S. currency flows across U.S. borders should be the Currency and Monetary Instrument Reports (CMIRs), which are compiled by the U.S. Customs Service. Individuals and firms making almost any shipment of more than \$10,000 in cash across a U.S. border are required to file CMIRs, so these reports should be quite comprehensive and informative. However, as noted in Treasury (2006) and in Judson (2012), CMIRs are neither accurate nor thorough measures of large cash shipments outside the banking sector, and hence we do not use the CMIR data in this study. For researchers who do not have access to the shipment data, or for certain countries and time periods, the CMIR data can provide useful insights. Refer, for example, to Feige (1996, 2012) for analysis of the U.S. economy and to Kamin and Ericsson (2003) for analysis of dollarization in Argentina. For the latter analysis, CMIR data were both available over a longer time period and more reliable than usual because of the patterns of dollar flows to Argentina.

15 Refer to BIS (2016).

16 On a Q4-to-Q4 basis, over 1980-2016, currency growth averaged 7 percent and nominal GDP growth averaged 4.7 percent. Over 1990-2007, currency growth averaged 6.9 percent and nominal GDP growth averaged 5.3 percent.

II.B Overall U.S. Currency Movements are Dominated by \$100s

In value terms, the driving force over this period has generally been growth in the \$100 denomination, as can be seen in Figures 1A and 1B.¹⁷ Figure 1A presents annual end-year data on U.S. currency in circulation by denomination from 1989 to 2016. At the end of 2016, U.S. currency in circulation totaled about \$1.5 trillion, of which nearly \$1.2 trillion, or nearly 80 percent, was in the \$100 denomination.¹⁸ Figure 1B presents annual growth rates for the same items, on a fourth-quarter-to-fourth-quarter basis. The overall growth of currency, the solid black line, moves closely with, though generally more slowly than, the growth of \$100 notes, the dashed purple line. The correlation of overall currency growth with \$100s over this period is over 0.9; correlations with the other denominations are generally decreasing in the denomination.

II.C Crises Are Reflected in Aggregate U.S. Currency Data

Figure 1B begins to reveal some general patterns in overall currency demand. In particular, currency growth was quite strong in the early 1990s, which coincided with the fall of the Berlin Wall and the collapse of the Soviet Union. After a brief lull in the mid-1990s, currency growth picked up again in the late 1990s, driven by crisis in Argentina in 1997 and then concern about Y2K in 1998 and 1999. Following a dip in currency demand in 2000, which largely reflected the return early in 2000 of precautionary stocks accumulated late in 1999, demand was boosted in the early 2000s by the events of September 11, which, judging by outsized commercial bank shipments, led to strong overseas demand for currency in the short run and, in the longer run, the apparent accumulation of precautionary stocks at home and abroad. Demand then slowed over the mid- to late-2000s until the

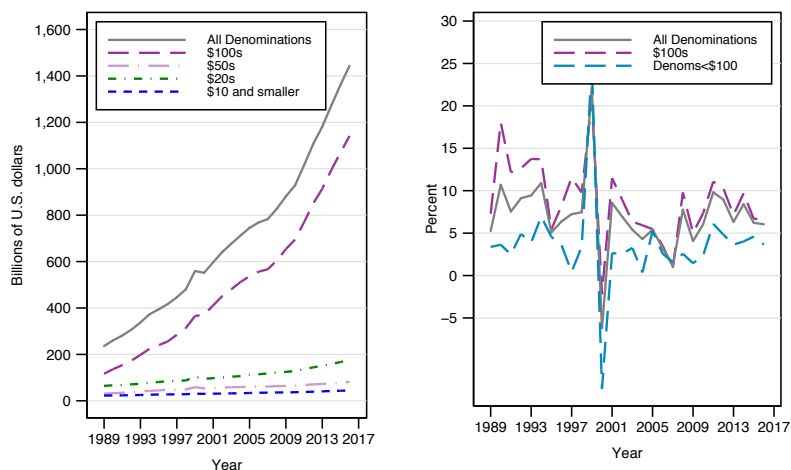
¹⁷ In piece terms, however, U.S. currency is dominated by smaller denominations. As of the end of 2016, \$1s were 30% of notes in circulation, \$2s to \$10s were 15%, \$20s were 22 percent, and \$50s and \$100s were 33%. Appendix Figures 1A and 1B provide a breakdown of U.S. and Canadian currency by denomination in value and piece terms.

¹⁸ These figures are from the Treasury Bulletin: https://www.fiscal.treasury.gov/fsreports/rpt/treasBulletin/b2017_1.pdf.

Left: U.S. Currency Levels, 1989 – 2016

Figure 1A and 1B

Right: Annual Growth of U.S. Currency, 1989 – 2016



Note left: Average of Sept. and Dec. currency in circulation.

Note right: Annual growth rates of four-quarter averages (average of end-September and end-December levels).

Source: Federal Reserve System

sharp reversal seen in late 2008.¹⁹ More formally, Banegas, Judson, Sims, and Stebunovs (2015) show that there was a strong correlation between international demand for U.S. dollars and indexes of economic and political uncertainty over 2000–2014.

II.D Canadian Patterns of Currency Demand Are Likely Similar to U.S.

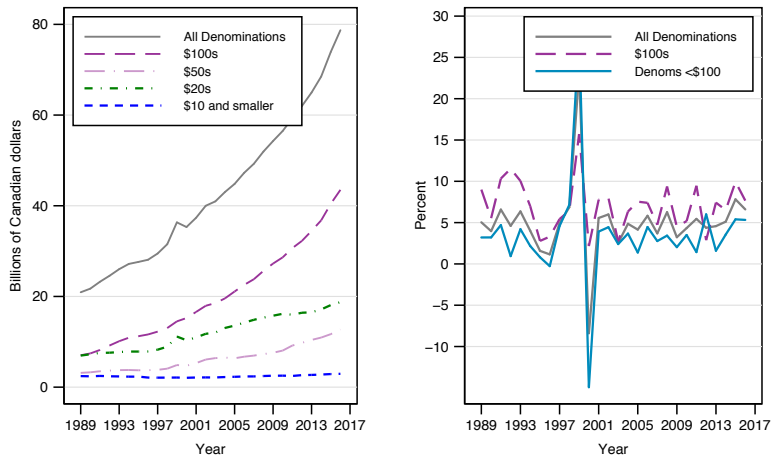
Domestic Currency Demand

One might look to Canada for evidence of what U.S. currency demand would look like without a foreign component. Canada has similar income levels, payments

¹⁹ Hellerstein and Ryan (2011) find systematic relationships between currency shipments and inflation and other factors.

Left: Canadian Currency Levels, 1989 – 2016

Figure 2A and 2B

Right: Annual Growth, Canadian Currency, 1989 – 2016

Note left: Average of Sept. and Dec. currency in circulation.

Note right: Annual growth rates of four-quarter averages.

Source: Federal Reserve System

technologies, holiday patterns, and GDP growth rates to those in the United States, but little Canadian currency is believed to circulate externally. Figures 2A and 2B display Canadian currency in circulation by denomination in levels and growth rates from 1989 to 2016. As can be seen in Figure 2A, \$100s are also prevalent in Canada, though less dramatically than in the U.S., accounting for just over half of Canadian currency in circulation at the end of 2016.²⁰ Overall currency growth rates for Canada are, not surprisingly, driven less strongly by \$100s and more strongly by \$20s and \$50s, the primary transaction denominations in Canada.

²⁰ Both the United States and Canada have notes of denominations above \$100 in circulation, but in both cases, these notes have not been issued to circulation for some time.

II.E U.S. and Canadian Currency Growth Relative to Income Diverged

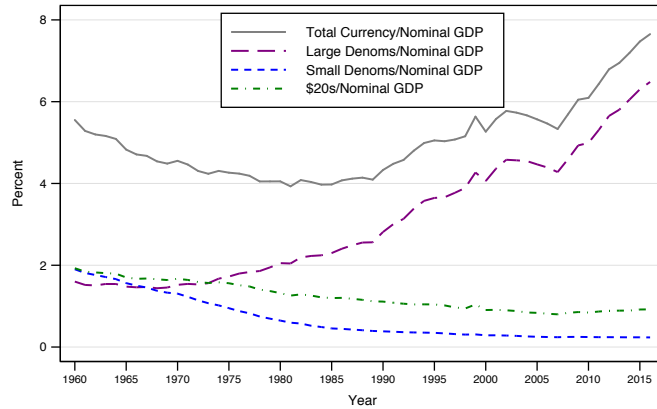
Beginning in the 1980s

As noted earlier, U.S. currency growth has been strong even relative to nominal GDP. Figures 3 and 4 display the ratios of total currency to nominal GDP for the United States and Canada over the past half-century. Ordinary theories of money demand would predict that the ratio of income to currency, or velocity (the *inverse* of the ratio shown here) should vary positively with the opportunity cost of holding money. That is, in terms of these charts, higher opportunity cost would be associated with lower demand for currency relative to income. As cashless payments become more common and, presumably, more cost-effective, one might expect that, abstracting from movements in market interest rates, demand for currency relative to income should decline. Indeed, that pattern prevailed in the United States until about 1985, and in Canada generally for the period. The upturn in the U.S. ratio of currency to nominal GDP beginning in 1989 is thus anomalous and is consistent with substantial and growing external use of U.S. currency.

In the next section, I present a very simple estimate of overseas demand for U.S. currency based on these patterns and the assumption that patterns of domestic demand for currency are the same in the United States and Canada. I then juxtapose these estimates with direct measurements of cross-border currency flows.

U.S. Currency to Nominal GDP Ratios, 1960 – 2016

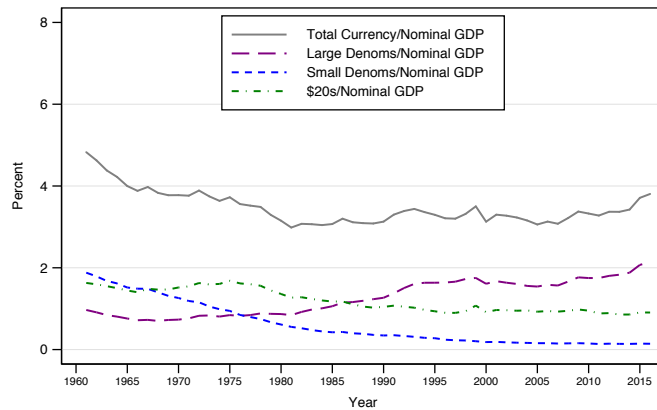
Figure 3



Source: Federal Reserve System

Canadian Currency to Nominal GDP Ratios, 1961 – 2016

Figure 4



Source: Federal Reserve System

III Simple Estimates of Stocks and Flows of U.S. Currency Held Abroad

III.A Two Estimates Based on Money Demand and Comparisons with Canada

III.A.1 A Very Simple Estimate

Taken together, the difference between the patterns seen for the United States and for Canada in Figures 3 and 4 suggest a simple estimate of the share of U.S. currency abroad. As noted above, and as displayed in Figure 5, U.S. and Canadian nominal GDP growth rates have been similar over this period. The observed U.S. ratio of currency to nominal GDP is the sum of domestic and foreign demand. If we assume that the Canadian ratio of currency to nominal GDP is the same as its U.S. counterpart for domestic demand, then the foreign share of U.S. demand can be estimated as follows. Define

$$CURRGDP_{Canada} = \frac{CURR_{Canada}}{GDP_{Canada}} \quad (1)$$

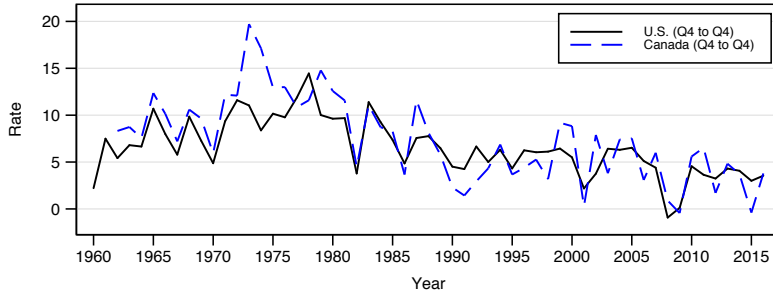
$$\begin{aligned} CURRGDP_{USA} &= \frac{CURR_{USA}}{GDP_{USA}} = \frac{CURR_{USADom}}{GDP_{USA}} + \frac{CURR_{USAFfor}}{GDP_{USA}} \\ &= CURRGDP_{USA\_Dom} + CURRGDP_{USA\_For} \end{aligned} \quad (2)$$

Replacing $CURRGDP_{USA\_Dom}$ with $CURRGDP_{Canada}$ in the equation above, it is then possible to solve for $CURR_{USA\_For} / CURR_{USA\_Tot}$ as

$$ForShare_{VerySimple} = \frac{Curr_{USA\_For}}{Curr_{USA\_Total}} = 1 - \left(\frac{CurrGDP_{Canada}}{CurrGDP_{USA}} \right) \quad (3)$$

**Growth Rates of U.S. and Canadian Nominal GDP,
1960 – 2016**

Figure 5



Source: Federal Reserve System

III.A.2 A Simple Estimate

The approach above carries with it the assumption that Canadian and U.S. domestic demand for currency are the same at the same point in time. However, the level of Canadian per capita income, while similar to that of the United States, has generally been a bit lower. Thus, an alternative assumption would be that Canadian and U.S. domestic demands for currency relative to income are the same at the same levels of per capita income. In order to construct an estimate of the share of U.S. currency abroad using this assumption, we proceed as follows. First we regress the ratio of Canadian currency to GDP on the log and level of Canadian per capita GDP, denoted GDPC:

$$CURRGDP_{Canada} = \alpha_{Canada} + \beta_1 \ln GDPC_{Canada} + \beta_2 GDPC_{Canada} + \varepsilon_t \quad (4)$$

To be sure, this specification is a very simple reduced form based on the chart shown; it effectively assumes a log-linear structure for demand for currency as a function of income and assumes no other factors. We then construct the estimated domestic share of U.S. currency for a given level of GDPC as

$$\widehat{CURRGDP}_{USADom} = \alpha_{Canada} + \beta \ln (GDPC_{USA} * X_{CanUS}) \quad (5)$$

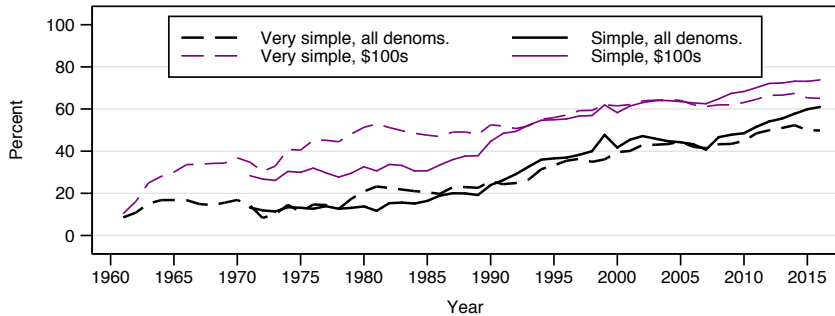
where X_{CanUS} is the U.S.-Canadian dollar exchange rate. The simple estimate is then constructed as before, replacing $\widehat{CURRGDP}_{USADom}$ with $\widehat{CURRGDP}_{USADom}$ rather than $CurrGDP_{Can}$ in Equation 2 and rearranging to solve for $Curr_{USAFor} / Curr_{USATot}$ which gives

$$ForShare_{Simple} = \frac{Curr_{USAFor}}{Curr_{USATot}} = 1 - \left(\frac{\widehat{CurrGDP}_{USADom}}{CurrGDP_{US}} \right) \quad (6)$$

These two estimates of U.S. currency abroad are displayed in Figures 6A and 6B. The GDP-based estimates, the solid lines, suggest that about 60 percent of all U.S. currency, and about 75 percent of \$100s, were held abroad as of the end of 2016, for a total value of about \$900 billion. Over the past two decades, these estimates point to a sharp runup in external demand for U.S. currency beginning in the late 1980s, a brief pop in 1999, a decline beginning in 2003, and a resurgence in 2008 that continued through 2016, all patterns consistent with the overall growth of U.S. currency.

Simple Estimates of the Share of U.S. Currency Abroad

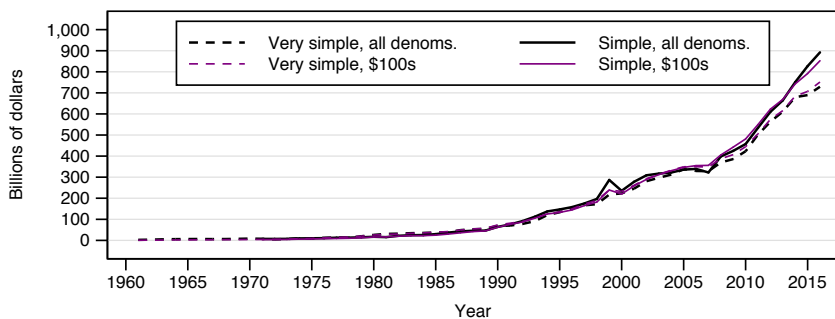
Figure 6A



Source: Federal Reserve System

Simple Estimates of the Value of U.S. Currency Abroad

Figure 6B



Source: Federal Reserve System

III.B Measurements of Cross-Border Flows of U.S. Currency

We now turn to the information provided by direct measurements of currency flows. Figures 7 through 11 display annual data on the primary measurements of cross-border currency flows in dollars, the international commercial bank shipment data described in Section I.B.1. Beginning with Figure 7, the solid black line indicates net commercial bank shipments and the dashed blue line indicates the total change in currency in circulation each year.²¹ Focusing only on the solid black and blue dashed lines, several features of the data stand out. First, reflecting the strong influence that international demand has on overall U.S. currency demand, the two series generally move in parallel, though the gap widens in the early 2000s and narrows in the most recent years. Second, the spike seen in total currency in circulation around 2000, the blue dashed line, is absent in the shipment flows. This feature of the data reflects the fact that a large share of the runup in holdings of currency immediately prior to the century date change (that is, in the final weeks of 1999) was held in commercial bank vaults and was then returned to the Federal Reserve early in 2000. Thus, while the currency was technically “in circulation” in the sense that it was held outside the Federal Reserve, the bulk of it never went to bank customers.²²

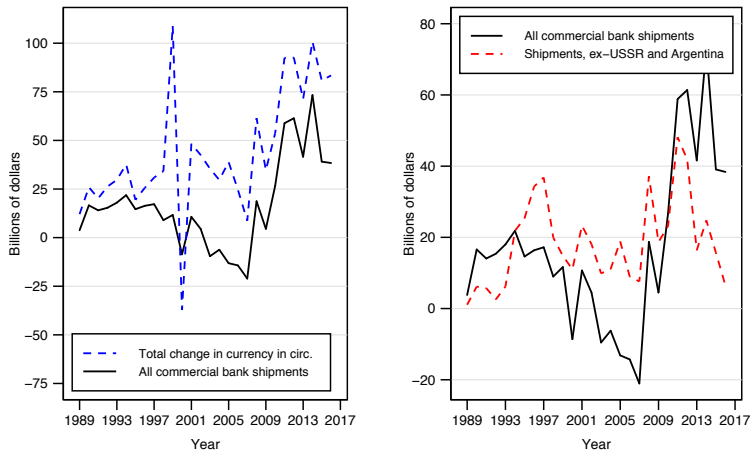
While U.S. currency is used in, and is shipped to and from, many countries, a few areas stand out because of their size and their appetite for dollars in times of crisis. In Figure 8, the dashed red line indicates net commercial bank shipments to the two leading markets in this category, the former Soviet Union and Argentina. For all but the first and last few years of the period shown, or from about 1995 to

²¹ Net commercial bank shipments are defined as shipments out of the United States to other countries (exports) less shipments from other countries into the United States (imports).

²² For many internal calculations, we typically smooth through this spike because of its extremely transitory and peculiar nature. The currency component of the money stock excludes currency held in the vaults of depository institutions. We would ordinarily prefer to use this currency component measurement, but data are not available by denomination on that basis.

**Left: International Commercial Bank Shipments
And Total Change in U.S. Currency in Circulation**
**Right: Total Commercial Bank Shipments and Shipments
to Selected Groups of Countries**

Figure 7 and 8



Source: Federal Reserve System

2008, these shipments more than fully accounted for all net commercial bank shipments. This phenomenon might also have been the case in the early part of the sample, but reporting in that period was not as detailed. As a result, shipments recorded with a destination of Europe might well have been sent to the former Soviet Union. In the early 2000s, net shipments to these markets declined as the financial conditions stabilized and as the need to use cash for saving and transactions has faded. In the past two years, though, global conditions as well as crisis and political uncertainty in these regions appears to have coincided with an

upswing in demand for dollars.²³

Figure 9 displays a proxy for commercial bank shipments based on currency processing data, the solid gray line. Commercial bank shipments are reported on a confidential basis, and monthly data are not always available on a consistent schedule. In order to have data for operational and publication purposes, Federal Reserve Board staff developed this proxy, which is the sum of net payments of \$100 notes from three Federal Reserve offices known to handle substantial volumes of deposits and withdrawals sent from or to international destinations: New York, Los Angeles, and Miami.²⁴ This proxy is based on two assumptions, which differ from the true net shipments series in two offsetting ways. The first assumption, which likely results in an overestimate, is that all payments and receipts at these offices are to or from international counterparties and that all payments and receipts at other offices are to or from domestic entities; in fact, every Federal Reserve office serves domestic and international customers. The second assumption, which would generally result in an underestimate, is that only \$100s are sent to or received from international destinations. This proxy moved very closely with the total shipments data in the 1990s, but was considerably higher than shipments over most of the 2000s, perhaps suggesting that domestic demand for \$100s was stronger in that period.

The two dashed series in Figure 9 indicate two experimental series. As noted above, one shortcoming of the shipment dataset is that it captures only cross-border flows carried through commercial banking, or “wholesale” channels. However, as reported in U.S. Treasury (2006), many countries receive large dollar flows through non-

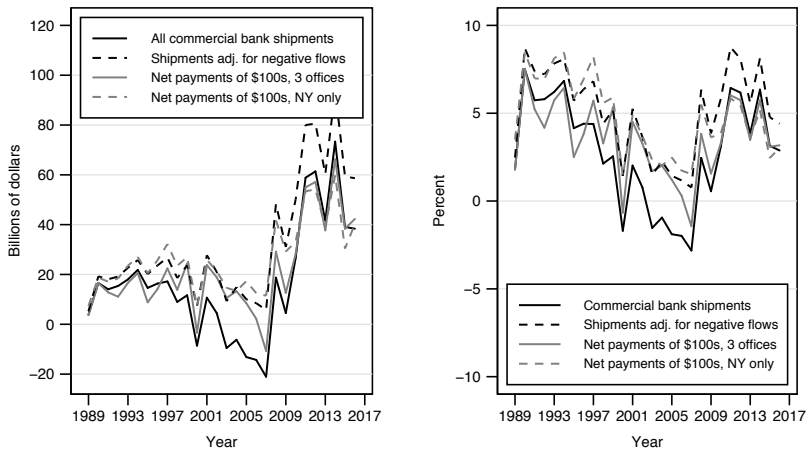
²³ See Banegas et al. (2015) for analysis of the significance internal and external economic and political crisis for currency demand at the global and country level.

²⁴ The Federal Reserve System has 12 regional Banks, whose locations are fixed. Many Federal Reserve Banks also have one or more branches, whose number and location can change over time as operational needs dictate. The Miami office is a branch of the Federal Reserve Bank of Atlanta and the Los Angeles office is a branch of the Federal Reserve Bank of San Francisco.

Left: Total Shipments, the Shipment Proxy, And Adjusted Shipments

Figure 9 and 10

Right: Estimated Flows of U.S. Currency Abroad Relative to Currency in Circulation



Note: The gray solid line in Figures 9 and 10 indicates net payments of \$100s from NY, LA, and Miami; right: Annual totals divided by currency in circulation at end of previous year.

Source: Federal Reserve System

bank, or “retail” channels and return dollars to the United States through banking channels. In the commercial bank shipment data, this phenomenon emerges in the form of persistent negative net shipment figures. That is, the shipment figures indicate large flows of dollars out of the foreign country into the United States and much smaller flows in the opposite direction.

For some such countries, the net commercial bank shipments figures are likely accurate and reflect dollar banknote inflows from third countries. For example, if tourists from Country A routinely carry dollars to Country B and the residents of Country B have little other use for dollars, the dollars might be shipped from

Country B to the United States. All other factors equal, this pattern would result in negative net shipments figures, and shipments figures summed across Country A and Country B would give an accurate indicate of flows into and out of the United States. For some countries, however, it is likely that dollars arrived in the country from the United States through nonbank channels. In such cases, the commercial banknote flows would not give an accurate indication of net flows to and from the United States.

The first experimental series imposes a very rough adjustment for this phenomenon as follows. First, a group of countries known to have significant tourism or significant populations of immigrants or migrant workers in the United States is identified. Second, a group of countries whose total net shipments is substantial and negative is identified. Third, for each year and for each country in both groups, the assumption is imposed that total net currency shipments to these countries, including the observed net commercial bank “wholesale” flows and nonbank “retail” flows, were zero.

As with the shipments proxy, this approach embodies two assumptions. First, this approach implicitly assigns a value of zero for net currency flows to these countries. This assumption could be erroneous in either direction: actual net flows could be positive or negative. Second, this approach assumes that other countries’ flows in aggregate are accurately measured by net commercial bank shipments. The blue dashed line shown here displays an adjustment that imposes this assumption for about a dozen countries. While this approach is admittedly crude, it is suggestive of the magnitude of flows that could be occurring through nonbank, or “retail” channels. Ideally, we could refine this measure by constructing series of “retail” (nonbank channel) banknote flows from the United States to other countries. While this type of data is not available universally, it is collected by some countries,

including Mexico.²⁵ This measure, the dashed black line, also tracks the shipments proxy for most of the sample, though it becomes implausibly large in the last few years of the sample. To the extent that this adjustment is useful, it is probably more applicable for cumulative, or stock estimates, than it is for flow estimates, because the nonbank flows likely occur at different times than the measured banking-channel flows back to the United States. For example, currency might be brought from the United States to another country through nonbanking channels over time and then return quickly in the event of a regulatory or other political or economic change.

Finally, the dashed gray line is an adjusted shipment proxy series. Along the lines of the adjusted commercial bank series, this series includes only payments of \$100s from the Federal Reserve Bank of New York, which are generally positive, and omits payments from the Miami and Los Angeles cash offices, which are generally negative and might reflect reflows of currency that moved across U.S. borders through nonbank channels.

Figures 7 through 9 display nominal values, which can be misleading even in a period with relatively low inflation. Figure 10, therefore, displays all of the same series as in Figures 7 through 9, but scaled by the stock of currency in circulation at the end of the previous year, or the approximate percentage-point contribution to currency growth that would be implied by each of these measures. While the measures certainly vary, they generally point to strong contributions from foreign

²⁵ Mexico is the largest single contributor to this adjustment, and it was the case of Mexico that inspired this approach. In the 1990s, Mexico collected customs data on cash imports from all travelers with no lower bound on the reporting threshold. This reporting is, of course, subject to the same problems of underreporting as other customs data, but the magnitudes were substantial and of a magnitude similar to reported commercial bank inflows. More recent customs reporting requires only declaration of amounts above \$10,000. Regardless, Mexican statistics on tourism flows indicate substantial volumes of people and revenue, though the form of the revenue (cash, credit card, or other) is not specified. Refer to Banco de Mexico (2012).

demand in the early to mid-1990s, a slowing in the mid-2000s, and a resurgence beginning in 2008.

III.C Using Cross-Border Flow Estimates to Construct Estimates of the Stock of U.S. Currency Abroad

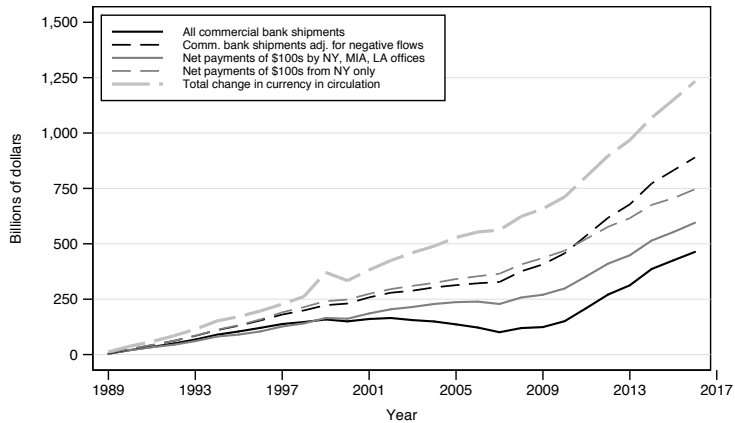
While tracking movements in currency in circulation is the major object of operational interest, having an estimate of the stock of U.S. currency abroad is also important for various analytical and operational questions faced by the Federal Reserve. Figures 11A and 11B chart the stocks of currency in circulation implied by the flow measures presented earlier. In Figure 11A, each line represents the cumulative change in the item since the end of 1988, when currency in circulation was about \$230 billion. As indicated by the thicker gray dashed line, total U.S. currency in circulation worldwide has increased by about \$1.2 trillion since 1990. The most direct measurement, commercial bank shipments, the solid black line, suggests that nearly \$500 billion has moved abroad since 1990, which would put the total at between \$500 billion and \$700 billion, depending on the assumed initial value. The shipments proxy, the solid gray line, suggests that about \$600 billion moved abroad over the period, putting the total at \$600 billion to \$800 billion.²⁶ Finally, the adjusted shipments and proxy figures, the dashed black and gray lines respectively, suggest that about \$750 to \$900 billion moved abroad over the period, putting the total at \$750 billion to \$1.1 trillion. These ranges are, of course, large, though the simple method proposed above in Section III.A.2 produces an estimate very close to the center of the range.

Finally, Figure 11B displays the cumulative flow measurement and estimates as a share of the cumulative increase in currency in circulation at each point in time.

²⁶ The proxy is the only measurement available before 1988. It indicates that \$40 billion moved abroad over the period from 1974 to 1989; during that time, currency in circulation increased by about \$180 billion.

Measures of Cumulative Flows of U.S. Currency Abroad, 1989 – 2016

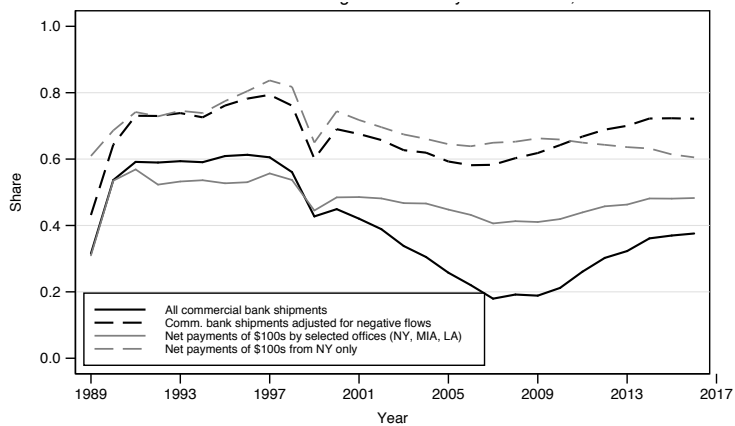
Figure 11A



Source: Federal Reserve System

Cumulative Flows of U.S. Currency Shipped Abroad relative to Cumulative Changes in Currency in Circulation, 1989 – 2016

Figure 11B



Source: Federal Reserve System

Again, the estimates are disparate, but indicate some common trends, including a strong role for international demand in the 1990s, a waning role in the early 2000s, and a resurgence in 2008 that shows signs of stabilizing but not waning. In this Figure, as earlier, the role of the former Soviet Union and Argentina is likely understated because of poor data coverage in the shipment data in the early 1990s.

IV Indirect Estimates of the Share of U.S. Currency: The Seasonal Method

Earlier work on estimates of the stock of currency abroad has developed and provided estimates from two methods, known as the seasonal method and the biometric method.²⁷ Updates to these methods continue to indicate that a substantial share of U.S. currency is abroad, but technical factors and shifting patterns of currency demand have made their use more challenging.

In particular, this paper does not present estimates based on the biometric (“fish”) method because current banknote distribution practice does not allow use of one of the critical assumptions. In particular, the biometric method relies on the assumption that, when a new banknote series is issued, all banknotes issued are of that series. However, for the issuance of 2003-series \$20s, \$50s, and \$100s, older designs co-circulated for a time, and so it is not currently feasible to produce these estimates for the current design.

IV.A The Seasonal Method: Key Assumptions

The seasonal method extracts an estimate of the share of U.S. currency abroad by working from four key assumptions. First, we assume that the seasonal pattern in domestic demand for U.S. dollars is similar to the seasonal pattern of demand within Canada for Canadian dollars (similar holidays, vacations, customs, and denominations). More specifically, we assume that the seasonal amplitude, or the

²⁷ Refer to Porter and Judson (1996), Judson and Porter (2001), U.S. Treasury (2006).

percentage difference between the seasonal peak and seasonal trough, is similar for U.S. and Canadian currency demand.²⁸ Second, we assume that foreign demand for U.S. dollars has no significant seasonal pattern, or, correspondingly, that the seasonal amplitude for the foreign component of demand for U.S. dollars is zero. Third, we assume that circulation of Canadian dollars outside of Canada is negligible, so that the demand for Canadian dollars can be attributed solely to domestic demand. Finally, we assume that U.S. currency is not used to a substantial degree inside Canada.

IV.B Model

Based on these assumptions, we can express the seasonal model as follows:

Define:

S_i^j = seasonal amplitude for country i , component j

β_t = fraction of currency held abroad at time t

The overall seasonal amplitude in U.S. currency, $S_{US,t}^T$, can be expressed as a weighted sum of domestic (d) and foreign (f) components:

$$S_{US,t}^T = \beta_t S_{US,t}^f + (1-\beta) S_{US,t}^d \quad (S1)$$

We cannot separately identify $S_{US,t}^f$ and $S_{US,t}^d$ but, using the assumptions above, we replace $S_{US,t}^f$ with 0 and $S_{US,t}^d$ with $S_{CAN,t}^T$ to obtain:

$$S_{US,t}^T = \beta_t * 0 + (1-\beta) S_{CAN,t}^T \quad (S2)$$

²⁸ Of course, Canadian and U.S. holidays are not identical: to give just two examples, Canada observes Thanksgiving in October and the U.S. observes it in November, and Canada's holidays include the day after Easter and the day after Christmas while these days are not generally holidays in the United States. Nonetheless, the broad outlines of holidays are very similar, especially at a monthly frequency.

Or, solving for β_t :

$$\beta_t = 1 - \frac{S_{US,t}^T}{S_{CAN,t}^T} \quad (S3)$$

IV.C Application and Estimates

We estimate the share of all currency abroad and the share of \$100s abroad using X-12 ARIMA and an alternative shorter smoothing window to obtain seasonal factors for U.S. and Canadian currency in circulation. Once the seasonal factors are estimated, the seasonal amplitude must be calculated.

In earlier estimates using this method, the peak month was December and the trough month was February of the following year. However, it seems that seasonal factor patterns have changed in the past several years, as illustrated in Figures 12A and 12B. December remains the clear peak, though its relative magnitude has declined precipitously. February is no longer the trough for U.S. currency in circulation. Rather, September is now the trough, though January is now about the same as September. Since this method requires that the same “peak” and “trough” months be chosen, I use December and January.

Because of these shifts over time, I propose two approaches to measuring the seasonal amplitude. For each, I report results using two different seasonal adjustment procedures, X12-ARIMA and X12 with a shorter 3x1 smoothing window, shown in black and blue respectively. The first approach estimates the annual amplitude as the difference between the seasonal factor for December of one year and January of the next year. These estimates are associated with the year in which December falls and are shown in Figures 13A and 13B as the “annual” estimate,

the solid lines. A third approach is to estimate the seasonal amplitude each month as the difference between the maximum and minimum seasonal factors over the most recent twelve months, and then to estimate the monthly share of currency abroad as the trailing average of the estimates for the past twelve months. The estimates from this approach are shown in Figures 13A and 13B as the “monthly” short-dashed lines.^{29 30}

The results of the seasonal estimates for all currency abroad and for \$100s through December 2016 are displayed in Figures 13A and 13B. As was the case in earlier work, these estimates are on the high end of the range. These estimates also show a quite different time series pattern relative to one another as well as relative to other flow-based measures, though the monthly measures generally indicate an upswing in the share of U.S. dollars held abroad.

One curious feature of these results is that the estimates for \$100s are lower than the estimates for currency overall despite our general impression that \$100s are more prevalent in international use of U.S. currency. It is difficult to know what to make of these results, though it seems likely that it is related to the quite substantial changes in seasonal amplitudes evident in both the U.S. and Canadian data. This topic is worthy of study in its own right.

²⁹ In this method, one could just as easily use the unsmoothed seasonal amplitude estimates. These estimates, though, show a step-function-like shape because the seasonal maximums and minimums generally change once per year. It seems unlikely that the share of currency abroad follows such a step function, and so the moving average imposes a smooth trend. Notably, this averaging does not affect the level of the share estimates on average over time.

³⁰ A third method presented in Judson (2012) has been dropped because it is now producing unrealistic estimates that approach 100 percent.

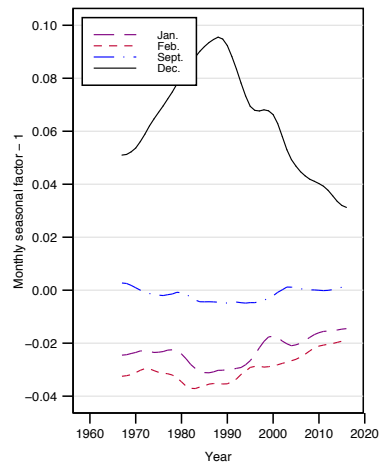
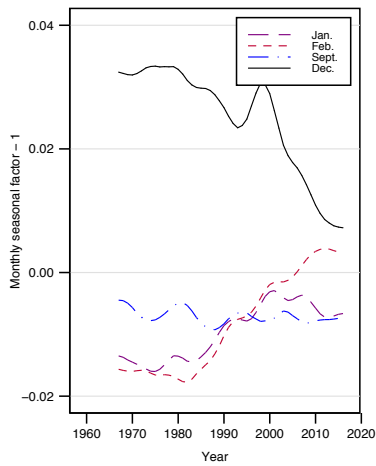
Left: X-12 Seasonal Factor Estimates

Total U.S. Currency in Circulation

Figure 12A and 12B

Right: X-12 Seasonal Factor Estimates

Total Canadian Currency in Circulation



Source: Federal Reserve System

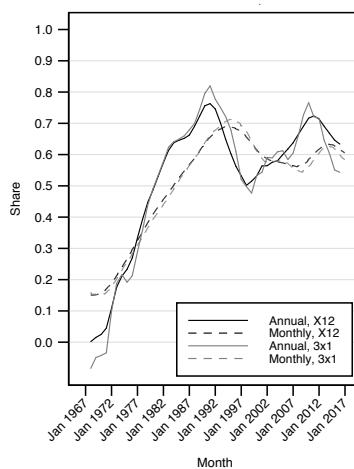
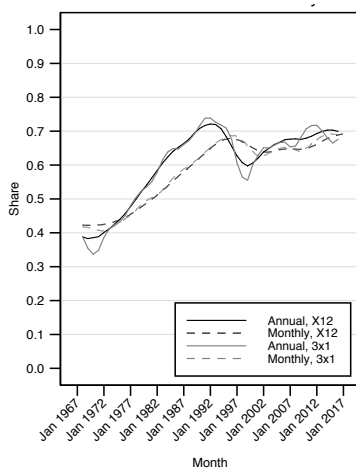
Left: Seasonal Method

Estimated Share of All U.S. Currency Abroad

Right: Seasonal Method

Estimated Share of U.S. \$100s Abroad

Figure 13A and 13B



Source: Federal Reserve System

V Estimating a Currency Demand Function

Finally, we return to the idea of a currency demand function, which was briefly explored in Section 3 with reference to Canada. Here, the approach is to specify a demand function for U.S. currency that allows for foreign shipments as well as domestic factors. Our general assumption has been that currency demand consists of two components: a domestic component, which should be correlated with the typical determinants of money demand; and an international component, which is driven by routine as well as crisis-related fluctuations in foreign demand for U.S. currency.

Table 1 presents coefficient estimates for a simple error correction model for the currency component of M2 estimated quarterly beginning in 1988, a date chosen for two reasons.³¹ First, 1988 marks the beginning of availability of the commercial bank shipment data as well as an apparent upshift in international demand for U.S. currency. Second, preliminary testing (not shown) indicates a distinct structural break in 1988. The regression model consists of two equations, one for the steady state and one for dynamics.

The steady state equation is

$$\text{Log}(\text{NGDP}) - \text{Log}(\text{Curr}) = \alpha_0 + \alpha_1 (R_{\text{short}}) + \alpha_2 \text{Trend} - \varepsilon_t$$

³¹ As noted in Section III.B., the currency component of M2 excludes currency held in the vaults of depository institutions, or vault cash, which was one of the most volatile components of currency in circulation just before and after the century date change. Thus, this measurement of currency is more useful for longer-term analysis where the inclusion of the large and transitory swings in vault cash might be inordinately influential, such as in quarterly measurements where the periods immediately before and immediately after the century date change fall into different quarters.

The dynamic equation is

$$d(\log(\text{Curr})) = \beta_0 \varepsilon_{t-1} + \beta_1 \text{SHIP} + \beta_2 (d(\log(\text{Curr})))_{t-1} + \beta_3 d(\log(\text{NGDP}))_{t-1} \\ \beta_4 d(\log(\text{NGDP}))_{t-4} + \beta_5 \text{Y2K} + \nu_t$$

Quarterly Error Correction Regression Results			Table 1
Dependent variable: Growth of seasonally adjusted currency component of M2			
Quarterly, 1988:1 – 2016:4			
Steady – state equation	Coefficient	T-Stat	
α_0 (Constant)	6.293	6.8	
α_1 (R_{short})	0.031	2.1	
α_2 (Trend)	-0.003	-3.0	
Dynamic equation			
β_0 (Error correction coefficient)	-0.026	-2.7	
β_1 (Shipments)	0.534	8.9	
β_2 (Y2K Dummy)	0.004	1.1	
β_3 $d(\log(\text{Curr}))_{t-1}$	0.558	10.3	
β_4 $d(\log(\text{NGDP}))_{t-1}$	0.200	3.5	
β_5 $d(\log(\text{NGDP}))_{t-4}$	0.241	--	
Adjusted R-squared = 0.70			
Number of obs = 116			

The variables are defined as follows:

- NGDP: Nominal GDP, seasonally adjusted
- Curr: Seasonally adjusted currency component of M2
- SHIP: Two-month moving average of commercial bank shipments adjusted for negative net shipments, divided by the previous period's seasonally adjusted currency component of M2. This formulation puts shipments on the same basis as the monetary aggregate growth data, which are calculated as monthly averages.
- Rshort: Short-term interest rate, a proxy for the opportunity cost of holding currency
- Trend: 1 for 1988:Q1 and increasing by 1 each quarter
- Y2K: Dummy: 1 for 1999:Q4 and -1 for 2000:Q1

The coefficients in the steady state equation are constrained to unitary elasticity, and the coefficients on the lagged values of log changes in currency and GDP are constrained to sum to 1. The equations are estimated by nonlinear least squares in one step by substituting for the error term in the dynamic equation. After controlling for the estimated contribution of overseas demand, the coefficients are generally of the expected sign and magnitude. The short interest rate is positively correlated with velocity, the error correction coefficient is negative, shipments are strongly significant, and recent lags of currency growth and income are significant. The time trend coefficient is somewhat counterintuitive, but its overall contribution is small and so we leave further examination of it for future work.

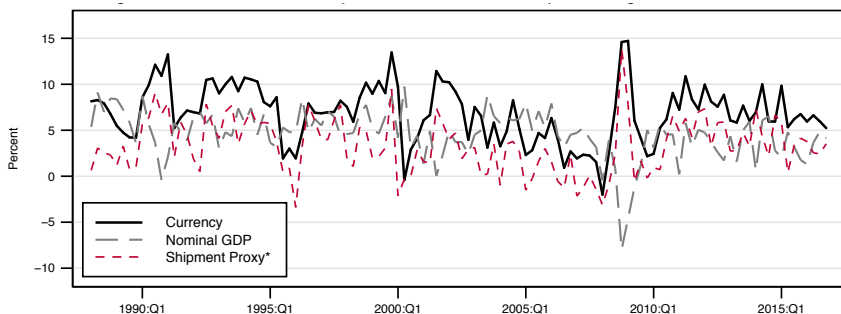
Figure 14A displays overall currency growth, the solid black line, the proxy measurement, the short-dashed red line, and nominal GDP growth, the dashed gray line, for the regression sample period. Finally, Figures 14B and 14C display the quarterly and cumulative contributions to currency growth from foreign demand implied by the regression in Table 1. In both figures, the contributions are calculated from dynamic forecasts with residuals applied equally to the two components.

As indicated by the dashed red line in Figure 14C, international shipments, as measured by the \$100s proxy, are responsible for about two thirds of the growth in currency over this period.

Notably, even the highest of these estimates suggests that currency holdings by U.S. residents are significant—at least \$1,000 per person—a finding at odds with survey work on currency holdings.³² Feige (1996, 2012) suggests that underground economic activity could account for this discrepancy, though underreporting, especially by individuals with large cash holdings, is also likely a substantial problem.

Growth of Currency, Nominal GDP, and Proxy for Foreign Demand, 1988 – 2016

Figure 14A

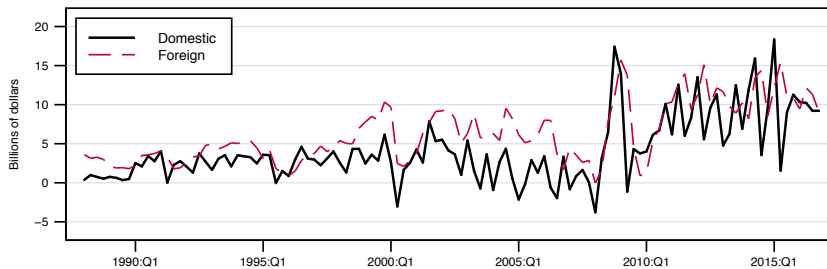


Source: Federal Reserve System

³² The most recent Survey of Consumer Payment Choice, conducted in 2014, indicates holdings of about \$200 per person (Greene et al., 2014).

Estimated Foreign and Domestic Contributions to Currency Increases, 1988 – 2016

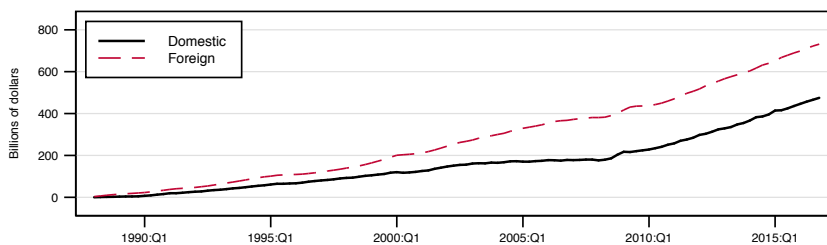
Figure 14B



Source: Federal Reserve System

Estimated Cumulative Contributions of Domestic and Foreign Factors to U.S. Currency Increases, 1988 – 2016

Figure 14C



Note: Foreign proxy is commercial bank shipments adjusted for negative net shipments as described in the text divided by currency stock at the end of the previous period. In this Figure, residual assigned equally to domestic and foreign factors.

Source: Federal Reserve System

VI The End of Cash? Demand for U.S. Currency by Denomination

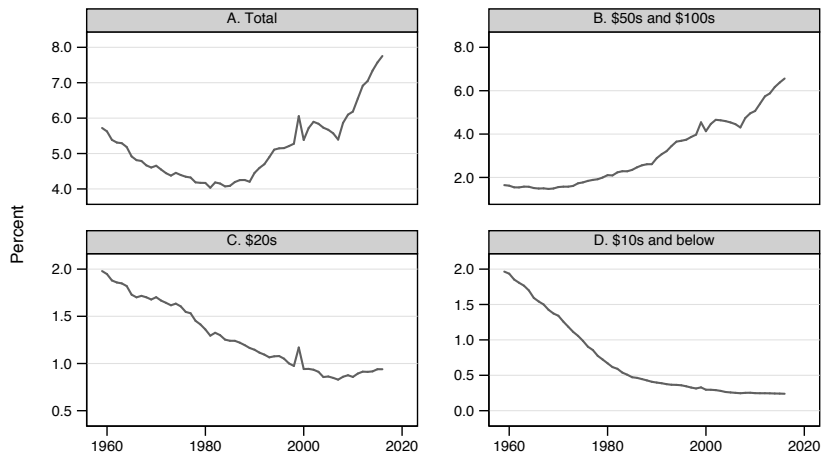
While \$100s are the largest denomination by value and dominate international flows, the evolution of demand for smaller denominations in recent years deserves examination. Figure 15 displays the ratio of currency to U.S. nominal GDP from 1960 to 2016 for all currency, for \$100s, for \$20s, and for \$10s and below. Not surprisingly, the path for total currency closely tracks that for \$100s, with a steady upward path. In contrast, the path for \$20s shows a slight uptick in the mid-2000s after years of steady decline, and the paths for \$10s and smaller shows signs of leveling off or even declining.

Focusing on growth rates gives a slightly different picture: as seen in Figure 16, which displays growth rates for the same denomination groups, currency demand growth has been slowing somewhat. While demand for \$50s and \$100s is still growing faster than in the 2000-2007 period, it is now slower than in earlier decades. The pattern is similar for \$20s, with growth edging back down. For the smallest denominations, growth is closer to earlier trends, but remains at or below the rate of GDP growth.

These trends are of relatively short duration, and it remains far too early to announce the death of cash. It is possible that demand growth will pick up with nominal GDP, but it is also possible that rising interest rates will limit growth. In addition, international demand is as difficult to predict as crises themselves, but the slowing growth rate of demand for \$100s is notable.

Ratio of Currency to GDP by Denomination

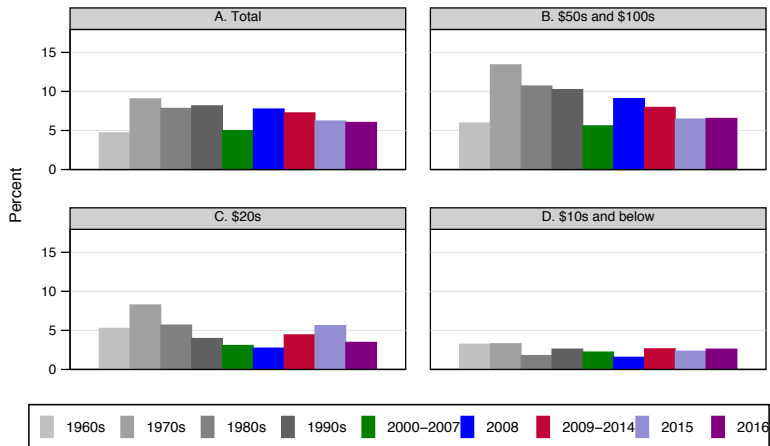
Figure 15



Source: Federal Reserve System

**Average Annual Growth in Currency in Circulation
by Denomination**

Figure 16



Source: Federal Reserve System

VII Summary, Conclusions, and Directions for Future Work

In sum, much as in earlier work, the currently available data do not allow for precise estimates of foreign holdings of U.S. currency, and the available estimates are somewhat disparate. Nonetheless, direct measurements, regression-based estimates, and indirect estimates all point to strong international demand in the 1990s, a falloff in the early 2000s, and a resurgence that coincided with the collapse of Lehman Brothers and has yet, nearly ten years later, to subside.³³ Collectively, these methods continue to suggest that half or a bit more than half of U.S. currency circulates abroad. For the U.S. dollar, the end of strong demand both abroad and at home seems to be far off, though, as noted, demand growth is slowing.

There are many promising avenues for future investigation, including the following. First, is there a good way to estimate hoarding of notes, using the biometric method or some other method based on banknote processing data? For the biometric method, what might we be able to learn about hoarding of notes? For the seasonal method, what is the significance, if any, of the shift observed in seasonal patterns of demand for U.S. currency? For the regression-based methods, would a more rigorous and sophisticated regression framework yield more precise or very different estimates? Are there ways to tease out the drivers of cash abroad? It is often asserted that cash is overwhelmingly used for illicit purposes, but can the forces driving licit and illicit use be identified and measured? Finally, as more and more ordinary transactions become cashless, will cash be increasingly marginalized?

³³ Indeed, weekly data, reported in Appendix Figure 2, show an unmistakable turnaround in demand patterns in the middle of September 2008.



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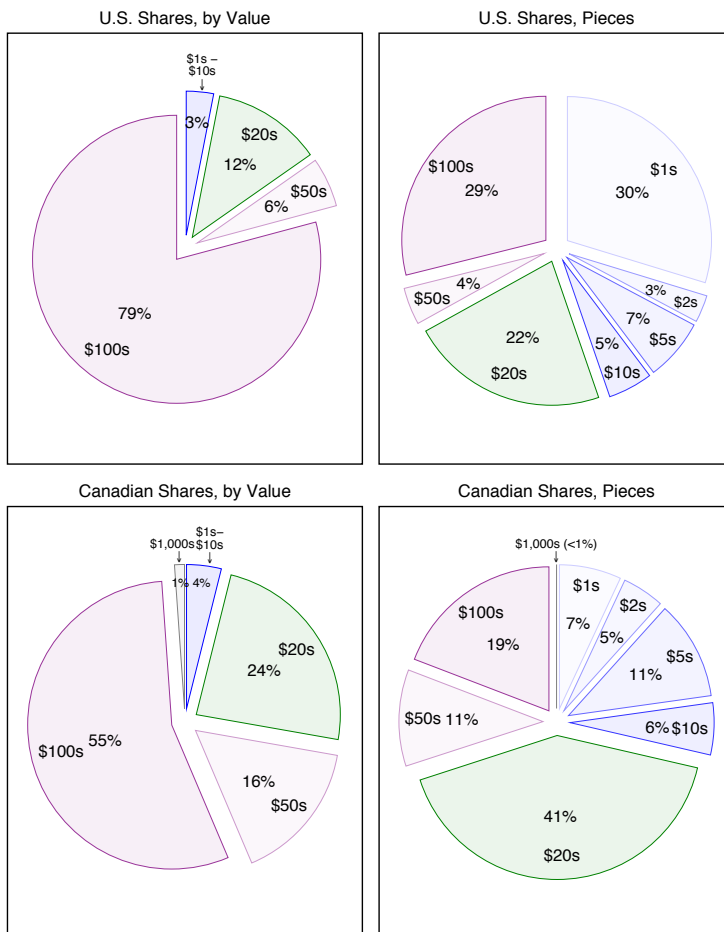
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Appendix

**Shares of U.S. and Canadian Currency in Circulation
By Value and Pieces, 2016 Average**

Appendix Figure 1



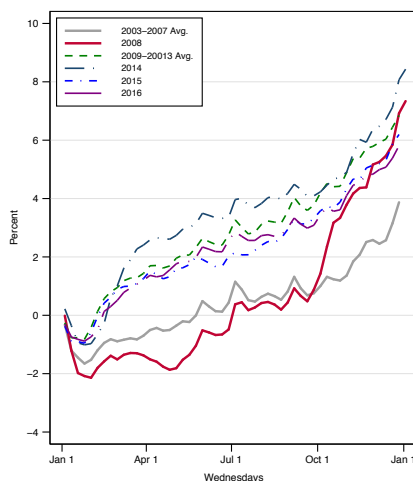
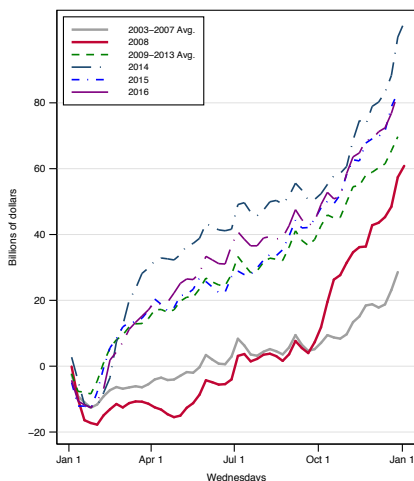
Left: Cumulative Change in Currency in Circulation

Appendix Figure 2A and 2B

Dollar Value

Right: Cumulative Change in Currency in Circulation

Growth Rate Terms

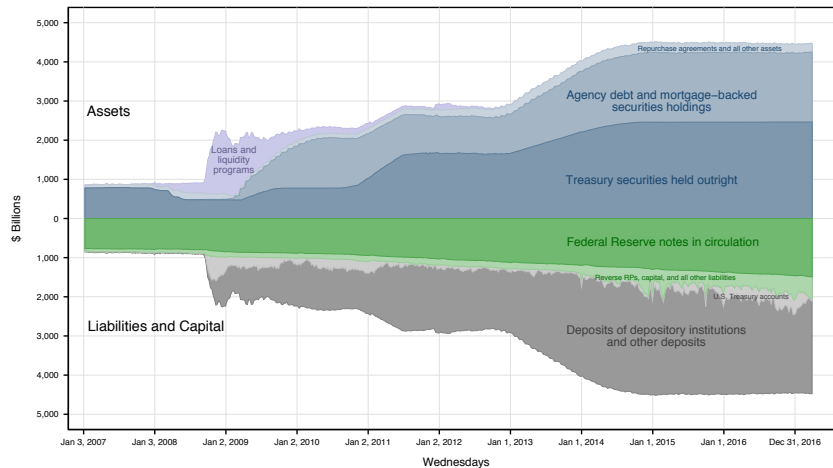


Source left: H.4.1 Statistical Release

Source right: H.4.1 Statistical Release. Cumulative totals divided by value for last Wednesday of prior year.

Federal Reserve Bank Assets and Liabilities and Capital, 2007 – 2017

Appendix Figure 3



Source: H.4.1 Statistical Release (<http://www.federalreserve.gov/releases/h41/>).



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Matthias Uhl, Nikolaus Bartzsch (Bundesbank) Domestic and foreign demand for euro banknotes issued in Germany



Matthias Uhl¹
Deutsche Bundesbank

Abstract

To facilitate a more detailed study of the volume of euro banknotes in circulation issued by the Deutsche Bundesbank, it is broken down into the components of foreign demand, domestic hoarding and domestic transaction balances. These banknote demand components are estimated using the direct approach “net shipments and foreign travel” as well as an indirect approach known as the “seasonal method”. According to the new estimates, which are based on a combination of the two approaches, around 65% to 70% of the arithmetical volume of euro banknotes issued by the Bundesbank were in circulation outside Germany at the end of 2015; of this figure, 40 to 50 percentage points were in circulation outside the

¹ Discussion Papers represent the authors personal opinions and do not necessarily reflect the views of the Deutsche Bundesbank or its staff

euro area, and 20 to 30 percentage points in other euro-area countries. Between 30% and 35% of the Bundesbank's cumulated net issuance was in circulation in Germany, of which 25 percentage points were hoarded and 5 to 10 percentage points held for transaction purposes. The newly estimated time series for domestic hoardings does not feature a noticeable break due to the euro area's low-interest-rate environment; instead, Bundesbank-issued euro banknotes may be circulating in other euro-area countries in greater numbers.

1 Introduction

As a rule, the banknotes of a given currency can be used as a means of payment and store of value not only in the relevant currency area, but outside it as well. Euro and US dollar banknotes, in particular, are likely to be used on a considerable scale worldwide. Using a combination of different estimation methods, Judson (2012) asserts that just over half of US currency in circulation is probably held outside the United States.² Based on an evaluation of euro currency flows through international banknote wholesale banks, the European Central Bank estimates that, in terms of value, much more than 18% of the stock of euro banknotes in circulation is likely to be found outside the euro area (European Central Bank, 2015).

It is particularly true of the euro area that banknotes issued by a central bank do not necessarily circulate in that bank's country. There are currently 19 national central banks (NCBs) in the Eurosystem, and the euro banknotes issued by each of them can migrate freely across national borders. An NCB's arithmetical stock of banknotes in circulation therefore cannot provide direct insight into the volume of

² Further analyses of foreign demand for US dollar cash can be found in Porter and Judson (1995, 1996) and Feige (2012), for example. Feige (2012) evaluates data on net shipments of US dollar banknotes by wholesale currency shippers as well as surveys on cash taken abroad by travellers and cash remittances by migrants. In the end, Feige (2012) estimates that the amount of US dollars in circulation outside the United States is just US\$230 billion, or 23% of US currency in circulation.

banknotes in circulation in that country. Against this background, the Bundesbank determines the components of its cumulated net issuance of euro banknotes on an ongoing basis; these are foreign demand, domestic transaction balances and domestic hoarding. These analyses help in gaining an understanding of developments in the circulation of the banknotes issued by the Bundesbank and are the key prerequisite for quantifying the scale of cash usage in Germany.

The new estimates of the components of demand for Bundesbank-issued banknotes that are presented in this paper build on the extensive studies contained in Bartzsch et al (2011a, 2011b), in particular, which analyse the period up to and including 2009. Those papers found that at the end of 2009 around 65% to 70% of the Bundesbank's cumulated net issuance of euro banknotes was in circulation outside Germany. Bartzsch and Seitz (2016) and Bartzsch (2017) use the biometric method, as it is called, to determine the holding of transaction balances of €5, €10 and €20 banknotes in Germany and outside the euro area. According to the estimates, between one-fifth and one-sixth of the arithmetical stock of banknotes in circulation issued by the Bundesbank in these denominations is held in domestic transaction balances. Holdings of transaction balances in these denominations outside the euro area are small; only in the case of the €20 banknote are the non-euro-area transaction balances significant, with a share of just over 7% in the total arithmetical stock of Bundesbank-issued banknotes of this denomination in circulation. In what is regarded as a landmark study, Seitz (1995) estimates that at the end of 1994 between 30% and 40% of the Deutsche Mark banknotes in circulation, or Deutsche Mark banknotes with a value ranging between DEM 65 billion and DEM 90 billion, were to be found outside Germany.

The present paper first uses a direct approach, namely the "net shipments and foreign travel" approach, to estimate the banknote demand components. In this approach, the volume of Bundesbank-issued banknotes in circulation outside Germany is determined using the Bundesbank's cumulated net issuance derived from

wholesale banks active in the global market for currency trading and using estimates of euro banknotes taken abroad by travellers. While total domestic transaction balances consisting of credit institutions', households' and retailers' transaction balances can be estimated, domestic hoardings are the resultant residual in this approach. In order to directly estimate domestic hoardings and also check the validity of the estimates of the other banknote demand components, an alternative, indirect estimation approach called the "seasonal method" is additionally used. According to the new estimate, which is based on both approaches, between 65% and 70% of the euro banknotes issued by the Bundesbank were in circulation outside Germany at the end of 2015, with 40 to 50 percentage points outside the euro area and 20 to 30 percentage points in other euro-area countries. Between 30% and 35% of the Bundesbank's cumulated net issuance was in circulation in Germany. The major part of this – 25% of the Bundesbank-issued euro banknotes in circulation – is hoarded. Only 5% to 10% of the cumulated net issuance is held in domestic transaction balances.

The development of banknote hoarding is particularly interesting in the context of the current low-interest-rate environment. The time series for domestic hoarding, estimated up to the end of 2015 using the seasonal method, indicates a smooth development despite the current low-interest-rate environment. Instead, there are indications that stocks of Bundesbank-issued euro banknotes in other euro-area countries have risen considerably in recent years.

The remainder of this paper is structured as follows. Section 2 describes developments in the circulation of euro banknotes issued by the Eurosystem and by the Bundesbank. Sections 3 and 4 go on to discuss the breakdown of the Bundesbank's cumulated net issuance into the components of foreign demand, domestic hoarding and domestic transaction balances using a direct approach or the seasonal method. Section 5 develops a combination of these new estimates, while section 6 concludes.

2 Demand for euro banknotes

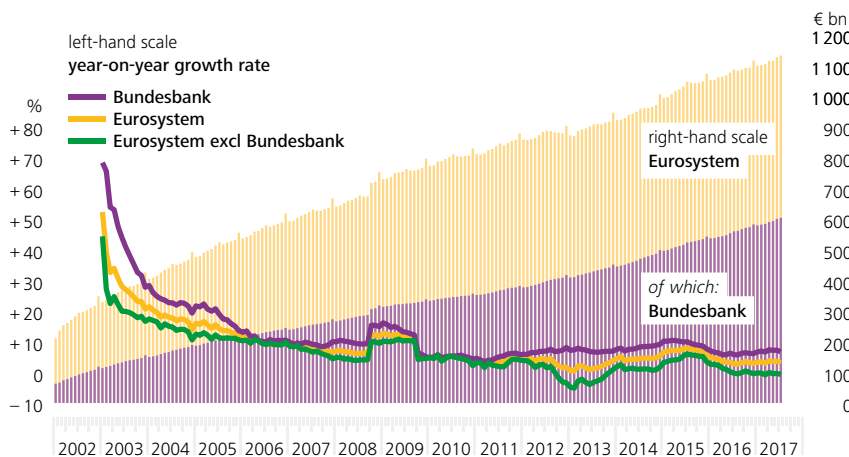
The volume of euro banknotes in circulation issued by the Eurosystem and by the Bundesbank is shown in Figure 1.³ The volume of euro banknotes in circulation signifies the volume of banknotes held by economic players within and outside the euro area and therefore represents the total usage of euro banknotes as a means of payment and store of value. At the end of January 2002, shortly after euro cash was introduced, the cumulated net issuance of euro banknotes by the Eurosystem totalled roughly €220 billion. At the end of 2004, this cumulated net issuance came to more than €500 billion for the first time, and at the end of 2014 it exceeded the €1,000 billion mark. The volume of euro banknotes in circulation stood at €1,126 billion at the end of 2016, in addition to which the 19 Eurosystem NCBs have issued euro coins in the net arithmetical amount of €26.9 billion. These figures show that the combined use of euro cash as a means of payment and store of value within and outside the euro area is on the rise.

The Bundesbank is part of the Eurosystem and contributes to the development of the total stock of euro banknotes in circulation by issuing and accepting euro banknotes. The arithmetical volume of Bundesbank-issued euro banknotes in circulation has grown particularly dynamically. At the end of January 2002, the outstanding volume amounted to €73.3 billion, or 33.1% of the total stock of euro banknotes in circulation, while at the end of December 2016, it stood at €592.2 billion, or 52.6% of the total stock of euro banknotes in circulation. The Bundesbank was therefore responsible for a considerable portion of the net issuance of euro banknotes in circulation. One particular reason for this is likely to be that the Bundesbank meets the foreign demand for euro banknotes to a large degree by way of

³ Descriptions of developments in the volume of euro banknotes in circulation issued by the Eurosystem and by the Bundesbank can also be found, for instance, in Bartzsch et al (2015) and Deutsche Bundesbank (2016).

Euro banknotes in circulation

Figure 1



Sources: Deutsche Bundesbank and European Central Bank.

banknote shipments to banknote wholesale banks and through banknotes taken abroad by residents travelling. The Bundesbank's role in wholesale euro banknote trade has also evolved historically, because it already had business relationships with wholesale banks active in currency dealing owing to the considerable volume of Deutsche Mark cash that was in circulation abroad. Other factors contributing to the particular growth in the outstanding volume of euro banknotes issued by the Bundesbank are probably Germany's geographical location at the heart of Europe, the convenience of Frankfurt airport and the significant amount of travel undertaken by the resident population.

Figure 1 also shows the growth rates of euro banknotes in circulation compared with the same month of the previous year for the Eurosystem and the Bundesbank. These growth rates of euro banknotes in circulation were very high in the first years

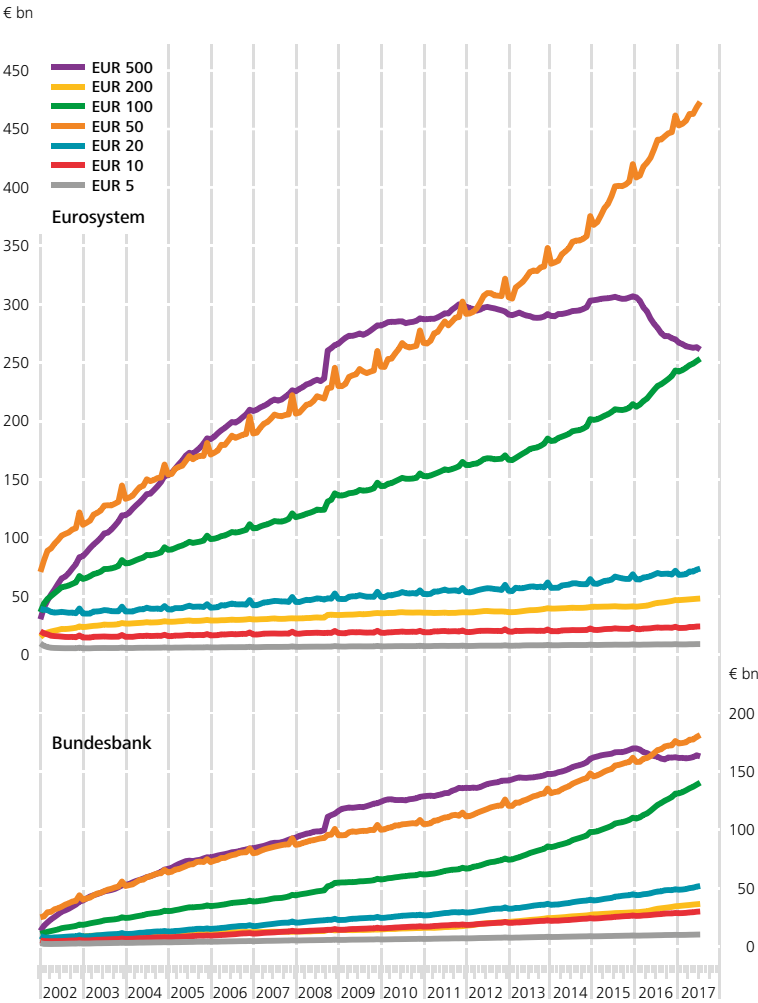
after the introduction of the single currency, in particular; between the end of January 2002 and the end of January 2003, for example, the total stock of euro banknotes in circulation grew by 53.3%, with the outstanding volume of euro banknotes issued by the Bundesbank even rising by 69.4%. These especially striking growth rates in the first few years after the introduction of euro cash can probably be attributed to the changeover of national currencies. Cash users are likely to have particularly dissolved banknote hoardings earmarked for long-term storage in the months preceding the replacement of the national currencies and subsequently replenished them after the introduction of euro cash. Nonetheless, the growth rates of euro banknotes in circulation are also consistently high. From December 2006 to December 2016, the stock of euro banknotes in circulation issued by the Eurosystem grew by an average of 6.0% each year, while the outstanding volume of euro banknotes issued by the Bundesbank even rose by an annual average of 8.8%. This growth can be explained, in part, by an increase in the price level as well as in economic output in the euro area and Germany. Even so, the volume of euro banknotes in circulation grew more dynamically overall than could have been expected based on these factors alone. One reason for this is the strong demand from abroad for euro banknotes, which will be analysed in more detail later in this paper. The increase in the growth rates of euro banknotes in circulation from October 2008 is also striking. During the Lehman crisis, as it came to be known, a number of investors evidently viewed euro cash as a safe investment.

Figure 2 and Table 1 show the value of euro banknotes in circulation, broken down by denomination, for both the Eurosystem and the Bundesbank. In terms of value, the €500, €100 and €50 banknotes, in particular, are significant. The increase in €500 and €100 banknotes in circulation in 2008 is notable, when investors sought these particular banknote denominations as a store of value while the financial crisis intensified. When news began emerging in February 2016 that halting production and issuance of the €500 banknote was under consideration, the outstanding volume of this banknote denomination declined. At the end of 2016, the

joint share of the large €100, €200 and €500 denominations in the total volume of banknotes in circulation stood at 55.4% for the Bundesbank and 43.4% for the rest of the Eurosystem excluding the Bundesbank. In other words, the share of large banknote denominations in the total volume of euro banknotes in circulation is much higher for the Bundesbank than for the rest of the Eurosystem. One possible reason for this could be the greater use of large banknote denominations as a transaction medium or store of value in Germany. However, a study by the European Central Bank, which analysed cash usage in Austria, Belgium, France, Germany, Italy, Luxembourg, the Netherlands and Spain, found that, if anything, Germany has a below-average number of users of €200 and €500 banknotes (European Central Bank, 2011). This suggests that the reason for the large percentage of high-value banknotes in the Bundesbank's outstanding volume of banknotes is likely to be the use of German-issued euro banknotes in other countries. Bartzsch et al (2011b) do indeed find that €500 euro banknotes issued by the Bundesbank are especially prevalent outside Germany. After a detailed evaluation of the denomination structure of the cumulated net issuance, Bartzsch et al (2011a) put the level of hoardings in Germany at the end of 2009 at €70 billion, or 20% of the Bundesbank's cumulated net issuance.

Euro banknotes in circulation

Figure 2



Source: Deutsche Bundesbank.

**Euro banknotes in circulation by denomination at the
end of 2016**

Table 1

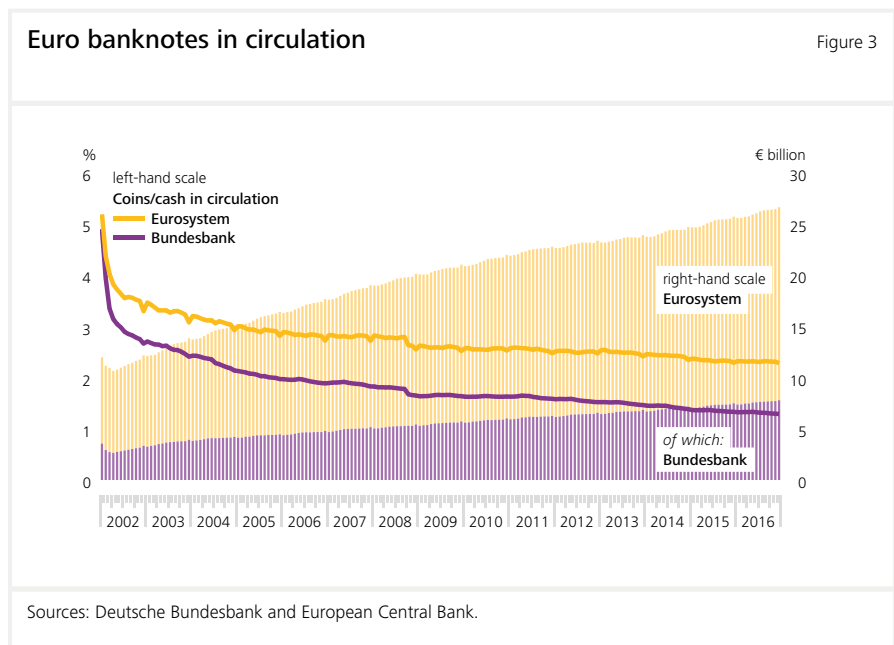
	Eurosysteem		Deutsche Bundesbank	
	€ billion	%	€ billion	%
EUR 500	269.9	24.0	162.2	27.4
EUR 200	46.7	4.1	34.6	5.8
EUR 100	243.3	21.6	131.0	22.1
EUR 50	461.6	41.0	176.1	29.7
EUR 20	71.8	6.4	49.2	8.3
EUR 10	23.9	2.1	28.9	4.9
EUR 5	9.0	0.8	10.2	1.7
Total	1,126.2	100.0	592.2	100.0

Sources: Deutsche Bundesbank and European Central Bank.

The volume of euro cash in circulation consists of the euro banknotes and coins in circulation. Figure 3 shows the cumulated net issuance of euro coins by the Eurosystem and by the Bundesbank. The analyses presented in this paper look at the components of the outstanding volume of euro banknotes issued by the Bundesbank. Concentrating on the banknotes in circulation is warranted given the low-value share of outstanding coins in the total volume of cash in circulation.⁴ At the end of 2016, coins in circulation accounted for a 2.3% share of the cash in circulation in the Eurosystem; the arithmetical volume of coins in circulation issued by the Bundesbank made up just 1.3% of the arithmetical cumulated net issuance of euro

⁴ The Bundesbank, as Germany's central bank, issues euro banknotes. In Germany, responsibility for coin minting lies with the Federal Government, represented by the Federal Ministry of Finance. The Bundesbank purchases euro coins from the Federal Government at their nominal value and introduces them into circulation.

cash by the Bundesbank. The balance of euro coins held for transaction purposes in Germany is analysed in Deutsche Bundesbank (2015a) and Altmann and Bartzsch (2014). According to these studies, euro coins with a value of €2.3 billion were held in domestic transaction balances in 2011, corresponding to 36% of the total stock in circulation at that time.



3 Components of banknote demand using direct approaches

3.1 Regional distribution of Bundesbank-issued euro banknotes using direct approaches

International migration of euro banknotes can take place via various channels, for instance shipments of euro banknotes abroad by banks that are active in the global market for currency dealing, euro banknotes taken abroad by travellers, remittances by foreign workers and the settlement of transactions in international payments. The “net shipments and foreign travel” approach looks at two of these channels. In this approach, the volume of banknotes in circulation outside Germany is derived from the Bundesbank’s household survey on foreign travel and data on cumulated net shipments to international wholesale currency shippers who supply the German-issued euro banknotes to non-euro-area countries.

As part of the balance of payments statistics, the Bundesbank conducts household surveys on how much euro cash Germans take with them when they travel abroad. For more on the methodology used, see also Deutsche Bundesbank (2003, 2005, 2015c) and Bartzsch et al (2011a). Some of the results are shown in Table 2.⁵ Where useful, this information includes breakdowns by cash flows to euro-area countries and non-euro-area countries (ie intra and extra-euro-area cash flows); however, Table 2 only shows the results for total inflows and outflows of euro cash as a result of foreign travel. In 2015, euro cash with a total value of €23.1 billion was taken abroad through foreign travel, of which €13.5 billion went to other euro-area countries and €9.6 billion ended up in non-euro-area countries. Travellers took euro cash totalling €4.8 billion abroad in 2015 and exchanged it for

⁵ As there are no comparable surveys on what euro cash inflows foreign travellers to Germany generate, the latter are estimated based on the assumption that the behaviour of foreign travellers to Germany is similar to that of German travellers abroad. The household survey looks at cash carried, though this is primarily likely to constitute banknotes.

foreign currency there, while they took a total of €18.4 billion abroad and used it for cash payments there. Conversely, travellers brought an estimated €6.7 billion into Germany in 2015. Of that, some €5.3 billion originated in other euro-area countries and €1.4 billion in non-euro-area countries. Overall, a net total of approximately €222 billion flowed abroad through foreign travel up until the end of 2015. By the end of the second quarter of 2016, this figure had increased to just over €228 billion. For reasons of data availability, banknote demand components will be analysed as at end-2015 in the remainder of this study.

**Inflows and outflows of euro cash as a
result of travel in € million**

Table 2

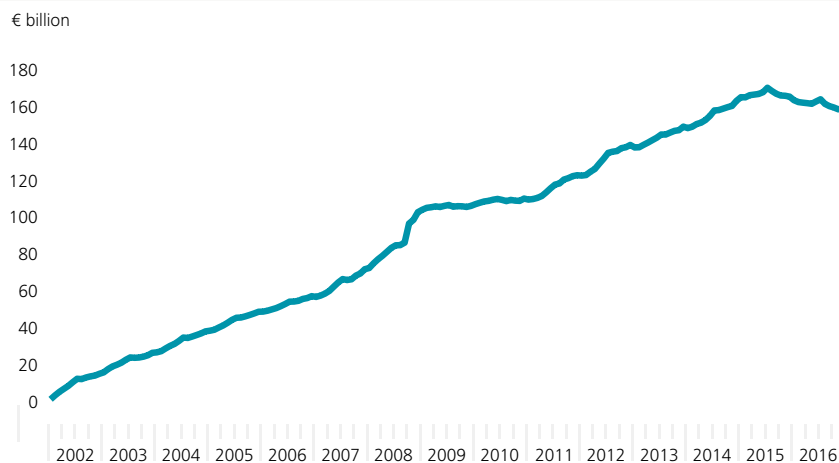
	Cash outflows			Cash inflows	Cash in circulation abroad as a result of travel	
	Total	Euro cash taken abroad and exchanged into foreign currency	Cash payments made abroad using euro imported from Germany	Estimated euro cash imports via travel	Net outflows	Cumulated
2015 Q1	3,975	806	3,169	1,418	2,557	208,228
2015 Q2	5,352	821	4,531	1,798	3,554	211,782
2015 Q3	8,059	1,786	6,273	1,934	6,125	217,907
2015 Q4	5,754	1,373	4,381	1,576	4,178	222,085
2016 Q1	3,972	753	3,219	1,397	2,575	224,659
2016 Q2	5,393	960	4,433	1,756	3,637	228,296

Source: Deutsche Bundesbank.

Another channel via which German-issued euro banknotes migrate abroad are outpayments to banks active in the global market for currency dealing. These banks order euro banknotes from the Bundesbank and ship them to non-euro-area countries, where they are used, for instance, to stock bureaux de change. Flows of banknotes between the Bundesbank and wholesale currency shippers are included in the Bank's accounting system.⁶ Figure 4 shows cumulated net shipments defined as the cumulated difference between the Bundesbank's outpayments to wholesale currency shippers and the latter's inpayments to the Bundesbank.

**Cumulated net shipments as a result of international
banknote wholesale trade**

Figure 4



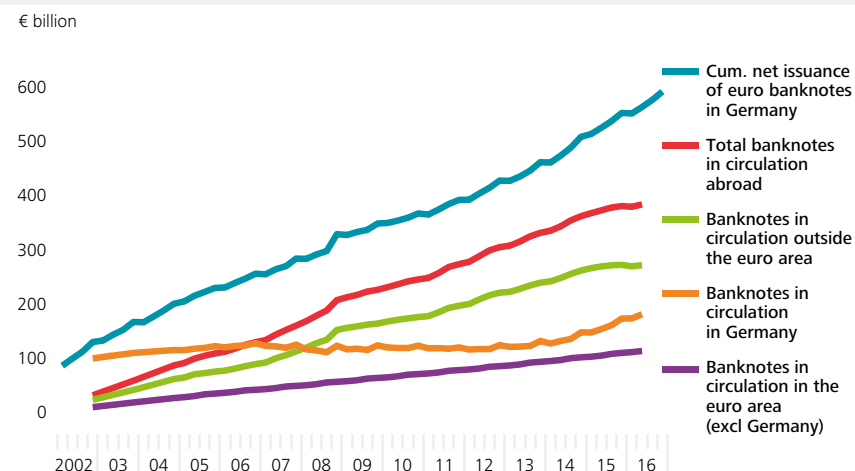
Source: Deutsche Bundesbank.

⁶ The data for 2002 and 2003 are, however, based on a Bundesbank survey among wholesale currency shippers and on information provided by the Bundesbank's branches.

The regional distribution of euro banknotes issued in Germany estimated using this approach is shown in Figures 5 and 6. At the end of 2015, the lion's share of the Bundesbank's cumulated net issuance in the amount of just over €550 billion was thus accounted for by banknotes in circulation abroad, namely €380 billion, or 70% of cumulated net issuance. At roughly €270 billion, or 50% of cumulated net issuance, the majority of banknotes in circulation abroad were outside the euro area. However, Germany was also a major net exporter of euro banknotes to the rest of the euro area via foreign travel, with banknotes with a net value of approximately €110 billion, or 20% of cumulated net issuance, finding their way there. The banknotes in circulation outside the euro area can be attributed to foreign travel and net shipments, with the latter, in cumulative terms, making the largest contribution at just over €158 billion, or 29% of the Bundesbank's cumulated net issuance. The volume of banknotes in circulation in Germany rose somewhat in the first few years after the introduction of euro cash, before standing at roughly €120 billion between 2005 and 2012, with slight fluctuations. Its percentage of cumulated net issuance consequently fell steadily, from 77% at the end of 2002 to 28% at the end of 2013. The volume of banknotes in circulation in Germany did not start picking up again perceptibly until 2013. It is therefore clear that, according to the estimates using the "net shipments and foreign travel" approach, cumulated net issuance of banknotes by the Bundesbank was driven almost exclusively by banknotes in circulation abroad up until the end of 2012, while domestic demand for banknotes for transaction balance and hoarding purposes was roughly constant. This did not change until 2013. Of the entire increase in cumulated net issuance of euro banknotes by the Bundesbank in 2015, to the tune of €45 billion, an estimated €25 billion, or more than half, was attributable to higher domestic demand. In 2014 and 2015, the circulation of banknotes within Germany rose as a percentage of cumulated net issuance. The reasons for the growth in banknotes in circulation in Germany are examined in the following subsection.

Regional distribution of euro banknotes issued in Germany in € billion

Figure 5

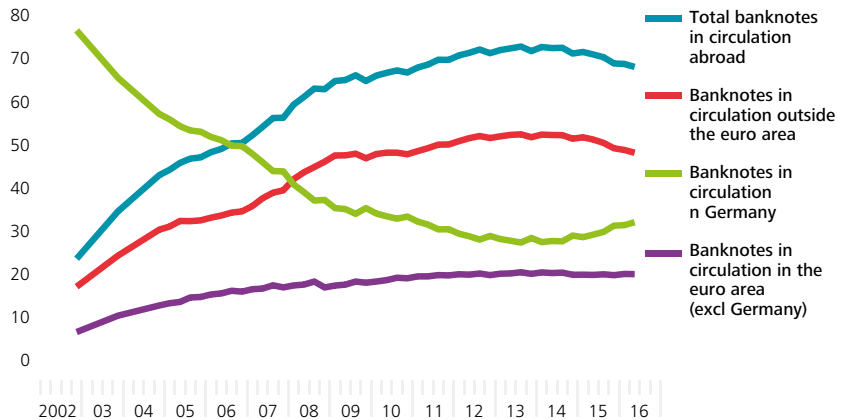


Quarterly data in 2003 and 2004 derived by linear interpolation of the year-end figures for 2002, 2003 and 2004.

Sources: Authors' own calculations and Deutsche Bundesbank.

Regional distribution of euro banknotes issued in Germany as
a percentage of cumulated net issuance by the Bundesbank

Figure 6



Quarterly data in 2003 and 2004 derived by linear interpolation of the year-end figures for 2002, 2003 and 2004.

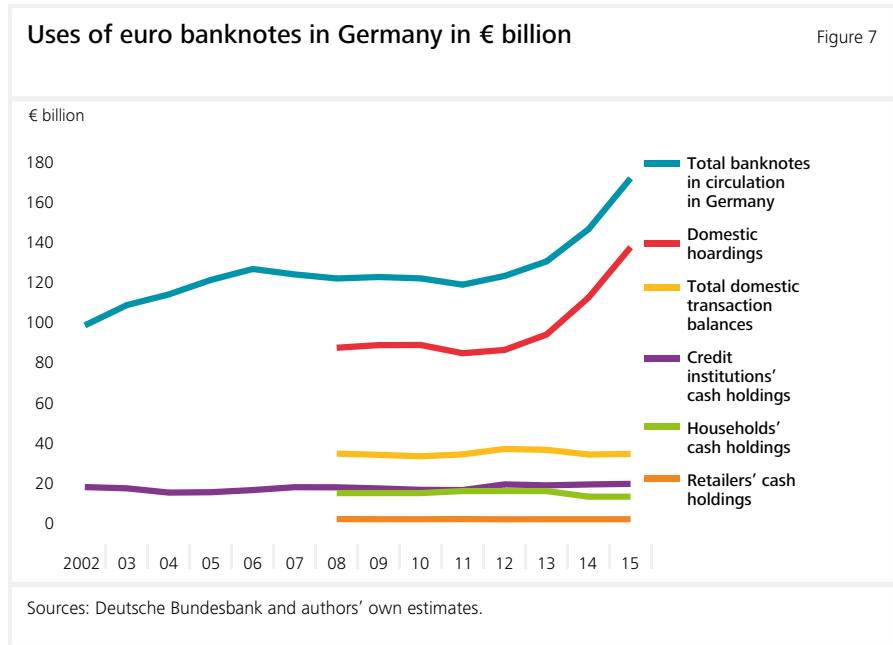
Source: Authors' own calculations.

3.2 Uses of euro banknotes in Germany according to direct approaches

The stock of euro banknotes in Germany held in the form of transaction balances is made up of the cash holdings of credit institutions⁷ and of retailers as well as households' transaction balances.⁸ While credit institutions' cash holdings are statistically recorded at month-end, the cash held by retailers and households has to be estimated; the following estimates are based on Deutsche Bundesbank (2009). For households, this is done using the Bundesbank's payment behaviour studies, for which data were collected for 2008, 2011 and 2014 (Deutsche Bundesbank, 2015b, 2012, 2008). Individuals aged 18 and over were asked how much money they normally withdraw from an ATM, bank cash desk or point of sale, and how much of this cash they have left when they make their next cash withdrawal. Assuming a linear reduction in the withdrawn funds until the next time money is taken out, this yields the average amount of cash that households hold for transaction purposes, albeit only from 2008 onwards. For those years in which no survey was conducted, ie for 2009, 2010, 2012, 2013 and 2015, the transaction balances determined in the last survey are applied. Earlier years are not covered by the payment behaviour study. Consequently, the entire domestic stock of euro banknotes in the form of transaction balances can be determined only from 2008 onwards. Retailers' average cash holdings are derived from consumers' estimated cash spending with retailers and assumptions as to the shipments of daily takings to commercial banks. Cash spending with retailers are estimated by adjusting private consumption for items that are thought to be paid for by cashless means.

⁷ Credit institutions' cash holdings normally stem almost exclusively from regular domestic transactions; see also Bartzsch et al (2011b). At the end of 2016, these cash holdings were approximately €6.5 billion higher than a year earlier. This increase is probably the result of funds being shifted out of the deposit facility, which had a negative interest rate. That would mean that these holdings constituted hoardings, not cash holdings. This development will be relevant going forward, but does not yet affect the estimates presented up until end-2015.

⁸ As Germany is a net exporter of euro banknotes, the value of euro banknotes in circulation in Germany is equal to the volume of euro banknotes issued in Germany in circulation within the country. In other words, demand for euro banknotes in Germany is completely covered by the Bundesbank's cumulated net issuance.



Domestic hoardings are calculated as the residual of the difference between the volume of banknotes in circulation outside Germany and the domestic transaction balances. The components of banknotes in circulation in Germany estimated in this way are shown in Figures 7 and 8.

Domestic transaction balances amount fairly consistently to approximately €35 billion and are made up, in roughly equal parts, of credit institutions' and households' cash holdings. Retailers' cash holdings are consistently just under €2 billion and consequently have barely any impact. The bulk of banknotes in circulation in Germany represent hoardings. These were roughly €90 billion in 2008 to 2013. After that, they rose considerably, namely by just under €20 billion in 2014 and some €25 billion in 2015. The increase in banknotes in circulation in Germany is therefore attributable solely to the growth in hoardings. In turn, the vast majority of

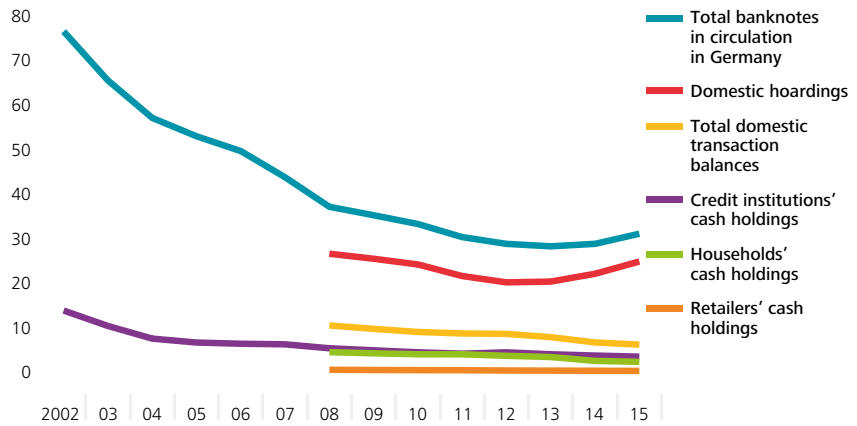
domestic hoardings probably constitute cash hoarded by households.

The sharp increase in domestic hoardings in 2014 and 2015 estimated here is problematic for the following reasons. First, households' bank deposits have not – with just a few exceptions – been subject to negative interest rates hitherto. This would suggest that the interest rate environment has not yet prompted a shift out of bank deposits into cash, particularly as this would also entail costs such as fees for renting a safe deposit box or the cost of buying a safe. Second, the sharp rise in domestic hoardings could be the result of an estimation error. Under the “net shipments and foreign travel” approach, domestic hoarding is calculated as the difference between the estimated total volume of banknotes in circulation outside Germany and the estimated domestic transaction balances. The volume of the domestic transaction balances can be estimated relatively reliably. It has a low absolute value which hardly changes over time. By contrast, the volume of banknotes in circulation outside Germany is very large. Estimating its size is fraught with a degree of uncertainty as this estimation approach does not capture every channel through which cash is imported and exported. For instance, a lack of statistical data means that cash remittances by foreigners are not considered. The direct estimates presented here, therefore, might underestimate the volume of German-issued euro banknotes in circulation abroad.

Ultimately, estimates of the domestic hoardings derived as a residual are associated with relatively large uncertainties. This is particularly true of the annual changes in domestic hoardings at the current end, which are important for assessing the question of whether the current low-interest-rate environment has caused banknote hoarding to increase. The aim is therefore to establish an alternative, more reliable estimate for the time series of domestic hoardings. This is done in the next section using what is referred to as the “seasonal method”.

Uses of euro banknotes in Germany as a percentage of
cumulated net issuance by the Bundesbank

Figure 8



Quarterly data in 2003 and 2004 derived by linear interpolation of the year-end figures for 2002, 2003 and 2004.
Source: Authors' own calculations.

4 Components of banknote demand using the seasonal method

4.1 Methodological considerations

Unlike the “net shipments and foreign travel” approach, the seasonal method to determine banknote demand components is an indirect rather than direct estimation approach, ie it is not based on available statistics or surveys. Instead, the aim of the seasonal method is to filter out information about banknotes in circulation outside Germany from the seasonality of banknote circulation. For this purpose, it is assumed that the volume of banknotes in circulation outside Germany has little or no seasonality. Hence, the stocks of banknotes in circulation in Germany and abroad exhibit different seasonal patterns, with the seasonal term for the total volume of banknotes in circulation being dampened by the stock circulating abroad. The individual components of Bundesbank-issued banknotes can be derived using various estimates of the unknown seasonal term for the volume of banknotes circulating in Germany. The main features of the seasonal method can be traced back to Sumner (1990), who applied it to investigate the transaction and hoarding balances for the US dollar. The calculations on banknote demand components that are performed in this paper using the seasonal method are an extrapolation of the results presented in Bartzsch et al (2011b), who analyse the period 2002-09, to the end of 2015. Other papers which apply the seasonal method include Seitz (1995), Porter and Judson (1996) and Judson (2012).

The starting point for the seasonal method is the following multiplicative seasonal model of a time series; see Bartzsch et al (2011b).

$$T_t S_t = T_t^d S_t^d + T_t^a S_t^a \quad (1)$$

where T_t stands for the trend component and S_t the seasonal term at time t . Furthermore, the superscript indices d and a indicate an additive decomposition of the overall time series $T_t S_t$ into the components $T_t^d S_t^d$ and $T_t^a S_t^a$, with d standing for

“domestic” and a for “abroad”. In addition, β_t denotes the share of the overall trend held domestically d , ie $T_t^d = \beta_t T_t$ and $T_t^a = (1 - \beta_t) T_t$. Thus, equation (1) can be reformulated as follows:

$$S_t = \beta_t S_t^d + (1 - \beta_t) S_t^a \quad (2)$$

To solve equation (2), the seasonal term S_t is first determined using standardised seasonal adjustment approaches and $S_t^a = 1$ is assumed throughout. The seasonal term for a suitable reference variable is used in each case for the unknown seasonal term S_t^d . The choice of reference variables is explained in greater detail in Bartzsch et al (2011b). This paper subscribes to the choice of reference variables in Bartzsch et al (2011b), as these reference variables are established and their use ensures continuity in the estimates of banknote demand components. In practice, determining the volume of banknotes in circulation outside the euro area, of banknotes in circulation abroad within the euro area, of domestic hoardings and of domestic transaction balances as a percentage of the total arithmetical stock of Bundesbank-issued euro banknotes in circulation is a three-step process, with components d and a each being defined differently.

In a **first step**, the component $T_t^d S_t^d$ covers the volume of banknotes circulating in Germany and abroad within the euro area, while the component $T_t^a S_t^a$ denotes the volume circulating outside the euro area, resulting in equation (3).

$$S_t = \beta_t^{T+H+EWU} S_t^{T+H+EWU} + (1 - \beta_t^{T+H+EWU}) S_t^{RW} \quad (3)$$

The superscript T is a symbolic representation of transaction balances, while H stands for hoarding, EWU for the volume of banknotes circulating in the rest of the euro area and RW for the volume of banknotes circulating in the rest of the world. The superscript symbol “+” indicates that the aggregate of each of the components forms part of the equation. The seasonal term $S_t^{T+H+EWU}$ is unknown and is

approximated by the seasonal term of French banknote circulation. France and Germany are indeed likely to be very similar in terms of their economic structure and probably play similar roles with respect to banknote migration within the euro area, be it in connection with foreign travel or via other channels. That said, the Bundesbank plays a special role when it comes to demand from non-euro-area countries owing to the fact that, in net terms, the bulk of the Eurosystem's cumulated net issuance derived from international banknote wholesale trade comes from Germany (Bartzsch et al, 2011b).

In a **second step**, the volume of Bundesbank-issued banknotes in circulation is broken down into the total volumes of banknotes in circulation in Germany and abroad; see equation (4).

$$S_t = \beta_t^{T+H} S_t^{T+H} + (1 - \beta_t^{T+H}) S_t^{EWU+RW} \quad (4)$$

Private consumption is the chosen reference variable for the unknown seasonal term in Germany, S_t^{T+H} . The reason for this is that private consumption is a typical explanatory variable in a banknote demand model for banknotes in domestic circulation.

In a **final step**, transaction balances as a percentage of the total volume of Bundesbank-issued euro banknotes in circulation are determined; see equation (5).

$$S_t = \beta_t^T S_t^T + (1 - \beta_t^T) S_t^{H+EWU+RW} \quad (5)$$

Here, credit institutions' cash holdings are used as the reference variable. In the period under review (2002-15), credit institutions' cash holdings served as households' extended transaction balances, as banks stocked as much euro cash as they needed to supply to households. Furthermore, retailers also deposit more cash at credit institutions in periods during which transaction balances for cash spending

are particularly high.

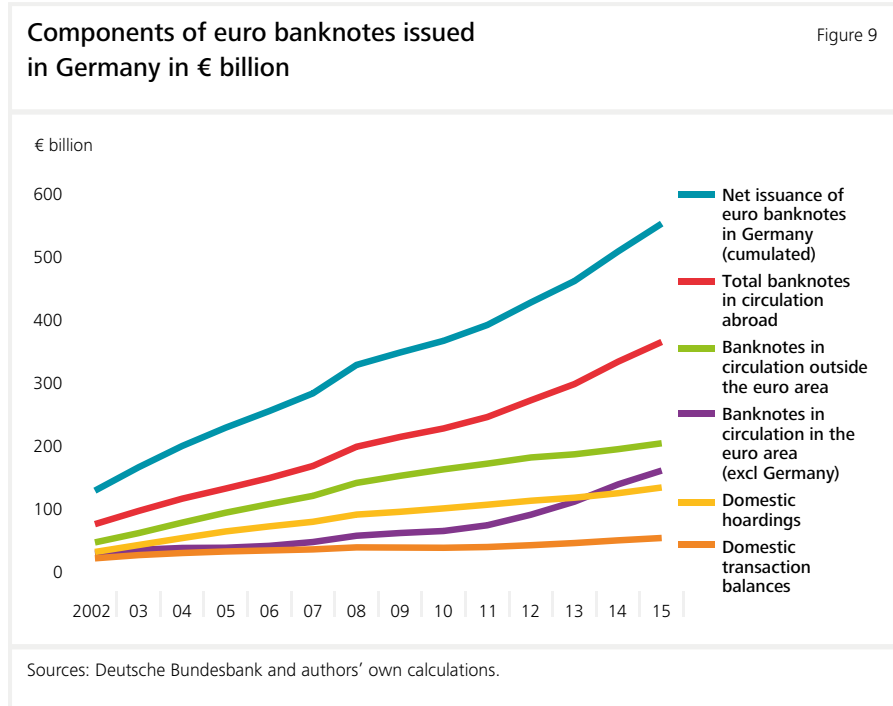
A key assumption of the seasonal method is that the volume of banknotes in circulation outside Germany and domestic hoardings have no seasonality. This assumption can be tested for a special case, as monthly data for the Bundesbank's cumulated net issuance derived from international banknote wholesale trade are available; see Table 3. A regression of cumulated net shipments on seasonal dummies shows that these are not significantly different from each other. Furthermore, there is no notable partial correlation of a time series value with the prior-year value. Both these points suggest that the volume of banknotes in circulation outside Germany does indeed have very little seasonality to speak of.

Seasonality tests			Table 3
	Test for deterministic season	Partial year-on-year autocorrelation	
Circulation of Bundesbank-issued euro banknotes	5.047 (0.000)	0.39	
Cumulated net shipments	0.39 (0.959)	-0.03	
Notes: Each of the time series shows a trend that has been removed by applying the Hodrick-Prescott filter (Hodrick and Prescott, 1997), where $\lambda=14,400$. The test for deterministic seasonality tests the equality of seasonal dummies after regressing the time series on seasonal dummy variables. Shown here are the F-test value and the associated p-value, the latter in brackets. Monthly data for 2002 to 2015 were used. Source: Authors' own calculations.			

Applied in practice, attempting to determine the share β_t for each calendar month t using equation (2) proves to be overly ambitious. If there is no seasonal influence in a given period, ie $S_t = S_t^d$, the share β_t cannot be determined using equation (2). In addition, individual months in which the seasonal term S_t^d is less pronounced than that of the total volume of banknotes in circulation yield potentially implausible values for β_t . In summary, equation (2) delivers plausible results for certain months but not all; see also Bartzsch et al (2011b) and Porter and Judson (1995). For this reason, it is advisable to move to an approach based on seasonal amplitude. To do this, the time index t first needs to be replaced by the index m, l , with m standing for the month and l for the year. The circulation of Bundesbank-issued euro banknotes typically experiences a seasonal high in December and a seasonal low in February. Deducting equation (2) for February from that for December of the previous year, the share β_l is determined as

$$\beta_l = \frac{S_{dec,l} - S_{feb,l+1}}{S_{ec,l}^d - S_{feb,l+1}^d} \quad (6)$$

One particularity that should be noted here is that statistical data on private consumption are only published quarterly. Equation (6) is applied in the same manner here – with a seasonal high in the fourth quarter and a seasonal low in the first quarter.

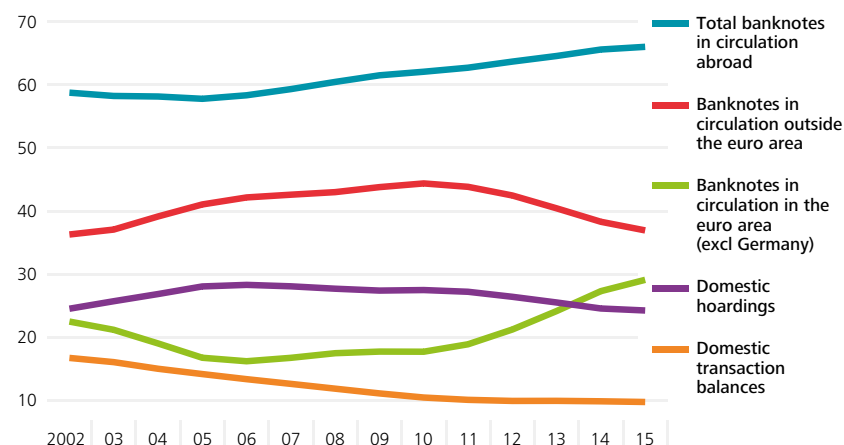


4.2 Banknote demand components using the seasonal method

The results of the estimates determined using the seasonal method are depicted in Figures 9 and 10. They show that the total volume outside Germany of euro banknotes brought into circulation by the Bundesbank amounted to €365 billion at the end of 2015 – an estimate which corresponds very closely to the €380 billion estimate calculated using the “net shipments and foreign travel” approach. The two approaches therefore come to similar conclusions regarding the volume of banknotes in circulation both in and outside Germany, and the same can be said of the trends for these time series over time. Major differences exist with respect to the regional distribution of banknotes in circulation outside Germany. According to the seasonal method, the volume of banknotes in circulation in the rest of the euro

Components of euro banknotes issued in Germany as a percentage of cumulated net issuance by the Bundesbank

Figure 10



Sources: Deutsche Bundesbank and authors' own calculations.

area stood at €160 billion at the end of 2015, which is significantly higher than the €110 billion estimated using the “net shipments and foreign travel” approach. The opposite is true in the case of the stocks of banknotes in circulation outside the euro area.

As was the case for the direct “net shipments and foreign travel” approach presented in Section 3, domestic transaction balances have a flat trend line. They amounted to around €55 billion at the end of 2015 – approximately €20 billion higher than the estimate calculated using that approach. However, this difference has barely any impact when measured against the share of cumulated net issuance by the Bundesbank. At the current end, both approaches arrive at the same estimates for domestic hoardings, ie just under €140 billion. That said, while domestic hoardings rose sharply in 2014 and 2015 based on the “net shipments and foreign

travel” approach, they have shown a steady, slight upward trend since 2010 when calculated using the seasonal method. Applying the seasonal method, there is therefore no structural break in domestic hoardings brought about by the low-interest-rate environment. Instead, this approach suggests that stocks of German-issued euro banknotes in other euro-area countries have risen considerably in recent years. Over the past few years, this component has made the greatest contribution by far to growth in the Bundesbank’s cumulated net issuance of euro banknotes.

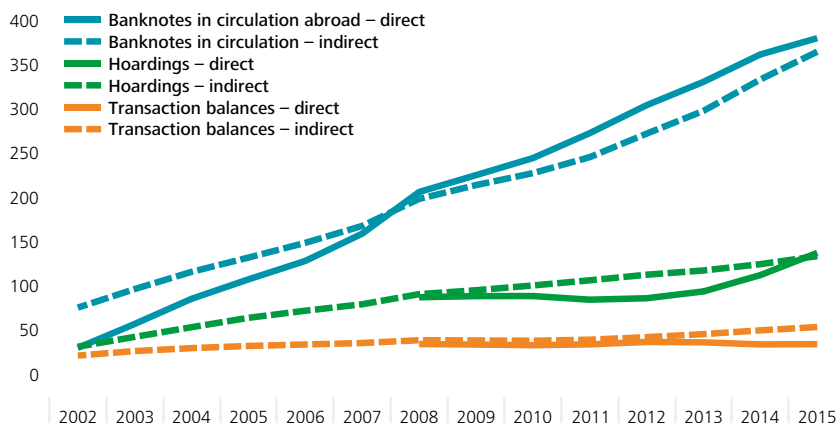
5 Combination of estimates using direct approaches and the seasonal method

This paper uses the “net shipments and foreign travel” and “seasonal method” approaches to determine banknote demand components. These are the most appropriate methods for estimating the components of the arithmetical stock of Bundesbank-issued euro banknotes in circulation. Other approaches only allow the interpretation of upper and lower bounds or the estimation of a few components at most; see also Bartzsch et al (2011a, 2011b). There is no consensus in the literature about the relative merits of direct and indirect approaches; Judson (2012) and Feige (2012), using indirect and direct approaches, arrive at different estimates for the scale of foreign demand for US currency. Direct approaches for determining the stock of banknotes in circulation abroad are based on capturing statistically as many as possible of the channels through which banknotes can flow abroad. The seasonal method presented here, meanwhile, is based on an appropriate selection of reference variables for the unknown seasonal term of banknotes in circulation in Germany; the assumptions made under this method ultimately cannot be verified empirically. Direct and indirect approaches yield comparable results for the stock of Bundesbank-issued euro banknotes in circulation; see the overview in Figure 11. The main differences between direct and indirect approaches can be found in the breakdown of banknotes in circulation abroad into non-euro-area countries and euro-area countries, which is not shown in Figure 11.

Overview of estimates

Figure 11

€ billion



Source: Authors' own calculations.

Finally, the paper presents a new estimate for the components of the stock of Bundesbank-issued euro banknotes in circulation, which is based on both approaches; see Table 4. Estimation intervals are used in Table 4 to show the shares of the banknote demand components, with the poles of these intervals being based on the estimates of one of the two approaches. Table 4 also contains an estimate of the stock at the end of 2016, which is calculated by weighting the arithmetical volume of banknotes in circulation for the end of 2016 with the estimated shares for 2015. All estimated figures are rounded to a multiple of 5 to articulate the uncertainty surrounding the estimates. Both approaches come to comparable results at the current end for the scale of banknote hoarding in Germany, but suggest that their patterns differ over time. Due to the presumption that the direct approach might fail to capture a notable volume of banknotes taken abroad, the seasonal method is used to estimate how banknote hoarding develops over time.

Components of Bundesbank-issued banknotes in circulation

Table 4

	Share end of 2015 (%)	Stock end of 2015 (€ billion)	Stock end of 2016 ^a (€ billion)
Total circulation abroad	65 – 70	365 – 380	385 – 415
of which outside euro area	40 – 50	210 – 270	235 – 295
of which rest of euro area	20 – 30	110 – 160	120 – 180
Circulation in Germany	30 – 35	170 – 190	180 – 205
of which hoarded	25	135	150
of which transaction balances	5 – 10	35 – 55	30 – 60
Total circulation		553	592

^aExtrapolating the components of banknote demand with shares as at the end of 2015.
Source: Authors' own calculations and Deutsche Bundesbank.

6 Conclusion and discussion

This paper presents a breakdown of the arithmetical stock of Bundesbank-issued euro banknotes in circulation into the components of foreign demand, domestic hoarding and domestic transaction balances. These components are estimated using the direct approach “net shipments and foreign travel” as well as the “seasonal method”. Overall, at the end of 2015, 65% to 70% of the stock of banknotes issued by the Bundesbank were in circulation abroad, with 40 to 50 percentage points in countries outside the euro area and 20 to 30 percentage points in other euro-area countries. 25% of the Bundesbank-issued banknotes in circulation were hoarded in Germany, and 5% to 10% were domestic transaction balances.

The estimates presented here show the development of cash usage in Germany throughout the period since euro cash was introduced. Of particular interest is the question whether the current low-interest-rate environment has led to a distinct increase in banknote hoarding in Germany. Where the direct approach is used to estimate hoardings as a residual at the current end, there is indeed evidence of an increase in banknote hoarding. However, the use of direct approaches to estimate foreign demand requires every last channel via which banknotes migrate abroad to be captured. Estimates based on the seasonal method do instead suggest that banknote hoarding in Germany has developed smoothly despite the low-interest-rate environment. Rather, the seasonal method points to a rise in the stock of Germany-issued euro banknotes circulating in the rest of the euro area.

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A man with glasses, wearing a dark suit, white shirt, and blue striped tie, is speaking at a podium. He is holding a small black device in his right hand and gesturing with his left hand. The podium has a white front panel with the text "DEUTSCHE BUNDESBANK" and "PROSYSTEM" visible. The background is a light-colored wooden wall.

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Nikolaus Bartzsch

Transaction balances of small denomination banknotes: findings from the introduction of ES2



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Abstract

At the end of 2015, the Deutsche Bundesbank had issued a total net amount of just over €45 billion in €20 banknotes. In statistical terms, each resident living in Germany was therefore issued with around 30 banknotes of this denomination. Up until now, it was not clear how many of these German-issued euro banknotes are actually used for payment purposes. Owing to the introduction of the new Europa series of banknotes on 25 November 2015, it was possible to estimate the volume of €20 banknotes that are held for transaction purposes both in Germany and outside the euro area.

The estimation of the volume of €20 banknotes held for domestic transaction purposes (known as the domestic transaction balance) is primarily based on the observed return flows of the old series (ES1) of €20 banknotes received by the Deutsche Bundesbank. The cash balance of €20 banknotes held for domestic transaction purposes was estimated at around €8.5 billion at the end of October 2015. This means that only 19% of the total (net) amount of €20 banknotes issued by the Deutsche Bundesbank up to the end of October 2015 were used for transaction purposes within Germany. The remaining 81% has either migrated abroad, been hoarded or got lost. The results of the analysis are also important as a means of explaining the just over €36 billion worth of ES1 €20 banknotes which are still outstanding in the Deutsche Bundesbank's balance sheet. Given that the cash balance held for domestic transaction purposes has since been almost fully replaced, it is no longer to be expected that ES1 banknotes will flow back to the Deutsche Bundesbank in any sizeable amounts.

The volume of German-issued €20 banknotes – officially stemming from banknote shipments by the Deutsche Bundesbank – held for transaction purposes outside the euro area was estimated at just over €3 billion at the end of July 2016 using the biometric method. This estimate represents a lower level for the actual cash balance held for transaction purposes, as it does not incorporate banknote exports resulting from foreign travel and cash amounts sent abroad. It is derived from cumulated shipments of ES2 €20 banknotes up to the end of July 2016 and the value of the ES1 and ES2 €20 notes deposited in July 2016 at the shipment branches. In terms of the Deutsche Bundesbank's cumulated net shipments of €20 banknotes in the amount of around €12 billion at the end of 2015, the estimated cash balance (resulting from shipments) held for transaction purposes outside the euro area accounts for around 28%.

1 Introduction

At the end of 2015, the Deutsche Bundesbank had issued a total net amount of around €45 billion in €20 banknotes (German-issued €20 notes). In statistical terms, each resident living in Germany was therefore issued with 30 banknotes of this denomination. Even though cash is still the most commonly used means of payment at the point of sale in Germany, the total number of issued banknotes still seems very high. Presumably, only part of this amount is actually used for payment purposes in Germany (known as the “domestic transaction balance”). The rest may either have been lost, hoarded on a permanent basis or may be in use abroad for transaction and hoarding purposes.

The fact that it is not possible to equate the cumulated net issues of a euro-area country with the national volume of cash in circulation in that country also becomes evident when making international comparisons (Figure 1).

The Deutsche Bundesbank’s cumulated net issues of €20 notes have been steadily increasing since 2002. The Deutsche Bundesbank therefore issues more €20 banknotes than it receives through inpayments. Conversely, the cumulated net issues of the (entity of) other Eurosystem member countries are steadily declining; in these countries, more banknotes are paid in in the form of deposits than are paid out. A significant share of German-issued banknotes therefore flows out of Germany either through tourists or business travellers, and is deposited by resident commercial banks at other Eurosystem central banks. The Deutsche Bundesbank is therefore making a sizeable contribution to the supply of cash in the Eurosystem and also to the seigniorage revenues of the other central banks.

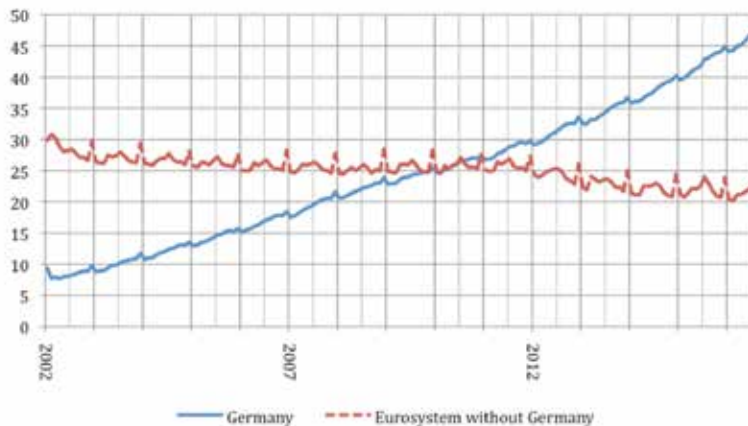
This raises the question as to how high the volume of €20 banknotes that are in active circulation in Germany actually is. According to our estimates, the value of the total domestic transaction balance lies between €35 billion and €55 billion. This equates between 5% and 10% of the Deutsche Bundesbank’s cumulated net

issues. Calculations for individual denominations are much more difficult as, depending on the face value, banknotes are not all equally suitable for transaction purposes or as a store of value and are also subject to varying degrees of demand from other countries.

In the following, the transaction balances of €20 banknotes are examined in greater detail both in Germany (section 2) as well as outside the euro area (section 3) with the help of data obtained during the introduction of the new Europa series of banknotes (ES2). The results are summarised in section 4.

Cumulated net issuance of €20 banknotes (in € billion)

Figure 1



Source: CIS II.

2 The volume of €20 banknotes held for transaction purposes in Germany

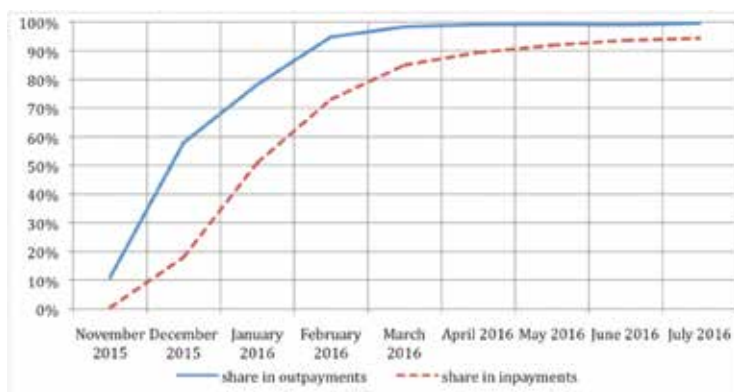
2.1 Replacement of the old ES1 banknotes

The Deutsche Bundesbank has been putting the new ES2 €20 banknotes into circulation in Germany since 25 November 2015. Figure 2 shows *inter alia* the **share of the new ES2 banknotes in relation to the Deutsche Bundesbank's gross monthly outpayments**. Since April 2016, this share has stood at roughly 99%. Accordingly, ES1 €20 banknotes have accounted for a share of around 1% of gross outpayments since then. Only remaining stocks of ES1 €20 banknotes are paid out again. ES1 €20 banknotes that flow back to the Deutsche Bundesbank are filtered out during processing and destroyed.

Figure 2 also shows **the share that is accounted for by the new ES2 notes in relation to the Deutsche Bundesbank's gross monthly inpayments**. Inpayments made at the Deutsche Bundesbank can be assumed to be a representative sample of the cash in circulation in Germany. These inpayment data therefore provide information about the extent to which the ES1 €20 banknotes have already been replaced with ES2 banknotes (and the last batch of banknotes issued from the first series). In July 2016 the new series has accounted for a share of around 95% of the gross inpayments at the Deutsche Bundesbank. This means that the share of ES2 banknotes held for domestic transaction purposes was roughly the same as the share of these banknotes that was paid out in the last few months (99%). During the period following the launch of the ES2 banknotes at the end of November 2015 up until July 2016, the volume of €20 banknotes held for transaction purposes in Germany therefore appears to have been almost completely replaced.

€20 ES2 banknotes as a share in the Deutsche Bundesbank's gross inpayments and outpayments of total €20 banknotes

Figure 2



Source: CIS II.

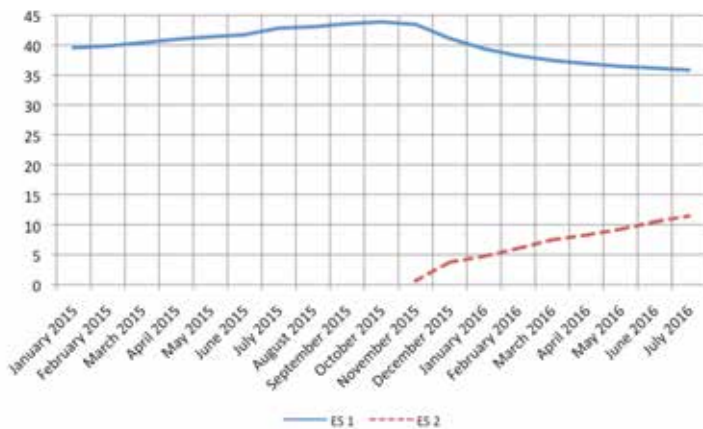
In order to determine how many €20 banknotes are in active circulation in Germany, we calculate how many banknotes flowed back to the Deutsche Bundesbank between the end of October 2015 and the end of July 2016. Given that Germany is a net exporter of €20 banknotes (see Figure 1), only a small amount of foreign banknotes end up in Germany. The return flows to the Deutsche Bundesbank are therefore primarily banknotes from the domestic cash cycle. By adding up these return flows over time, these data can be used to estimate the domestic transaction balance. The sum of the return flows can be determined using the Deutsche Bundesbank's cumulated net issues. Figure 3 shows the development of the Deutsche Bundesbank's cumulated net issues, with separate curves for the old and the new series of €20 banknotes. Between the end of October 2015 and the end of July 2016, the cumulated net issues of ES1 banknotes declined from €43.9 billion to €35.8 billion. During this period, the Deutsche Bundesbank therefore withdrew a net amount of around €8.1 billion old ES1 banknotes from circu-

lation and replaced them with ES2 notes. If it is also taken into consideration that, owing to the parallel issuance of ES1 and ES2 banknotes, around 5% of (active) domestic circulation is still accounted for by ES1 notes that have not yet been replaced by ES2 notes, the calculated €8.1 billion makes up around 95% of the domestic transaction balance. **Based on this calculation method, the domestic transaction balance contains around €8.5 billion (= €8.1 billion divided by 0.95) worth of €20 banknotes. Of the total amount of €43.9 billion German-issued €20 banknotes in circulation at the end of October 2015, only around 19% were accounted for by the domestic transaction balance.** Each resident living in Germany therefore keeps an average of five €20 banknotes for transaction purposes and not 30 banknotes as estimated on the basis of the net issues.

Since the introduction of the new series of €20 banknotes at the end of November 2015, the total value of these notes has increased from €0 to €11.4 billion. Assuming a relatively constant transaction balance of €8.5 billion, just over 70% of the ES2 €20 banknotes brought into circulation by the Deutsche Bundesbank were in the domestic transaction balance at the end of July 2016.

Cumulated net issuance of €20 banknotes by the Deutsche Bundesbank (in € billion)

Figure 3



Source: CIS II.

2.2 Conclusion

The cash balance of €20 banknotes held for domestic transaction purposes was estimated at around €8.5 billion at the end of October 2015. This means that only 19% of the total amount of €20 banknotes issued by the Deutsche Bundesbank up to that point were in active circulation in Germany. Each resident living in Germany accounted for approximately five €20 banknotes for transaction purposes, and not 30 banknotes as estimated on the basis of the net issues.¹

The calculations are largely in line with our estimations regarding the share of the total domestic transaction balance accounted for by banknotes in relation to the Deutsche Bundesbank's cumulated net issues, which stands at between 5% and 10%. By comparison, the estimated share of €20 banknotes held for transaction purposes in Germany (approximately 19%) seems quite plausible given that the €20 note is a denomination typically used for payment.

Furthermore, the analysis clearly shows that it is not possible to equate the Deutsche Bundesbank's cumulated net issues with the volume of cash in active circulation in Germany, ie the volume of cash held for domestic transaction purposes. This should be borne in mind, especially when assessing the level of market penetration of the new banknote series. The cumulated net issues could, for instance, lead one to assume that just over €36 billion in ES1 banknotes are still in

¹ With regard to the five €20 notes in the transaction balance accounted for by each resident living in Germany on average, it should be noted that the domestic transaction balance is not only accounted for by households, but also includes the cash holdings of credit institutions and the volume of change held by retailers. According to our estimates, the domestic cash transaction balance had a value of at least €35 billion in 2015. €13 billion of this amount was accounted for by households, just under €20 billion by the cash holdings of credit institutions and only just under €2 billion by the volume of change held by retailers; the latter can therefore be disregarded. The cash holdings of credit institutions, on the other hand, arise almost exclusively from domestic transactions. They can therefore be interpreted as an external component of the transaction balance of domestic households (Bartzsch, Rösl and Seitz, 2011b, subsection 2.2.2). When considering the domestic cash transaction balance, coin holdings can be disregarded as they only account for an estimated value of around €2 billion (Altmann and Bartzsch, 2014).

active circulation in Germany, whereas in actual fact, these banknotes were taken out of the German cash cycle quite some time ago. A large share of these notes has migrated abroad and has been paid in at other central banks or will at some stage be paid in at these central banks (see Figure 1). A further share may have been permanently hoarded or lost. It is therefore better to use the inpayment flows at the Deutsche Bundesbank when assessing the level of market penetration of the new series, with the new series currently accounting for a share of just under 95%.

2.3 Review of the estimates

Finally, the estimates of domestic transaction balances of (all of the) small denominations (see Table 2 in section 4) shall be compared with similar estimates from the Deutsche Bundesbank's study of payment behaviour (Deutsche Bundesbank, 2015). Both estimates are juxtaposed in Table 1.

The estimates from the payment behaviour study refer to transaction balances held by *households*. In order to make these estimates comparable with *total* domestic transaction balances (households, credit institutions and retail trade) from Table 2, the latter are multiplied by the estimated percentage share of the total transaction balances of *households*, ie comprising all denominations, in the total domestic transaction balances, ie comprising all denominations. The transaction balances of households derived from this can be taken from the penultimate row of Table 2. They are about twice as high as the transaction balances of households reported in the 2014 payment behaviour study; see last row of Table 1. One explanation for this discrepancy is that the estimate with the payment behaviour study only captures balances held in *wallets* but not total regular cash withdrawals for transaction purposes. In the absence of data on composition by denomination, only an estimated value for households' total transaction balances, ie comprising all denominations, can be derived for withdrawals. For all three waves of Deutsche Bundesbank's payment behaviour survey, this estimated value is around twice as high as the estimated value derived from the stock of cash held in wallets.

Comparison between estimates on domestic transaction balances and estimates based on the 2014 payment behaviour study				Table 1
	€5 banknote	€10 banknote	€20 banknote	
Domestic transaction balances according to the estimate from Table 2	€1.8 billion	€4.0 billion	€8.5 billion	
Estimated households' transaction balances as a percentage of total domestic transaction balances (across all denominations in each case)	44% (end-2013)	38% (end-2014)	38% (end-2015)	
Derived households' transaction balances according to the estimate from Table 2	€0.8 bn (= 0.44 * €1.8 bn)	€1.5 bn (= 0.38 * €4.0 bn)	€3.2 bn (= 0.38 * €8.5 bn)	
Households' transaction balances in their wallets according to the 2014 payment behaviour study	€0.4 billion	€1.0 billion	€1.5 billion	
Sources: Deutsche Bundesbank and author's own estimates.				

On balance, the estimates of domestic transaction balances from Table 2 are a very good fit with the estimates of households' transaction balances derived from the study on payment behaviour.

2.4 Outlook

Whether the approach outlined in this paper could also be used to calculate the volume of cash held for domestic transaction purposes in other euro-area countries would have to be examined on a case-by-case basis. The calculations are based on the assumption that the domestic demand for euro banknotes is fully met by the Deutsche Bundesbank's cumulated net issues. This approach is therefore only suitable for countries that are net exporters of €20 banknotes. This assumption is plausible in the case of Germany as Germany has, over time, issued just under 68% of the current aggregate demand for €20 banknotes (see Figure 1) which is a

disproportionately high share. This assumption is not true of other countries, however. As soon as the remaining denominations of the ES2 series have been brought into circulation in Germany, the volume of banknotes held for domestic transaction purposes is also to be calculated for these denominations using the method presented in this paper.

3 Volume of German-issued €20 banknotes held for transaction purposes outside the euro area

3.1 The biometric method

The early 1990s saw the launch of a new series of US dollar banknotes featuring a security thread. Back then, Porter and Judson took advantage of this opportunity to estimate the volume of \$50 and \$100 notes in circulation abroad.² The introduction of the ES2 €20 notes, which were issued for the first time on 25 November 2015, was similarly used to gauge the volume of German-issued €20 banknotes (ie notes brought into circulation by the Deutsche Bundesbank) outside the euro area. To this end, use was made of the “biometric” method, originally devised by the Danish biologist Carl Petersen. Biologists are often confronted with the problem of not knowing the size of the total population N (eg the number of fish in a lake). By marking newly added fish of population size M and taking a random sample from the lake some time later it is, however, possible to produce a ratio estimator. This allows a conclusion to be drawn concerning the size of the population N .

3.2 Estimation procedure

Measuring the volume of cash in circulation presents a similar problem inasmuch as the volumes circulating in Germany and abroad are not known.³ The biometric

² See Porter and Judson (1996).

³ However, Bartzsch, Rösl and Seitz (2011a, 2011b) have demonstrated that Germany is a net exporter of euro banknotes both to other euro-area countries and to non-euro-area countries.

method can be used to estimate the volume of German-issued €20 banknotes held for transaction purposes outside the euro area (non-euro-area countries), the intrinsic assumption being that these notes are in free and random circulation.⁴ **The biometric method can therefore only capture the volume in circulation in the strict sense, that is German-issued €20 notes held for transaction purposes that are actually in circulation in non-euro-area countries, and not those being hoarded in these locations.** The term “hoarded banknotes” refers to notes that return to branches at a much slower pace than notes in circulation in the narrower sense. This definition encompasses not just notes used as a long-term or temporary store of value but also notes that have gone astray or been destroyed.⁵ If, as presumed, the notes are circulating in an unhindered and random fashion, after some time the share of marked banknotes in the random sample matches the share of marked banknotes among the population as a whole.

$$\frac{M}{N} = \frac{m}{n} \quad (1)$$

M denotes the collective value of all marked notes (ES2 €20 banknotes). n represents the value of all €20 notes belonging to the random sample while m denotes the value of all marked €20 notes included in that sample. If these volumes are broken down according to the value of all German-issued €20 notes belonging to shipments held in non-euro-area countries for transaction purposes, N , this results

⁴ See Porter and Judson (1996, p 893). For a more precise account Porter and Judson (1995, section 3.2). Since Germany is a member state of the European monetary union, the term “abroad” refers to two categories of country: other euro-area countries and non-euro-area countries. In this context, the biometric method therefore takes a different approach to that deployed by Porter and Judson for the United States.

⁵ Banknotes paid in to the Deutsche Bundesbank via shipments stem either from the volume of cash held for transaction purposes or from temporary hoarding. The problem here is that it is not possible to visibly discern whether a given note belongs to the former or latter category.

in the following:

$$N = \frac{m}{n} M \quad (2)$$

Variables n , m and M on the right-hand side of equation (2) refer to “shipments”. This term refers to all €20 banknotes paid in to branches of the Deutsche Bundesbank via official deliveries of banknotes to countries outside the euro area or any such notes brought into circulation by these branches.⁶ In other words, the random samples n and m are only taken from branches handling shipments (**shipment branches**). The above works on the assumption that banknotes in these random samples (forming part of a shipment) were brought into circulation by the *Deutsche Bundesbank* (and not other Eurosystem central banks). This assumption can be justified by the fact that the vast majority of shipments occurring within the Eurosystem are handled by the Deutsche Bundesbank. Shipment branches thus comprise branches that strive to satisfy not just the demand coming from within Germany and from other euro-area countries but also from non-euro-area countries alike. In order of importance, these are first and foremost the Deutsche Bundesbank’s branches in Frankfurt am Main and Mainz, followed by its branches in Freiburg and Villingen-Schwenningen (which “replaced” the Lörrach office), with Berlin and Munich in third place.⁷ Variable n denotes the value of all €20 notes (ES1 and ES2) paid in to the above branches in July 2016 *from countries outside the euro area*. Variable m stands for the value of all the ES2 €20 notes included in this volume. Drawing of the random sample was held off until July 2016 in order to

⁶ The shipments are processed by wholesale banks active in the international wholesale banknote market.

⁷ The Lörrach office, which occupied an important position in the international wholesale banknote market in terms of the Swiss banking system’s logistical links with the euro cash cycle, was closed on 30 September 2012.

give the €20 notes from the old and new series enough time to achieve a good mix. Inpayment flows at the Deutsche Bundesbank have been used to assess the level of market penetration of the new series, with the new series accounting for a share of 94% in July 2016.

Apart from via shipments, German-issued euro notes are mainly transported abroad to non-euro-area countries either as a result of travel or as cash taken by migrants back to their home countries.⁸ These channels are not captured by the biometric method, notwithstanding the fact that inpayments arising from the shipments also include notes that were originally exported abroad through travel to countries outside the euro area. **N from equation (2) thus relates only to that share of the volume of German-issued €20 notes held for transaction purposes in non-euro-area countries that is attributable to shipments.** However, presumably most of German-issued €20 banknotes kept outside the euro area stem from shipments.

Value M denoting the volume of ES2 €20 notes brought into circulation by shipment branches between 25 November 2015 and 31 July 2016 and destined for non-euro-area countries comes to €1.4 billion.⁹ The sum total n comprising all €20 notes (ES1 and ES2) paid in to shipment branches in July 2016 as shipments from non-euro-area countries amounts to around €150 million. Value m denoting the

⁸ At the end of 2015, German euro notes worth an estimated €272 billion were to be found in circulation outside the euro area. Of this amount, €158 billion stemmed from shipments, with €113 billion arising from foreign travel. These figures represent an update of the estimate made by Bartzsch, Rösl and Seitz (2011a, section 3.1). No data is available showing how the various denominations break down regarding German euro notes exported through travel.

⁹ This represents the cumulative value of net outward payments from Germany to countries outside the euro area (ie the sum total of all outward payments less all inpayments) in the context of the official shipments described above.

volume of ES2 €20 notes included in n totals €65 million.¹⁰ In equation (2), it follows that N , which constitutes the volume of German-issued €20 notes held for transaction purposes outside the euro area and deriving from shipments, had an estimated value of around €3.3 billion at the end of July 2016. In the next section we investigate whether this estimation is plausible.

3.3 Review of the estimates

Viewed in relation to the total volume of German-issued €20 banknotes in circulation, which amounted to €44.9 billion at the end of 2015, the estimated cash balance held for transaction purposes (arising from shipments) outside the euro area accounts for no more than just over 7% of the whole. At first glance this would appear to be a very low figure. But this result was to be expected for a number of reasons. First, a large share of German-issued €20 banknotes is to be found in other euro-area countries (see Figure 1). Second, euro banknotes kept outside the euro area are primarily being hoarded.¹¹ The cumulative value of net shipments of German-issued €20 banknotes (in countries outside the euro area) as at the end of 2015 was estimated to have reached a level of €11.6 billion, equivalent to one-quarter of the (mathematical total) volume of this denomination in circulation. An estimated share of no more than around 28% of these cumulated net shipments (worth €3.3 billion) relate to transactions. The remaining share, worth €8.3 billion, is hoarded. At the end of 2015, the total cash balance of German-issued €20 banknotes held outside the euro area came to an

¹⁰ According to the ECB guideline dated 9 December 2011 on the statistical reporting requirements of the ECB in the field of external statistics (ECB, 2011), national central banks are obliged to supply monthly data on the importing and exporting of euro notes to and from non-euro-area countries. These figures are meant to be broken down according to denomination using the most accurate estimates available. To this end, the Deutsche Bundesbank makes use of the BMS cash management system, which records shipment banknotes according to denomination, also differentiating between types ES1 and ES2. Inpayments (imports) data broken down by denomination have only been available since January 2013. For the period between 2002 and 2012 it was, however, possible to derive estimates of cumulative net shipments according to denomination using inpayment shares (in value terms) from the year 2013.

¹¹ See Bartzsch, Rösl and Seitz (2011a, section 3.4).

estimated amount of about €13 billion.¹²

Finally, we use the following tests to check the estimate derived in subsection 3.2 relating to the volume of German-issued €20 notes held for transaction purposes outside the euro area (arising from shipments), N .

Test 1 “ N may not be larger than the total volume of shipments (ie the cumulative value of net shipments) of €20 notes effected by the Deutsche Bundesbank since the introduction of euro coins and banknotes.”

N is a partial amount of the total volume of shipments. Therefore, it may not exceed the latter. With respect to shipments information, only data on the cumulative outpayments are broken down by denomination. Inpayments data have only been broken down by denomination since January 2013. Assuming that the proportion of €20 notes among inpayments arising from shipments in 2013 can also be applied to the period between 2002 and 2012, the estimated (net) cumulative value of shipments of €20 notes effected by the Deutsche Bundesbank is found to stand at €11.6 billion at the end of 2015. This figure lies well above the estimated value of N (€3.3 billion) which has therefore not been disproved by test 1.

Test 2 “ N should be low”

This test also works on the assumption that €20 notes held in non-euro-area countries are seldom used for transaction purposes. Presumably, most euro notes in these countries are being hoarded.¹³ At the end of 2015, N (€3.3 billion) made up just 7% of the total volume of German-issued €20 notes in circulation

¹² According to an estimate based on the seasonal method, the volume of German-issued €20 notes held outside the euro area rose linearly from just under €3 billion in 2003 to €8 billion in 2009 (Bartsch, Rösl and Seitz, 2011b, subsection 2.2.2). Extrapolating from this, the year-end figure for 2015 stands at €13 billion.

¹³ See Bartsch, Rösl and Seitz (2011a, section 3.4).

(€44.9billion).¹⁴ Similarly, when compared with the (estimated) volume of €20 notes held *in Germany* for transaction purposes amounting to €8.5 billion, *N* accounts for a rather modest share (around 38%) of the total figure. The estimated value of *N* is thus also compatible with the hypothesis presented in test 2.

4 Summary and conclusions

Table 2 gives an **overview of the key estimates**, including existing estimates for €5 and €10 banknotes.¹⁵

The volume of German-issued €20 notes arising from shipments and held outside the euro area for transaction purposes accounts for an estimated value of around €3.3 billion (end-July 2016). Therefore, of the cumulated net shipments (with an estimated value of about €11.6 billion as at end-2015) and hence **of the total volume of German-issued €20 notes held outside the euro area (estimated total of around €13.2 billion at end-2015), the vast majority of notes are hoarded.** The (total) volume of German-issued €20 notes in circulation amounting to €44.9 billion (end-2015), less 1) **the estimated value of €20 notes held for transaction purposes in Germany amounting to €8.5 billion** (end-October 2015) as derived in section 2 and less 2) the (extrapolated) estimated value of the total volume of German-issued €20 notes held outside the euro area amounting to €13.2 billion (end-2015) **leave an estimated residual value of €23.2 billion.** This figure represents around half of the cumulated net issues of German-issued €20 notes. It consists of hoards in Germany and (transaction and hoarding-related) balances in the rest of the euro area. Demand for €20 notes there is to some extent met by the Deutsche Bundesbank.

¹⁴ At the end of 2015, (cumulative net) shipments of German-issued €20 notes (with an estimated value of €11.6 billion) accounted for one quarter of the total volume of German-issued €20 notes in circulation.

¹⁵ See Bartzsch and Seitz (2016).

Components of the (arithmetical) volume of small-denomination “German” banknotes in circulation

Table 2

€ billion	€5 banknote	€10 banknote	€20 banknote
Total arithmetical volume in circulation (cumulated net issues)	8.5	24.5	44.9
Cash balance held for transaction purposes in Germany	1.8 (21.2%)	4.0 (16.3%)	8.5 (18.9%)
Total volume of such cash kept outside the euro area	–	8.5 (34.7%)	13.2 (29.4%)
<i>of which</i> (cumulated net) shipments	0.56 (6.6%)	6.2 (25.3%)	11.6 (25.8%)
<i>of which</i> held for transaction purposes	0.24 (2.8%)	0.5 (2.0%)	3.3 (7.3%)
<i>of which</i> hoarded	0.32 (3.8%)	5.7 (23.3%)	8.3 (18.5%)
Residual (ie hoarded in Germany or hoarded/held for transaction purposes in other euro-area countries)	6.1 (72.2%)	12.0 (49.0%)	23.2 (51.7%)

Sources: Deutsche Bundesbank and author's own estimates.

Notes:

1) Percentage share of cumulated net issuance in brackets.

2) €5 banknote: Volume of cash held in Germany for transaction purposes as at beginning-May 2013; cash balance held for such purposes outside the euro area arising from shipments as at end-January 2014. All other figures relate to end-2013.

3) €10 banknote: Volume of cash held in Germany for transaction purposes as at end-August 2014; cash balance held for such purposes outside the euro area arising from shipments as at end-May 2015. All other figures relate to end-2014.

4) €20 banknote: Volume of cash held in Germany for transaction purposes as at end-October 2015; cash balance held for such purposes outside the euro area arising from shipments as at end-July 2016. All other figures relate to end-2015.

Domestic transaction balances account for roughly one-fifth of the total volume in circulation of all three denominations (cumulated net issuance). However, in the case of €10 and €20 banknotes, cumulated net shipments account for around one-quarter of the total volume in circulation of each denomination, which is significantly higher than in the case of the €5 banknote, at only 7%. The reason for this difference is that there is typically less demand for the €5 abroad than for the two next higher denominations.

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Callum Miller¹

Addressing the limitations of forecasting banknote demand



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Abstract

Central banks need to forecast banknote demand. It determines the number of notes they need printed and the future distribution network required. Yet forecasting demand is an inherently complex problem - banknotes are anonymous bearer instruments and so many of the sources of demand are difficult to research.

This paper sets out a framework for identifying and assessing drivers likely to influence banknote demand. It presents, for the first time, the findings from an

¹ I would like to thank Carleton Webb who constructed the forecasting models described in this paper and provided much advice and guidance on their interpretation. I would also like to thank Roy Whymark, Cordelia Kafetz, Martin Etheridge and Victoria Cleland for their comments on earlier drafts of this paper. The views expressed in this paper are those of the author, they do not necessarily reflect the views of the Bank of England and should not be reported as such. The author is solely responsible for any errors

econometric model, looking at the past relationship between demand for Bank of England notes and a range of economic variables and cash industry statistics, to help forecast future demand.

But this approach has its limitations. There will be determinants of demand not included in the model. Furthermore, what is to say that past relationships will hold into the future? Perhaps we are now approaching a point of inflection - a paradigm shift in the demand for cash that causes the pre-existing relationships to break down.

To account for this, central banks must continue to research cash demand, its current and future drivers, and how significant they might be going forward. They must look for leading indicators that suggest a break with the past, and attempt to understand how, and when, the impact of technological change may significantly change the trajectory of cash use. This paper will set out a structure for capturing all of this information and using it to make judgements on the future of cash.

Whilst it might improve central bank's forecasting capability, and thus the basis for policy decisions, it will not eliminate all uncertainty. Therefore, central banks must retain flexibility, and ensure the wider cash industry does as well. There is a future for cash but we must constantly be alert to events that might change what that future looks like.

1 Introduction: The curious case of cash

Despite regular reports of its demise, cash demand is stronger than ever. In the run-up to Christmas 2016, the total value of Bank of England notes in circulation (NIC) peaked at over €70 billion for the first time (an increase of 10% on a year earlier). This represents over €1,100 for every man, woman and child in the UK.

Demand has grown despite the fact that cash's popularity as a transactional payment method is gradually declining. In 2015, cash accounted for less than half of consumer payments for the first time. Clearly some other factors are driving this growth.

Whilst this may be unexpected to the lay observer, it is a pattern consistently seen across the world. From Australia to the United States, parts of Europe to Canada, the paradox of falling cash use in transactions alongside strong overall growth persists.

Why do central banks need to forecast demand?

Central banks need to maintain public confidence in the availability, quality and security of the currency to meet their objectives of monetary and financial stability. In order to do so they need to forecast what demand for their banknotes will be. This helps them determine:

i. How many notes to print

- Central banks need to know volumes of notes to print in advance because many components have significant lead-times.
- New notes are printed to both replace old notes deemed 'unfit' for circulation and to meet increases in overall demand. This paper focuses on forecasting changes in overall demand, rather than unfit returns, which are forecast separately.

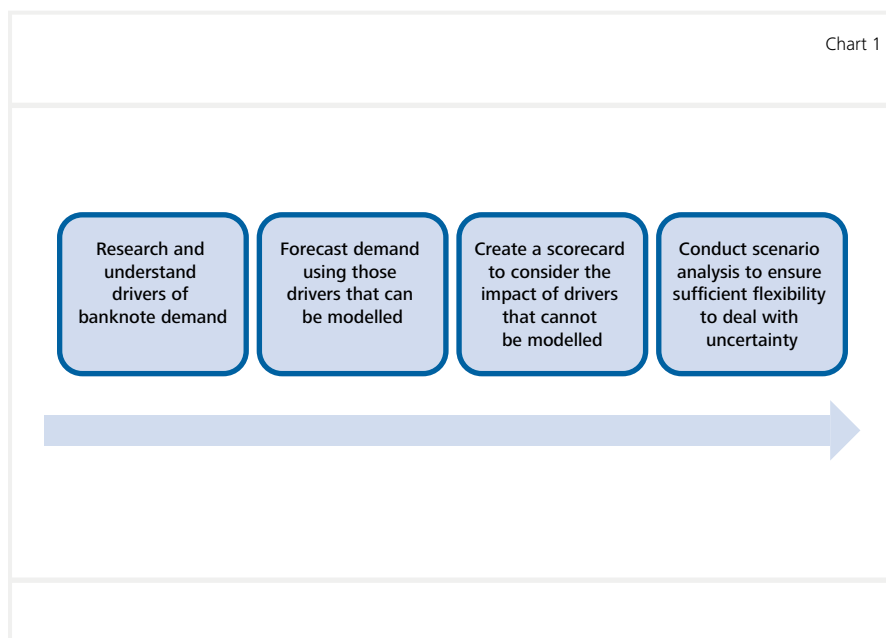
ii. The infrastructure needed

- Whilst exact distribution models and outsourcing arrangements differ internationally, the wider distribution system serves broadly the same functions in each country. Central banks need to ensure the system has sufficient capacity to: distribute new notes to where they are needed, sort and recirculate used notes, and destroy old notes when they become unfit for use.

Central banks need to balance the inherent risk aversion to running out of banknotes with controlling costs, and responsibly managing public funds.

This paper presents a framework to help enable central banks to understand the demand for their banknotes and how this can be forecast to help steer policy decisions. The framework considers: (i) the drivers of banknote demand, (ii) how demand can be modelled using these drivers, (iii) how to account for drivers that cannot be modelled and (iv) how uncertainty about the future and potential shocks can be managed. The framework is flexible, and allows for the analysis to be refined and updated regularly so that conclusions on the future of banknote demand can evolve.

The framework is as follows:



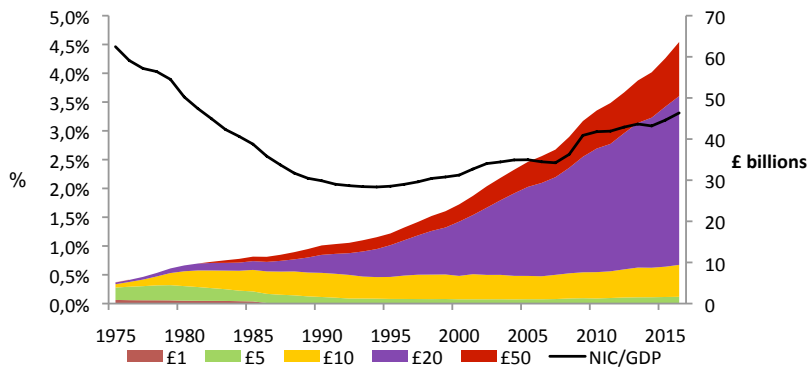
The remainder of this paper is structured as follows. Section 2 sets out a simple extrapolation approach for forecasting demand, by looking at demand for Bank of England (BoE) notes. Section 3 sets out a conceptual approach for classifying the sources of banknote demand. Section 4 presents a longlist of potential drivers in each market. Section 5 describes how some of these drivers can be incorporated into an econometric model, presenting for the first time a drivers-based model for assessing demand for BoE notes. Section 6 discusses the limitations of this model and what this means for how models should be used. Section 7 sets out an approach to combine the outputs from a model with data on the other drivers of demand that were not suitable for inclusion in the model using a ‘scorecard’ approach. It also presents the supporting evidence for two of those drivers. Section 8 concludes with how central banks can use this framework to help to plan for the future: how to manage uncertainty and maintain an orderly, effective and future-proof distribution model for banknotes.

2 Extrapolating from the past

One way to forecast future demand for banknotes is to look at the past. The chart below shows how BoE NIC has grown since 1975. Growth has persisted throughout the period, with NIC as a proportion of GDP falling swiftly from 1975 before starting to climb gradually in the mid-1990s. It also shows that growth since then has been largely driven by the €20 and €50.

**Value of Notes in Circulation (€billions)
and as a proportion of GDP (%)**

Figure 1



Source: Bank of England, ONS

When forecasting based on historic data, typically one would place more weight on the recent past because, *ceteris paribus*, recent changes can be expected to persist as the majority of the drivers of those changes will continue at their recent trajectory. As is demonstrated later, this reasonably simple extrapolation can help

2 (a) Data are based on the last day in February each year. (b) GDP figures based on nominal GDP, GDP figures used for 2016 are Q3 2015 - Q3 2016 as full 2016 data was not available at time of publication.

forecast NIC growth over the short-term. For example, based on recent trends it would tell us to expect strong growth in demand for BoE notes to persist.

But this methodology gives few insights into what is driving changes in demand. From a forecasting point of view, if the factors driving growth change, a model that simply extrapolates recent growth is unlikely to perform well until those factors' effects on growth have stabilised. For example, because interest rates determine the opportunity cost of holding cash, they are likely to be negatively related with growth in NIC. Some of the growth seen since 2008 in BoE NIC may reflect the large cuts in interest rates around that time. A model that could not foresee or account for these cuts would have under-forecast growth.

Unless enhanced, such a simple model does not offer central banks the opportunity to factor in possible changes to variables that may drive demand.

3 Classifying the drivers of banknote demand

When considering the drivers of demand, it is helpful to consider where notes might be held and for what purpose. This paper uses the conceptual framework described by Whymark & Fish in 2014³, which considers that banknotes are demanded for two uses⁴: (i) as a medium of exchange (for transactional use); and (ii) as a store of value, across three markets: (a) the domestic legitimate economy; (b) overseas; and (c) the shadow economy.

As anonymous bearer instruments, central banks cannot know exactly where their

³ Fish T and R Whymark (2015), 'How Has Cash Usage Evolved in Recent Decades? What Might Drive Demand in the Future?' Bank of England Quarterly Bulletin, Vol. 55, pages 1–12, available at <http://www.bankofengland.co.uk/publications/Pages/quarterlybulletin/2015/q3.aspx>

⁴ Money as a unit of account is for our purposes captured by use as a medium of exchange and store of value.

notes are or how they are being used, but this framework provides a structure for considering what drives banknote demand.

Transactional demand

Cash is used in the domestic economy to facilitate transactions for goods and services; it circulates between financial institutions (in branches and ATMs), consumers (in wallets) and merchants (stored in tills or safes waiting to be banked). It is the source of demand that is most easy to identify, and is of most importance to central banks.

That is because central banks have sight of notes that return to the national distribution system; and have strong contacts with stakeholders in this market. In 2014 it was estimated that, at any one point in time, between 21% and 27% of the value of Bank of England NIC was held within the domestic transactional cycle.⁵

It is the most important market, because it largely determines the infrastructure the distribution system needs to maintain. Notes used in the transactional cycle tend to be carried, spent and banked more often and thus determine much of the processing activity the distribution system needs to meet.

Hoarding

Cash is hoarded in the domestic economy, where savings are kept as cash, often at home as opposed to in a bank account. Hoarded cash is more difficult to research, central banks can draw on survey data but we suspect that underreporting occurs.

A 2014 survey into the uses of cash⁶ suggested that 18% of people hoarded cash.⁷

⁵ Fish T and R Whymark (2015)

⁶ An unpublished survey commissioned by the Bank of England's Notes Directorate and conducted by GfK NOP involving 1,000 respondents

⁷ Hoarding was defined as money kept at home for saving but that was not used for regular spending.

Extrapolating the results indicated that a minimum of €3 billion was hoarded domestically – around €345 per hoarder. However, these results are highly sensitive to methodology. A more recent survey⁸ found that 41% of people⁹ reported that they kept money in their home as savings but, on average, a much lower amount of €78. This range demonstrates that surveys provide an indication of hoarding but should not be solely relied upon. As an illustrative example, if one in every thousand adults in the United Kingdom were to hoard as much as €100,000, this would account for a further €5 billion (nearly 10% of NIC).¹⁰

Overseas

Banknotes are demanded outside of their country of origin: for tourists to facilitate spending, and as a store of value for overseas investors. Central banks may have visibility of some of these flows and demand sources, but not all. Due to the challenges with disentangling overseas transactional and hoarded cash demand, this paper treats all overseas demand as one classification.

Shadow

Banknotes are also used in the shadow economy. The shadow economy can be broadly defined as “those economic activities and the income derived from them that circumvent government regulation, taxation or observation”.¹¹ This definition covers a wide range of unreported income, from both legal and illegal activities and in this paper all cash demand from the shadow economy is treated as one source.

⁸ Face-to-face survey commissioned by Cash Services, carried out by Optimisa Research of 1,945 individuals.

⁹ 22% of people chose not to say, so the true figure may be higher.

¹⁰ Fish T and R Whymark (2015)

¹¹ Schneider and Buehn (2016), ‘Estimating the size of the Shadow Economy: methods, problems and open questions’, IZA Discussion paper series, No. 9820. This definition is taken from Del’Anno (2003), Del’Anno Schneider (2004) and Feige (1989).

4 Identifying the drivers of banknote demand

Central banks cannot always differentiate between the various uses, and there are likely to be regular movements between each category. Nonetheless, this framework is useful for identifying, researching and unpicking the drivers of banknote demand.

It is possible, based on research, literature and experience, to select a longlist of drivers likely to influence banknote demand. These drivers will be sensitive to many factors specific to individual currencies such as cultural issues; exposure to international markets; domestic financial structure; and national banknote distribution system. The table below identifies drivers of demand for Bank of England notes. It is based on international literature, primary research, data from the distribution system, economic theory and experience.

5 How do these drivers help forecast demand for banknotes?

Once a longlist of drivers that influence demand for banknotes has been identified, central banks need to have a process for assessing how they will combine in the future to affect overall demand.

This paper sets out two approaches that, which used in conjunction, should comprehensively capture the prevailing influences on banknote demand:

- i) An econometric model
- ii) A 'scorecard' of indicators

Drivers of banknote demand

Table 1

			Use	
			Transactional (Medium of exchange)	Hoarded (Store of value)
Market	Domestic	Consumers	Availability of alternatives to cash Acceptability and cost of those alternatives Overall consumer spending: – Consumption – Unemployment Attitudes to cash versus alternatives, in terms of: – Security – Ease of use – Budgeting implications Self-employment	Trust in financial institutions (eg influenced by cyber attack, or national/global financial crisis) Interest rates Security concerns to storing cash at home Perceived need to hold money outside of the financial sector Alternatives to cash as a store of value
		Merchants	Cost of payment methods Consumer attitudes to cash Safety and fraud concerns Attitude to cash from a business continuity perspective Interest rates	
		Financial institutions	Interest rates Industry structure – Number of ATMs – Number of bank branches	
	Overseas	Exchange rates/perceived changes in future exchange rates Tourism levels Migration Status as an international reserve currency		
	Shadow	Tax and social security contribution burdens Quality of institutions Labour market regulations Tax morale Deterrence Self-employment		

An econometric model

Econometric modelling can be used to assess the past relationship between changes in these drivers and changes in banknote demand. In order to be included in an econometric model, the indicators must be robust, statistically significant, and regularly produced – but not all drivers meet these criteria.

There are a variety of models that central banks could use and the indicators included will depend on data available to them at the time. This paper presents the results from a model produced to forecast demand for Bank of England banknotes.

Bank of England experience

Building on previous work¹², an error correction model was constructed to forecast NIC growth.

The model estimates a long run relationship between the level of NIC and the drivers of demand that, when tested, proved to be statistically significant. This includes macroeconomic measures such as the interest rate, exchange rates and nominal consumption, as well as variables covering industry structure such as number of ATMs, which help control for changes in the opportunity cost of accessing cash. For completeness, other variables included in the model are: the number of bank branches, self-employment, and the number of regular payments made in cash. The number of regular payments made in cash should proxy for the popularity of alternatives to cash amongst consumers, accounting for the availability and acceptance of, and attitudes towards those alternatives.

It was not possible to include variables for a number of drivers identified in Table 1. For example, whilst data on alternatives to cash, such as payments made by con-

¹² Cusbert T and T Rohling (2013), 'Currency Demand during the Global Financial Crisis: Evidence from Australia', RBA Research Discussion Paper, No 2013-01.

tactless cards, are available, they are not recorded over a sufficient time frame to be included. Others factors¹³ were identified but when modelled, they were found to not be statistically significant. However, they can still be of use in understanding future demand and this paper will later discuss how they can be combined with the forecast model.

The model's long run relationship is (in logarithms)¹⁴:

$$NIC_t = c_0 + \beta_1 Cons_t + \beta_2 BankRate_t + \beta_3 (LinkATMs_t - Pop_t) + \beta_4 (BankBranches_t - Pop_t) + \beta_5 SelfEmp_t + \beta_6 CashRegPay_t + \beta_7 URate_t + \beta_8 ER_t$$

This relationship passes the Johansen test for cointegration, indicating a long run relationship between the variables. The model calculates a level of NIC consistent with its long run determinants and the forecasts return NIC to its long-term equilibrium over time, with some short-term deviation dependent on recent changes in the variables. So if NIC is above the equilibrium, the model forecasts weaker NIC growth, conversely if NIC is below, it forecasts stronger growth. Given the speed of adjustment coefficients in the total and denominational models are around -0.1 to -0.25, the equilibrium adjustment should be almost complete after around 4 to 10 quarters (mostly within 1-2 years).

13 Other variables tested included the unemployment rate, the proportion of workers born in Eastern Europe, (ONS estimates of) the shadow economy, the sterling effective exchange rate, official foreign holdings of sterling, the VIX measure of stock market volatility, a measure of sterling-dollar volatility, tourist expenditure, the number of state benefit payments per person and the number of students in the UK.

14 Where *Cons* is nominal consumption, *BankRate* is Bank Rate (or Base Rate): the rate set by the Monetary Policy Committee of the Bank of England, *LinkATMs-Pop* is the number of ATMs per person aged 16+ (as in the Labour Force Survey data), *BankBranches-Pop* is the number of bank, building society or Post Office branches per person, *SelfEmp* is the proportion of self employed in employment, *CashReg-Pay* is the number of regular payments made in cash per person per year, *URate* is the unemployment rate and *ER* is the sterling effective exchange rate index, all at time *t*. Nominal consumption captures both the transactional demand for cash, and the effect of inflation on demand for cash through rising prices.

The total NIC model is useful for discussing what influences cash demand but central banks also have to model by denomination in order to determine note orders. Denomination-specific models are more sensitive to series changeovers and policy interventions and these exogenous shocks must be accounted for. For example, in 2010, the Bank of England responded to concerns about the deteriorating quality and availability of €5 notes in circulation. As a result, the Bank asked the ATM operators to increase the number of €5 notes dispensed. To account for this, a dummy variable had to be included in the model, so as not to attribute this change in demand to other factors. From the model it appears that the policy change raised €5 NIC by 9%.

Generally, the financial crisis period triggered a shift in the coefficient estimates (β_n) – the patterns observed before the crisis between various indicators and NIC were impacted by it. While some seem to have subsequently drifted back toward their pre-crisis values, others have remained at notably different values. This may be because the volatility around the crisis induced enough variation in the data to distinguish the effects of certain variables. For example, the large cuts in Bank Rate were unprecedented and helped to uncover the strength of the relationship between NIC and Bank Rate.

The full list of coefficients is in appendix 1.

The results indicate a number of intuitive relationships, focussed on in the table below.

Relationship between explanatory variables and NIC

Table 2

Variable	Impact and possible rationale
Consumption	Cash demand rises with nominal consumption. The coefficient is slightly less than one, implying that a 1% rise in consumption leads to a slightly less than 1% rise in cash demand. Consumption growth disproportionately drives demand for €20 notes, while boosting €10 demand less than one for one. This might reflect a substitution effect from €10 notes into €20 notes due to inflation.
Interest rates	Higher interest rates reduce cash demand, a relationship that became clearer during the financial crisis when rates were cut significantly. The contagion effect following the financial crisis may be captured both by lower rates and the exchange rate – which may over-attribute growth in cash demand to these variables. The relationship shows that a 100 basis point increase in Bank Rate is estimated to push down on cash demand by 2%. Bank Rate was not statistically significant for the €5 note but was for the €10. The clearest effects are on the €20 and €50 notes. For the €50 the US Federal Reserve's policy rate has been included as international demand is larger for this denomination. The 450 basis point reduction in Bank Rate and 500 basis point cut in the Federal Reserve's policy rate between 2007 and 2009 explains a fifth of the €6 billion increase in €50s since.
Exchange rate	A fall in sterling's exchange rate increases demand for cash. This was highlighted by an immediate increase in demand for the €50 note following the fall in sterling's exchange rate in summer 2016 in the aftermath of the results of the UK's referendum on EU membership. Acquiring BoE notes when the pound is cheap makes sense for foreign visitors to the UK who are in essence bringing forward spending even when those notes will not be spent for a number of months or even years. We also have intelligence that there are individuals who hold a basket of currencies as cash and, for whom, a fall in sterling's exchange rate allows them to purchase BoE notes cheaply.
Number of cash payments	The number of regular payments made per person per year in cash increases demand for cash, although this variable lost significance when updating the model using 2015 data. This variable captures payments like household utility bills, made in cash but may also proxy the long run decline in cash usage overall for all types of payments. The number of spontaneous payments made in cash was also tested but was not significant. This might be because regular payments made in cash are of higher value than spontaneous cash payments.
Self-employment	Self-employment appears to raise demand for cash, consistent with small businesses receiving a larger proportion of their transactions in cash compared to large businesses. However for €50 notes there is a negative effect, although it is unclear what drives this.

Other findings revealed by the use of dummy variables in the model are that:

- There was a 2.9% increase (around €1.2 billion) in NIC in 2008-09 not associated with the other variables that may be related to the shocks hitting the economy – especially the financial sector – at that time. That could be interpreted as pre-cautionary holdings of cash.
- The €50 note appears to be affected by series changeovers in a way that other denominations are not, reflecting the note's store of wealth use and the fact that returned €50 notes are more likely than other notes to be exchanged for electronic payment as opposed to a new series note.
- Concerns about electronic payments and bank computer systems around the year 2000 appear to have temporarily boosted cash demand by a little over 1%.

But there are a number of patterns implied by the model's results that are more complex to explain:

A rise in unemployment appears to push down on NIC. One might expect unemployment to boost cash demand as households often use cash for budgeting (given that reduced spending should be captured by the consumption variable). This holds true for demand for €5 notes, but higher unemployment lowers demand for €20 notes, explaining the negative effect on overall NIC. The negative coefficient might capture some cyclical factor not fully accounted for by consumption. Or it may reflect some people drawing on previously hoarded cash, already in circulation, when they become unemployed in order to smooth consumption.

A rise in the number of ATMs per person pushes up demand for cash. This might reflect the fact that the banking sector requires extra cash to stock the ATMs, which more than offsets the reduced need for consumers to hold larger stocks of cash if cash is easier to access. Conversely, it could reflect the fact that consumers withdraw more cash when ATMs are more readily available. This coefficient

suggests that around 5% of cash is stocked in ATMs or their supply chains, which seems reasonable given the value of cash withdrawn from ATMs. Before 2008, the coefficient implied that over a quarter of cash was associated with ATMs which is an unrealistically high proportion. It has since reduced and it is possible that variation in the other variables since 2008 has revealed a weaker underlying relationship between ATMs and NIC.

For individual denominations, the picture is even less clear. ATMs per person reduce €5 and €10 NIC, but push up on the €20.

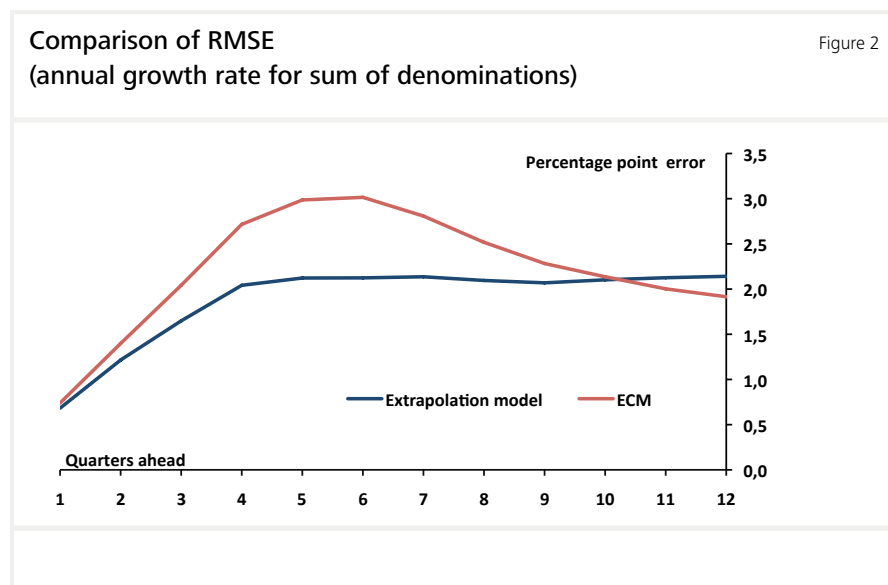
In contrast to ATMs, a rise in the number of bank branches per person reduces demand for banknotes. The increase in cash stocked is more than outweighed by changing behaviour. The coefficient implies that if around 200 branches close (or 1% of the total), NIC increases by 0.4% as households stock higher amounts of cash. Small businesses may also play a significant role in holding larger amounts of cash. The role of branches was insignificant before 2008, perhaps because there were so many branches at that time that closing some made little difference.

Projecting forward

Once the past relationship between different variables and changes in demand for each denomination is known, it is then possible to produce and use forecasts for these variables to calculate forecasts for NIC growth by denomination.

How accurate is the model?

It is also possible to measure how accurately the model would have performed in the past given the data available at the time. The chart below compares the performance of the error correction model (ECM) with a simpler extrapolation model¹⁵ by calculating the root mean squared error (RMSE) of the forecasts.



The extrapolation model tends to perform better over the short-term, with evidence that the ECM's economic determinants help it to perform better after that. Both models still exhibit relatively large forecast errors, of 2-3 percentage points in terms of annual growth rates up to three years ahead.¹⁶ In terms of NIC levels, it should be noted that this annual errors would compound over time.

¹⁵ The exact type of model is an autoregressive (AR) model, which regresses current growth on the last period's growth rate (or the last few periods'). These models tend to revert to the mean, but the short term dynamics are driven by the observed persistence of changes in growth over time.

¹⁶ These results are specific to the sample period and may not hold for the future.

6 Modelling challenges

There are three key challenges to producing an effective forecast model that help explain this inaccuracy and also provide insights into how to supplement this forecasting approach:

- (i) specification challenges with the model itself;
- (ii) inaccuracies in our forecasts for the variables included; and
- (iii) concerns that past relationships may be disrupted going forward.

Specification challenges

Specification challenges have to be overcome with any forecasting model. In the model above, judgement was used, based on the evidence, to remove variables deemed responsible for spurious relationships. For example, the inclusion of point of sale terminals in the model suggested an unrealistically large proportion of NIC growth was driven by cash obtained as part of a sale hence this variable was removed. As the complexities interpreting some of the coefficients demonstrate, it is often not clear whether or not to include certain variables.

Models may also suffer from omitted variable bias: the model may not have captured all the factors that influence cash demand. For example, as stated above, demand from overseas and the shadow economy are important components of NIC yet we do not have the data to measure and model the drivers of this demand.

Input forecast inaccuracies

A model can only be as accurate as the information inputted. The model's outputs are likely to be incorrect, if the forecasts for the explanatory variables are. For example, forecasts for variables like consumption are normally subject to certain conditioning assumptions, which may not materialise and forecasts for other variables

are based on simple extrapolation. But as discussed below, one of the main benefits of the model is that it allows us to conduct scenario analysis for a number of possible future states, making it less reliant on identifying just one set of inputs.

Reaching a paradigm shift when past relationships no longer hold

The model is based on historic relationships and so can only forecast based on relationships that have held true in the past. Whilst it can incorporate past trends, it is not able to take into account paradigm shifts that fundamentally alter existing relationships or new relationships that may emerge.

There is the added complexity that drivers are interrelated and changes to one could have knock-on effects on others. For example, if transactional demand continues to fall whilst non-transactional demand rises, will there be a tipping point where banknotes no longer have the same utility as a store of value if it was extremely difficult to bank and spend them? This model will not be able to predict such a point of inflection. In countries with falling transactional demand and falling NIC, it is possible that 'de-hoarding' has occurred already.

Moreover, non-linearities may exist in a number of relationships (for example, with the exchange rate or interest rates) that have not been modelled.

7 How can models be supplemented?

Given models' theoretical and practical limitations, it is important to develop an approach that takes account of a broader range of drivers.

This paper uses a scorecard approach to help collate information on these drivers and weight them based on:

- The likelihood of a change in one of the drivers occurring;
- The market and use for cash affected, and thus;
- The magnitude of the potential impact; and
- The time lag between a change in a driver and the resultant impact on cash demand.

Research has helped to identify which indicators to monitor, as set out in earlier in Table 1, as well as to understand the transmission mechanism through which these drivers influence demand.

Below is the evidence used in two instances to judge the potential impact various drivers could have on i) merchant demand for BoE notes, and ii) hoarding demand for BoE notes. It explains why a driver is influential, the potential impact it might have, and how it can be monitored whether through inclusion in the model or in the scorecard. This evidence is then used to inform the scorecard below.

Merchants' use of cash

Merchants are responsible for a significant portion of NIC¹⁷. Cash may be held by merchants as takings before being banked, in tills as floats or for business continuity purposes. As set out in Table 1, drivers for merchants' use of cash are: cost of

¹⁷ In our 2014 quarterly bulletin article we estimated that this could amount to up to €5 billion.

payment methods, consumer attitudes to cash, safety and fraud concerns, cash in transit costs and interest rates.

One might expect that historically low interest rates, compared with the costs of cash-in-transit (CiT) services for banking takings would mean that merchants would hold onto cash for longer before banking it. This is somewhat evidenced by the fact that the value of notes returned to wholesale cash distribution centres has fallen 13% in the last two years.¹⁸ This has partly led to the increase in NIC as notes have been held in the transactional cycle by financial institutions and retailers for longer. Merchants are also keeping cash in the transactional cycle by refilling ATMs in their stores directly from their tills. Due to this increasing trend, in 2013, to encourage these notes to be authenticated before use, the Bank of England, along with the industry¹⁹, introduced the Code of Conduct for Authentication of Machine-Dispensed Banknotes.

To understand whether merchant's had a strategy for encouraging or discouraging the use of cash, we at the Bank of England undertook qualitative research²⁰ with a range of large, cash-intensive businesses. The research found that many businesses had seen a steady but significant fall in proportion of cash sales in recent years which they expected to continue into the future, reflecting changing consumer attitudes. Some of this was driven by changing behaviour, such as a shift in the point of sale from in person to online. Businesses in other industries reported a stable cohort of cash users (in one example accounting for 20% of sales) for whom alternatives did not appear popular. This is accounted for in the model by the variable which measures the number of regular payments made in cash, and the

18 From €15.25 billion in July 2014 to around €13.31 billion in July 2016.

19 The Code has broad industry support and is sponsored by the British Retail Consortium, Cash Services, LINK, the Association of Commercial Bank Issuers and Payments UK. See <http://www.cashservices.org.uk/what-we-do/codes-conduct>

20 12 interviews were conducted with large, cash-handling businesses, across different sectors, broadly representative of total cash spending as reported in Payments UK, 2016 UK Consumer Payments.

forecasts will cover a trend over time. To inform the forecast, it is also necessary to monitor leading indicators that may signify an acceleration or deceleration of this movement away from cash going forward.

Banking policies were thought to be relatively unresponsive to falling cash volumes and decisions on how often to bank takings were driven by practical concerns such as safety and insurance limits and CIT costs. Interestingly, merchants said they were not strongly influenced by the potential interest they could earn.

Cash was still the cheapest form of payment for most merchants but the differential between cash and debit card was narrowing. This matches with industry-wide data provided by the British Retail Consortium survey, which shows that as a proportion of tender value, cash is the cheapest payment method although debit card costs are falling, with possible further reductions to come once the full impact of interchange fee reductions are realised²¹. Cash costs on the other hand, such as the cost of a business account with cash services, have stayed fairly stable. The relative costs of card and cash will depend on the individual merchant because a significant share of cash processing costs are fixed, and card processing requires initial investment. Thus costs per transaction are dependent on scale of the business.

Costs of collection as a % of tender turnover, 2011-2015

Table 3

	2011	2012	2013	2014	2015
Cash	0.14%	0.16%	0.14%	0.14%	0.15%
Debit cards	0.32%	0.32%	0.32%	0.36%	0.22%

Source: BRC Payments Survey 2015

²¹ The Interchange Fee regulation is EU legislation that came into effect in June 2015. In the UK, this means that on average debit interchange cannot exceed 0.2% of transaction value.

This is emphasised by research with small businesses²², which found that majority of businesses not currently offering electronic payments are unlikely to change their approach. Four in five of these businesses ‘probably’ or ‘definitely will not’ offer debit/credit card, contactless, or mobile payments in the next 2-3 years. An aversion to change and cost were cited as the top barriers.

Overall, whilst larger businesses are responsive to costs, merchants interviewed reported that they would continue to offer as many methods of payment as consumers wanted, and that they would not push customers away from cash. However, around a third of the merchants interviewed said that they may attempt to “nudge” customers if cash became too costly. Smaller businesses appear more resistant to card payments although they are similarly motivated by cost.

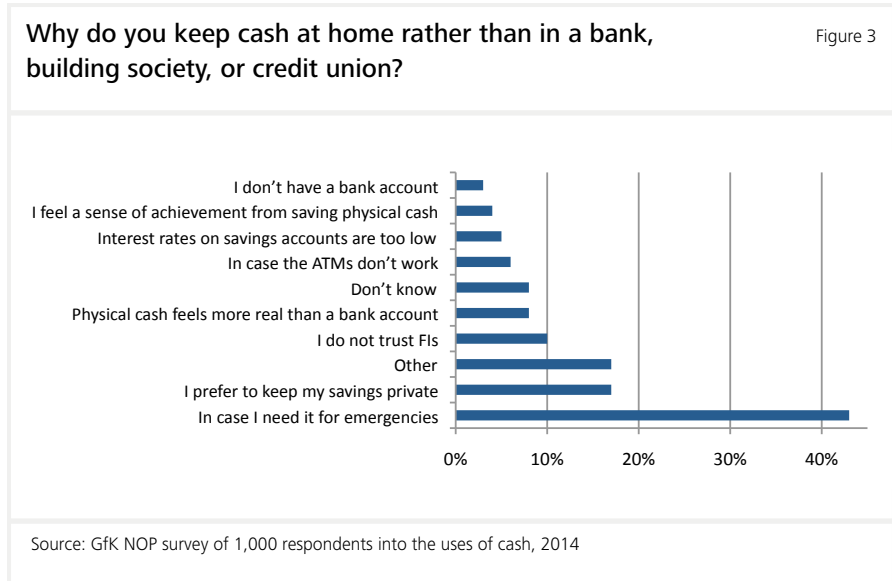
Hoarding

There are many motives for hoarding cash. One would think interest rates are an important factor, as presumably there is a level at which the opportunity cost of foregone interest outweighs the perceived benefit of cash. However, the only available information on hoarding comes from surveys, and they have found that people keep cash mainly to provide comfort against potential emergencies.

As can be seen in the chart below, issues about privacy, trust and access to cash in emergencies were the most important drivers. It is not clear if these drivers will persist into the future or what might influence them. Perhaps greater knowledge of deposit insurance limits would reduce hoarding. A widely-publicised cyber-attack, on the other hand, might reduce trust in financial institutions to keep data private and increase the incentive to hoard. These are events we can monitor, although measurable indicators are more difficult to determine. Stability of earnings, as measured by wage levels for example, could be used to proxy the need for

22 Tu, T & Salmon, C (2016) Uses of cash and electronic payments, Ipsos Mori Research Report 432.

cash in emergencies.



Similarly central banks can monitor whether an alternative to cash as an anonymous store of value is developed and adopted. Whilst take-up is hard to predict, such a product would seemingly have to be anonymous, widely accepted, exist outside of the traditional banking system and be controlled by some other trusted party. It is unlikely such a product will be developed in the near-future.

Nevertheless, the impact of these factors will be limited given that 42% of those who hoard reported that “nothing” would influence them to put cash in a bank account in the future. Of those that could be influenced, interest rates and

perceived access to cash were the most important factors.²³ Interest rates are in the econometric model and the variables on ATMs and bank branches are included to account for access to cash. This finding appears to contradict the data in the chart – highlighting the shortcomings of surveying about future intentions.

Scorecard

The drivers not included in the forecast model have been assessed in the scorecard below. Continued research and analysis will help refine the scorecard, which should be considered preliminary at this stage. Whilst the ratings assigned in the scorecard are subjective, they are informed by the evidence.

Once the scorecard has been fully specified, central banks can decide whether to deviate from a model's central forecast and the extent to which they should do so. There needs to be a robust process for how this is done in practice, with sufficient checks, challenges and balances to ensure that bias is removed from the decision. The scorecard should, therefore, be used as a tool to help to ensure that the full range of potential impacts are discussed and taken into account.

23 When asked "What would influence you to put the cash you are keeping at home in an account with a bank, building society, or credit union?" 42% replied "Nothing", 20% "Higher interest rates on savings accounts" and 14% "Easier to withdraw the cash again if I need to."



Preliminary scorecard for drivers of banknote demand

Table 4

Indicator	Market and use, rough proportion of overall demand	Brief description of transmission mechanism	
Interchange fee	Domestic transactional (21-27% of stock of notes)	Determines cost of accepting card (and thus relative cost of cash) for merchants.	
Use of alternative payment methods	Domestic transactional (21-27% of stock of notes)	Reflects changing use of payment methods.	
Cash costs (Cash in transit, business banking)	Transactional – merchant demand	Increases cost of banking cash takings and encourages cash to remain in circulation.	
Safety and fraud concerns	Transactional – merchant demand	If potential cash losses are deemed more likely than card, merchants will nudge customers away from cash.	
Cyber attacks	Transactional and hoarding	Influences attitudes to cash due to safety concerns of alternatives	
Alternatives to cash as a store of value	Hoarding	Potential substitution from cash hoarding to ‘saving’ via an alternative product.	
Stability of earnings/wage growth	Hoarding	Influences perceived need of cash in case of emergencies	
Deposit insurance limit	Hoarding	Influences need for cash in case of emergencies, unlikely to have significant impact.	

	Rating of potential impact (1-5, where 5 is high impact)	Feedthrough time Lagging or leading indicator	Likelihood of change occurring
	2	Leading Likely to take 6-12 months for changes in legislation to feed through to cost changes and further lag to influence merchant behaviour.	Unlikely in the next year
	4	Lagging Data will reflect substitution away from cash.	Trend likely to continue but deviations possible
	2	Leading Uncertain as to how quickly merchants would respond to cost changes, likely to be dependent on magnitude of change. Should lead to a step change in level of NIC as opposed to impacting growth in long run.	No indication of significant change in the next year
	2	Leading Merchants will take time to react to changes, although data may not be produced regularly enough to be considered a leading indicator.	Unlikely
	3	Leading Public response to cyber attack dependent on scale and reporting of incident.	Unknown
	1	Leading Uncertain as to how quickly developments would influence behaviour.	Low Attachment to cash for hoarding is attitude unlikely to change
	1 (stock market volatility not significant)	Leading Unknown given absence of information on hoarding behaviour	Low
	1	Leading Unknown given absence of information on hoarding behaviour	No indication of a change.

Preliminary scorecard for drivers of banknote demand (continued) Table 4

Indicator	Market and use, rough proportion of overall demand	Brief description of transmission mechanism	
Tourist spending	Overseas	Increased tourist spending reflects greater demand for cash, either acquired abroad or once entered the UK.	
Status as a reserve currency	Overseas	If sterling was to be considered less valuable as an international reserve currency, overseas demand for BoE notes would fall.	
Migration	Transactional/shadow	Migrants to UK are likely to be more cash-dependent than residents.	
Tax and social security contribution burdens Quality of institutions Labour market regulations Tax morale Deterrence	Shadow	If taxes, contributions or regulations increased then cash demand would be expected to rise, although clear link with self-employment variable. Increased deterrence for using cash in shadow economy will reduce cash use, as would higher morale.	

	Rating of potential impact (1-5, where 5 is high impact)	Feedthrough time Lagging or leading indicator	Likelihood of change occurring
	0 (not significant in model)	Lagging Indicative of future patterns but data produced fairly regularly.	Uncertain
	2	Leading However changes in 'status' role will probably only materialise as reduced demand for sterling.	Uncertain
	2	Lagging Migration will have already impacted NIC once migration statistics reported.	Unknown
	3	Leading Lag unknown	Uncertain Taylor review on modern employment practices may report on some of these drivers Tax morale difficult to predict and deterrence changes unknown

8 Conclusion: helping to plan for the future

This paper sets out a framework for understanding banknote demand. Following extensive research, it seeks to identify the drivers of demand for Bank of England banknotes. It describes how a forecast model was developed, using the relationship between changes in some of these drivers and changes in NIC to predict demand going forward. It also sets out how this can be supplemented with broader research and information that could not be properly accounted for in the model. Together, this information can be used to help determine a forecast for NIC.

However, calculating a central forecast for banknote demand, by denomination, is a rather narrow output. As central banks, it is the range of possible outcomes that interests us. For example, demand can be forecast based on interest rates rising sharply, the pound depreciating and the number of bank branches falling sharply. It can also be forecast based on a cyber threat causing a reversal of the trend away from cash for transactions whilst consumption was growing strongly.

This is arguably the more important output. It allows central banks to assess future infrastructure needs against a range of stretch scenarios, and to ensure they are resilient to a combination of exogenous shocks.

Practically, this can be done by negotiating agile and flexible contracts with suppliers to guarantee sufficient flexibility to banknote production. Central banks can also hold contingency stocks of banknotes to meet demand under a range of severe but plausible events. These stock levels can be set according to a broad risk appetite dependent on the range of scenarios they want to mitigate against.

It is not possible to know exactly what demand for banknotes will be in the future, but this paper sets out a framework for understanding what demand might be and how it might be influenced. It also describes how to identify leading indicators that

may signify a change of demand in the future. With this knowledge, processes can be put in place to manage uncertainty to ensure confidence in the currency is maintained.

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Appendix 1: ECM estimates for total NIC

Table 5

	1993Q4 – 2008Q2	1993Q4 – 2015Q4 without crisis dummies	1993Q4 – 2015Q4 with crisis
Constant	14.798***	14.204***	14.204***
Consumption	0.908***	0.85***	0.85***
BankRate	-0.002	-0.022***	-0.022***
LinkATMs	0.288***	0.052*	0.052*
Branches	-0.049	-0.524***	-0.524***
SelfEmp	0.917***	0.865**	0.865**
CashRegPayments	0.136***	0.046	0.046
UnemploymentRate	-0.009**	-0.008**	-0.008**
ExchangeRate	-0.048**	-0.091***	-0.091***
Speed of adjustment	-0.658***	-0.194***	-0.183***
d(NIC(t-1))	0.335***	0.27***	0.202**
d(Consumption(t))	0.453***	0.103	0.232**
d(ExchangeRate(t))	-0.055*	-0.085***	-0.059**
Crisis 2008Q4	–	–	0.015***
Crisis 2009Q1	–	–	0.014**
Crisis 2009Q2	–	–	–
Millennium (1999Q4)	0.015***	0.011**	0.011**
Adjusted R-squared	0.43	0.28	0.36
Standard error	0.005	0.005	0.005

***, ** and * indicate p-values less than 0.01, 0.05 and 0.10 respectively



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U.S. consumer cash use, 2012–2015: an introduction to the diary of consumer payment choice



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Abstract

U.S. consumer cash payments averaged 26 percent by number (volume share) from 2008-2015, according the Survey of Consumer Payment Choice (SCPC), and essentially flat from 2012 to 2015. In contrast, new estimates from the Diary of Consumer Payment Choice (DCPC) suggest that the volume share of consumer cash

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payments is higher than estimated in the SCPC, as expected, but 8 percentage points lower in 2015 than in 2012. Unfortunately, the DCPC most likely does not provide an accurate estimate of the actual changes in cash payments due to major changes in survey methodology between 2012 and 2015. Furthermore, improvements in economic conditions during this period may have influenced the estimates in ways that do not reflect longer run trends. Counterfactual simulations that control for survey and economic changes suggest the cash volume share declined about 1 to 3 percentage points due to changes in consumer preferences during this period, closer to the SCPC estimate. The DCPC estimates also indicate that the dollar-value share of cash payments was flat.

1 Introduction

Cash does not appear to be “dead,” or even “dying,” in the United States despite widespread diffusion of electronic payment networks and proliferation of consumer payment instruments in recent decades. Using the Federal Reserve Bank of Boston’s Survey of Consumer Payment Choice (SCPC), Greene, Schuh, and Stavins (2016) shows that the volume share (number) of U.S. consumer payments that are cash averaged about 26 percent from 2008 to 2015; the cash share was notably higher in 2015 than it was in 2008. Using the Diary of Consumer Payment Choice (DCPC), which was co-sponsored by the Federal Reserve Banks of Boston, Richmond, and San Francisco, Bagnall et al. (2016) reported the U.S. cash volume share of payments in 2012 was 41 percent – 15 percentage points higher than in the 2012 SCPC.

This paper provides a more detailed, official introduction to the DCPC, reporting new results for 2015 to compare with 2012 and focusing on consumer use of cash (or currency, that is, notes, bills, and coins). The DCPC represents an improvement in measurement of consumer payment choices over the SCPC for two reasons. First, the DCPC asks respondents to record every payment they make each day,

whereas the SCPC asks respondents to recall from memory how many payments they typically make during a longer period of time (week, month, or year). Thus, the DCPC is expected to produce more accurate estimates of consumer payments. Second, the DCPC collects data on not only the number of payments but also the dollar value of each payment. Thus, the DCPC adds a second dimension of payment use – value as well as volume – that enriches understanding of consumer payment decisions.

SCPC and DCPC estimates of the volume of cash use in 2012 and 2015 are quite different statistically and economically. The SCPC estimates indicate that the cash volume share was about unchanged (0.3 percentage points higher in 2015). However, Matheny, O'Brien, and Wang (2016) reported preliminary and unofficial 2015 DCPC estimates that suggest cash volume was 8.2 percentage points lower than in 2012 (40.7 percent in 2012 versus 32.5 percent in 2015). Unfortunately, the 2012 and 2015 DCPC raw data estimates are unlikely to be an accurate estimate of the actual change in cash's share due to substantial changes in survey methodology. Therefore, the implied change in U.S. consumer cash use (a decline of 8 percentage points in volume) is almost surely not an accurate reflection of actual changes in consumer preferences for cash between 2012 and 2015.

Differences in survey methodology and economic conditions between the 2012 and 2015 DCPC likely contributed to differences in the DCPC estimates of consumer payments during this period. The survey methodology of the 2015 DCPC includes two improvements relative to 2012: revisions to the DCPC questionnaire and switching to a better sampling frame. Both improvements likely affected the measurement of consumer payments, although both also had some limitations. A second reason for the lack of comparability is the U.S. economic conditions changed from 2012 to 2015, with unemployment falling and uncertainty from the financial crisis diminishing. While changes in economic conditions could affect measurement of consumer payments by the SCPC and DCPC, the latter may be

more susceptible to economic fluctuations because it measures actual daily activity whereas the former measures “typical” behavior that presumably abstracts from high-frequency developments.

The DCPC motivates an enhanced view of consumer payment choices relative to the SCPC by providing data on the dollar value of payments as well as the number (volume). According to the DCPC, the consumer value shares of cash payments were similar in 2012 and 2015 (12.4 percent and 11.4 percent, respectively). This 1.0 percentage point difference is modest compared with the 8.2 percentage points in the cash volume share. Thus, the value shares suggest little change in consumer cash use, while the volume shares point to a potentially large decline. Moreover, this apparent discrepancy in the picture of cash volume and value shares over time implies another intriguing development, namely, that the average value of consumer cash payments (the total value of payments divided by the total number) must have been higher in 2015 than in 2012, which it was (\$77 versus \$70, respectively).²

Economic intuition suggests that consumers likely choose both the value and number of payments intentionally and simultaneously. Economic theory offers considerable guidance about the determination of payment values, which represent consumer spending from income (see Schuh 2017). However, neither economic theory nor the economics literature provides much guidance for understanding how consumers choose the number of payments they make during a period. The economics literature has demonstrated empirically that the choice of payment instrument is correlated with the dollar amount of payment. As first shown by Klee (2008), consumers tend to use cash more often for small-value payments. Thus, consumer joint decisions about the value and volume of payments together determine the average payment value. Even without measurement challenges, it is

² Throughout the paper, all dollar values are expressed in constant 2015 dollars to adjust for inflation.

difficult to decompose and interpret changes in the total value, total volume, and average value of payments without a rigorous economic model.

Although we do not present such a model in this paper, we conduct two analyses to assess the observed DCPC data. First, we describe how the value, volume, and average value of consumer payments changed over time at the aggregate U.S. level and for individual consumers. These data begin to suggest how changes in survey methodology and economic conditions may have influenced consumer payment choices. Second, we conduct counterfactual simulations to quantify a likely range of estimates of the actual change in consumer preferences for cash between 2012 and 2015. We estimate standard models of consumer choices of payment instruments that depend on individual payment values, other factors related to economic conditions (for example, income and employment status), and survey methodology. These estimated models show very little change between 2012 and 2015 in consumer payments defined by the probabilities of choosing particular instruments at various payment values. We then simulate the effects of substituting the actual 2012 and 2015 distributions of individual payment values into the models of consumer payment choices for alternate years (that is, 2012 distributions into the 2015 model and vice versa). We conclude that a reasonable estimate of the change in cash volume shares that is attributable to changes in consumer preferences for cash is about -1 to -3 percentage points, which is much less than the observed change (-8.2 percentage points) and closer to the SCPC estimate ($+0.3$ percentage points).³ The remainder of the observed change in cash volume share is likely attributable to changes in survey methodology, changes in economic conditions, or both, but we do not estimate these influences separately.

³ Although we estimate the aggregate change to be modest, changes at individual merchants could differ from the aggregate. For example, Wang and Wolman (2016) report a 2.5-percentage-point-per-year decline in the volume shares of cash at a discount retailer between 2010 and 2013. For the same time period, 2010 to 2013, the SCPC finds a smaller 0.75-percentage-point-per-year decline in aggregate cash use (volume).

The remainder of this paper is organized as follows. Section 2 introduces the DCPC in greater detail and describes its relationship to the SCPC. Section 3 presents aggregate time series data on the number of payments, value of payments, and average payment value from the SCPC and DCPC. Section 4 reports the microeconomic distributions of these same payments data for individual consumers, cumulated over their three diary days. Section 5 describes the estimated models of consumer choices of payment instruments in 2012 and 2015, and reports the results of the counterfactual simulations. Section 6 concludes, and an appendix contains the technical details.

2 The Diary of Consumer Payment Choice

This section briefly introduces the DCPC and provides a high-level comparison with the SCPC. The purpose here is not to provide an exhaustive description of the DCPC or a comprehensive reporting of all the DCPC data in 2012 and 2015.⁴ Instead, the goal is to summarize the key similarities and differences between the DCPC and SCPC, and between the 2012 and 2015 DCPC, focusing on the estimates of consumer cash use.

2.1 Brief History

Since 2008, the Federal Reserve Bank of Boston has conducted the annual Survey of Consumer Payment Choice (SCPC) to provide reliable and representative time-series data on U.S. consumers' responses to the transformation of payments from paper to electronic means of payment. The SCPC was designed to measure the adoption and use of traditional and emerging payment instruments by U.S. consumers. A key contribution of the SCPC is the inclusion of currency or "cash"

⁴ More publications doing so will come later. Previous research using the 2010, 2011, and 2012 DCPC includes Bagnall et al. (2016), Briglevics and Schuh (2016), Briglevics and Shy (2012), Fulford, Greene, and Murdock (2015), Greene and Schuh (2014), Shy (2012), Shy (2013), and Shy and Stavins (2013).

(notes, bills, and coins), which had not been tracked for U.S. consumers since the mid-1980s.⁵ By including cash together with all noncash payment instruments, the SCPC provides comprehensive data about consumer payment choices.

Despite providing time series data that offers a unique measure of U.S. consumer payment trends, the SCPC has two potential shortcomings. First, the SCPC questionnaire asks respondents to recall from memory their payment choices in a “typical” week, month, or year rather than relying on recordkeeping or the use of electronic transaction files. Thus, the SCPC is potentially vulnerable to measurement error stemming from poor respondent recall, rounding, and related difficulties. Second, the SCPC collects only the number of payments made by consumers and not the dollar values of those payments. The latter shortcoming is particularly limiting for research and projection of trends because of the empirical correlation between payment value and consumer choices of payment instruments.

Consequently, in 2010, the Fed Banks began fielding pilot versions of the *Diary of Consumer Payment Choice* (DCPC) that complement and enhance the measurement of consumer payments in the SCPC. Based on early success, the Banks decided to field an official version of the DCPC in 2012. In contrast to recall-based surveys, payment diaries ask respondents to record their daily payment choices (and cash withdrawals), so they are likely to obtain better measurement of consumer payments.⁶

The primary motivation for the DCPC was to test the SCPC’s ability to accurately measure the number of consumer payments. Results of the 2012 DCPC, which revealed a much higher estimate of the cash volume share than in the 2012 SCPC

⁵ See Avery, Robert B., Gregory E. Elliehausen, Arthur B. Kennickell, and Paul A. Spindt (1987).

⁶ See Bagnall et al (2016) for an introduction to payment diaries in seven industrial countries, most of which were sponsored by central banks.

(41 percent versus 27 percent, respectively) appeared to support the presumption that the DCPC provides better estimates of payments than the SCPC, especially for small-dollar-value cash payments. A preliminary analysis by Hitczenko (2013) found that the optimal period of recall for cash is less than one week, which is the highest frequency recall period in the SCPC; thus, daily diaries likely give better estimates of cash use.

The 2012 DCPC cash volume estimate seemed to receive further support from the estimate of the value share of cash payments. At 12.4 percent, the estimated cash volume share revealed that the average value of cash payments is relatively small (\$21), and thus perhaps more likely to be overlooked in a recall-based survey. In addition, Schuh (2017) demonstrated that the aggregate value of payments in the 2012 DCPC approximately matched the estimate of personal income from the National Income and Product Accounts and generated more accurate estimates of consumer expenditures than the Consumer Expenditure Survey. Based on this relative success of the 2012 DCPC, and armed with a better understanding of the character and merits of payment diaries, the Fed Banks fielded the DCPC again in 2015 and 2016, enabling a quantitative comparison of changes in cash use over time with the SCPC estimates.

2.2 Comparison of SCPC and DCPC

The SCPC and the DCPC are complementary data collection tools that aim to measure consumer use of payment instruments (**Table 1 and Figure 1**). The SCPC and DCPC both estimate the number of consumer payments, the number of cash deposits and withdrawals, and the value of cash holdings plus (beginning in 2016) other account balances (checking, PayPal, GPR prepaid card). They also distinguish between bills, online and offline purchases, and person-to-person (P2P) payments.

**Overview of the Survey (SCPC) and Diary (DCPC)
of Consumer Payment Choice**

Table 1

	SCPC	DCPC
Owner (co-sponsors)	FR Bank of Boston	FR Bank of Boston (FR Banks of SF, Richmond)
Frequency	Annual	Irregular
History	2008-present	2010-2012, 2015-2016
Reporting period	September - December	October (except 2015)
<i>Questionnaires</i>		
Observation unit(s)	Consumers, households	Consumers
Mode(s)	Online (Internet, unaided)	Mixed – paper/online (Instructions, memory aids & Internet, unaided)
Data collection	Recall (typical period: day, month, year)	Recording and recall (day)
Time burden	30 minutes	Up to 20 minutes/day, 3-4 days
Incentive	\$20	\$60-70
Summary of contents	Instruments, ratings of traits Adoption of accounts Account balances Adoption of instruments Cash balances Cash withdrawals Use of instruments (#)	Instruments, preferences Account balances Instruments carried/available Cash balances Cash deposit & withdrawals Use of instruments (#,\$) Instruments, choice reasons
Measurement period	"Typical" [period] (week/month/year)	Daily (3 consecutive, randomly assigned)

Source: Federal Reserve Bank of Boston.

DCPC evolution, 2012 to 2015

Figure 1

SCPC	Night Before 2015	Recording—3 Days		SCPC 2012
		Payments	Accounts	
Some complete SCPC before DCPC	Account ownership	Date, time, \$ value, payment instrument, in person/not in person, device, payee	Cash balances on person & elsewhere	Some complete SCPC after taking DCPC
All complete SCPC before DCPC	Cash balances on person & elsewhere	45 payee types 9 payee categories with follow-ups to further classify	Cash deposits to checking account	
Assessment, adoption, use of payment instruments	Checking, GPR prepaid, PayPal balances	Follow-up questions appropriate to payee	Other deposits to checking account (including income)	
Adoption of bank & nonbank accounts	\$ value & timing of income receipt	More follow-up questions based on payment instrument	Cash withdrawals	
Cash balances	Payment preferences (by transaction type)	Timeliness of bill payment	Other withdrawals	
Checking balances			Transfers between accounts	
Underbanked				
Virtual currency				
	First Day 2012	Special Modules 2015		
	Opening cash balance on person	Day 1: Emergency savings Day 3: Bill payment (41 types)		
	Timing of income receipt			
	Payment preference (general)			

Source: Federal Reserve Bank of Boston.

Note: 2015 additions and enhancements in bold.

Important differences between the SCPC and DCPC, however, could lead the two instruments to produce different estimates of the total number of payments and of cash use. These differences include recall versus reporting (described above), reporting periods, payment information that is collected, survey mode, and survey administration period. The SCPC and DCPC also have different reporting periods for measuring payments. The SCPC asks respondents to estimate numbers of payments in “typical” time periods, for example, a “typical month,” and estimates the total number of payments made by U.S. consumers in a typical month. The DCPC asks respondents to report every payment they make over an assigned three-day-period (during October in 2012 and between October 16th and December 15th in 2015) and reports an estimate of the total number and value of payments made by U.S. consumers during these periods. In contrast to the SCPC, and as noted above,

the DCPC asks respondents to report information about specific payments, including dollar values. Consumers also report the date and time of their payment, the payee, and whether or not a device, for example, a mobile phone or laptop, was used.

The SCPC and DCPC also differ in survey methodology. The SCPC is an online internet survey; respondents are asked to take both the SCPC and DCPC but receive no instructions about the SCPC before they begin. The DCPC is mixed mode, with respondents receiving various supports. Before the DCPC begins, consumers receive an introductory email describing its multi-day structure; are sent written and video instructions for reporting payments, and receive two types of paper memory aids (large format including instructions and pocket-sized) as well as a pouch for collecting receipts. These additional supports are expected to lead to more precise reporting of consumers' actual activities. Respondents take the SCPC in one sitting; DCPC respondents go online over three or four days to record payments activity, cash holdings, income receipt, deposits and withdrawals, etc. The DCPC builds its monthly estimate of payments from three-day waves of respondents randomly distributed throughout the month. The SCPC estimate is based on consumer recall.

2.3 Improvements to DCPC Survey Methodology

The 2012 and 2015 DCPC estimates differ due to two improvements in survey methodology between the two periods: 1) revisions to the survey questionnaire (**Figure 1**); and 2) a switch to a better sampling frame (**Table 2**). In addition, some of the questionnaire improvements had some practical flaws, and the sampling frame was so new that the 2015 sample was limited to a smaller size than desired. Furthermore, the changes in survey methodology make it difficult to identify economic changes that could be affecting consumer expenditures and changes in consumer preferences for payment choice over the three years. Therefore, readers should not treat the difference between the 2012 and 2015 DCPC estimates as an unbiased estimate of the actual change during this period. This warning applies to

the total number of payments, the numbers and shares of payments by payment instrument, and potentially other estimates from the DCPC for 2012 and 2015.

**Comparison of DCPC sampling frames and samples,
2012 and 2015**

Table 2

	2012 DCPC	2015 DCPC
Vendor	RAND Corporation	University of Southern California
Target population	Age 18+, non-institutional	Age 18+, non-institutional
Sampling frame	American Life Panel (ALP)	Understanding America Study (UAS)
Frame recruitment	80% convenience sample, some referrals by panel members, some address-based sampling	100% address-based sampling
Frame size	~5,500	~1,400
Outsourced sampling frame	None	GfK Knowledge Panel
DCPC sample recruitment	Random representative subject to maximum matching with SCPC longitudinal panelists	Invite all panel members; random selection of UAS repeat diarist (509); random selections of GfK members
DCPC time period	October 1-31	October 16-December 15
DCPC sample size, # of respondents (# of completed diaries)	2,468 (2,468)	Total: 1,392 (1,901) UAS: 1,076 (1,585) GfK: 316 (316)
DCPC sample size in comparable time period (October 16-October 31)	1,398	390

Source: Federal Reserve Bank of Boston.

2.3.1 Questionnaire Revisions

Changes to the 2015 DCPC questionnaire include new questions and improvements to existing questions. New questions were added to collect additional information about consumers' assets and income available for making payments, to capture information about noncash deposits and withdrawals, and to expand understanding of consumers' payment preferences. Improvements were designed to refine classification of consumer expenditures and to improve recall and reporting of bill payments. New questions likely did not play a role in the measurement consumer payment choices for 2015 relative to 2012. Improvements, while important for the DCPC in the long run, may have reduced comparability of the 2015 and 2012 DCPC data. Important additions and improvements are described below and summarized in **Figure 1**.

There are four important additions. First, a 10-minute "night before" survey was added to ensure accurate reporting of cash holdings and other financial assets *before* consumers began reporting payments. In comparison, in 2012, consumers were asked to report cash in their pocket, purse, or wallet but not cash they stored elsewhere or their balances of other financial assets. The 2015 night-before reporting makes it possible to maintain a running tally of cash, checking account balances, GPR prepaid card balances, and PayPal balances as consumers make payments during their three-day reporting period and to cross-check that tally against consumers' reported holdings and balances. This is valuable for error-checking and also for understanding consumers' payment choices in the context of their available financial resources and flows into and out of their accounts.

Second, in 2015 consumers provide more detailed information about their sources of income and directly report the timing of its receipt. Similar to the improved reporting of financial assets, this change makes it possible to examine payment instrument choices in the context of current and expected financial resources. In 2012, consumers reported their primary source of income, their last receipt of

primary income, and their next expected receipt of primary income. In 2015, this category of questions was expanded and consumers reported all sources of income and the frequency with which they received them. In addition, consumers were asked to report the dollar value of any income received on the date of their “night before” survey and also on each of their three diary days. In 2012, consumers did not report dollar values for income received.

Third, the scope of the DCPC was expanded to include more information about deposits and withdrawals. In 2014, the reporting of such transactions was limited to cash deposits and withdrawals. In 2015, consumers also reported transactions that affect noncash balances, including the dollar values of transfers from one account to another, the receipt of income by noncash payment methods, and non-cash withdrawals.

Fourth, in 2015 questions about consumers’ preferred method(s) of payments were expanded to put preferences in the context of specific payment situations and dollar amounts. In 2012, consumers reported the payment method they most prefer to use. In 2015, as part of the night-before survey, consumers answered four sets of questions about their preferred payment methods for bills, for purchases, for online payments, and for in-person purchases conditional on dollar value (arranged in four groups by dollar value). Then in 2015, as consumers reported each payment over the next three days, they answered follow-up questions about their reasons for using (or not using) their stated preferred payment instrument, given the transaction type (bill or nonbill).

Two changes to methods of asking about payee and bills in the DCPC questionnaire could have affected measurement in 2015 and comparability to 2012. First, the change to the payee classification method made it possible to add follow-up questions dependent upon payee type (medical, financial services, etc.) in order to

more clearly distinguish among different types of consumer expenditures.⁷ In 2012, respondents were asked to report what person or entity was paid in 44 categories according to NAICS codes.⁸ In 2015, nine filter categories were used for the initial identification of payee type and respondents received additional entry screens to further classify the payee type. Follow-up questions were conditional on which of the nine filter categories was selected.

Second, a new 10-minute module was added to 2015 DCPC reporting day 3, where respondents were offered reminders about 42 types of bills in six categories.⁹ Results of the 2012 DCPC compared to the 2012 SCPC suggested that the DCPC may have been undercounting bill payments¹⁰; this new module addressed that concern. Prior research in survey methodology would predict that these reminders would result in a larger number of bills being reported compared to the number reported in response to a more general question (Menon 1993; Winter 2004; Comerford, Delaney, and Harmon 2009; Jagger et al. 2012; Hitczenko and Tai 2014).

2.3.2 New Sampling Frame

The sampling frame for the DCPC was the RAND American Life Panel (ALP) in 2012. Beginning in 2014, the Boston Fed began to implement the SCPC, and eventually the DCPC, with the University of Southern California's Understanding America

⁷ Analysis of the 2012 DCPC found that it accurately estimated consumption expenditures and disposable personal income (Schuh, 2017). In 2015, follow-up questions conditional on payee classification identify consumption spending, purchases of durable goods, and the need to make a payment in response to an emergency.

⁸ North American Industry Classification System.

⁹ The Boston Fed conducted two experimental surveys in 2014, where consumers were offered lists of bill types as reminders (Zhang 2016). As a result of these experiments, reminders of the following categories of bills were added to the 2015 DCPC: household or utility payments; phone, cable, or internet payments; credit card or loan payments; insurance payments; other types of payments, including tuition and medical bills; and tax payments.

¹⁰ Bill payments include bills paid automatically, bills paid electronically, and bills paid by mail, in person, or by phone.

Study (UAS) panel. The main reasons for the switch were to take advantage of UAS improvements in panel recruitment, hence representativeness, and to avoid some limitations in the ALP. While this panel change is expected to provide more representative results, the transition necessitated a different sample period and a smaller sample size in 2015, both of which reduced comparability with 2012.

The UAS panel is being drawn with improved sampling methods, so it is expected to provide more representative results.¹¹ The ALP, used from 2008 to 2014 for the SCPC as well as for the 2012 DCPC, was recruited using a combination of 80 percent convenience (volunteers from existing panels), snowball (referrals to friends and relatives), and address-based sampling. In contrast, 100 percent of the UAS panel has been recruited using the address-based sampling method of Dillman (2014), which is expected to lead to a more representative group of respondents, such as respondents who are not particularly interested in personal finance, who do not necessarily take surveys, and who may be English language learners.

Indeed, evidence from the 2014 SCPC suggests that differences between the ALP sample in 2012 and the UAS sample in 2015 could be affecting DCPC estimates. The 2014 SCPC was administered to samples of both the ALP and the UAS. The two questionnaires were identical but some 2014 survey estimates are markedly different between the two samples. In particular, the UAS sample found greater shares of consumers adopting prepaid cards, money orders, bank account number payment (BANP), and debit cards. These differences in adoption rates were statistically significant and are not explained by observable demographic differences.¹²

¹¹ For details about the discrepancies between estimates from the 2014 ALP and 2014 UAS, see Angrisani, Foster, and Hitczenko (2017).

¹² Bank account number payment is defined as “a payment made by providing your bank account number to a business, organization, or person, such as an insurance or utility company. You can give your number on websites, paper forms, etc.” Additional research is needed to understand the effects of panel differences. One possibility is survey experience. In 2014, ALP respondents had been taking surveys for seven years and the UAS panel was new.

On the other hand, the 2014 SCPC estimates of payment instrument shares from the ALP and UAS are more similar, as shown below.

In 2012, the DCPC was in the field from September 29 through November 2. In 2015, the DCPC was implemented later (October 14 to December 17) due to the transition from ALP to UAS, and extended to study payment instrument choice during the holiday shopping period. This extended implementation period has some advantages, but it makes it more difficult to compare estimates for the two years. For purposes of this report, we look at the two 16-day periods of October 16th through October 31st to minimize discrepancies between the estimates due to seasonal effects from non-overlapping time periods.

One limitation of drawing a sample from the UAS panel in 2015 was that the sample size were smaller than desired. The UAS panel only began in 2014, so it was still small and in the formative stages. By October 2015, the UAS contained less than 2,000 total panelists. Consequently, there were only 1,392 unique UAS respondents included in the 2015 SCPC and DCPC, although some DCPC respondents agreed to take the diary twice to increase the number of responses. By contrast, there were 2,468 unique DCPC respondents in 2012. Thus, for the comparable time periods (October 16-31), there were only 1,398 respondents in 2012 DCPC and 390 respondents in the 2015 DCPC (see **Table 2**).¹³

Table 3 describes the demographic composition of the two panels for the comparable periods. There are no statistically significant differences between the two years for the following observed variables: household income, age, race, education, and gender. While not statistically significant, the percentage of people employed was 3.5 percentage points higher in 2015 at 60.4 percent. However, the

13 No members of the GfK Knowledge Panel took the survey between October 14 and November 2, 2015. The 2015 sample used for this paper is exclusively the UAS.

**Demographic composition of DCPC samples,
2012 and 2015 (percentage shares)**

Table 3

		Full Sample			Did not make a payment		
		2012	2015	Difference	2012	2015	Difference
Income	Less than \$25,000	22.3	23.5	1.3	49.9	47.5	-2.40
	\$25,000-\$49,999	25.4	25.2	-0.2	27.0	16.0	-10.98
	\$50,000-\$74,999	17.8	16.6	-1.2	8.0	12.4	4.44
	\$75,000 - \$99,999	13.1	12.5	-0.6	10.1	10.2	0.19
	\$100,000-\$124,999	9.6	8.5	-1.1	3.3	3.6	0.27
	More than \$125,000	11.7	13.5	1.8	1.7	10.2	8.48
Age	Under 25	7.9	6.6	-1.4	15.1	8.6	-6.50
	25-34	21.0	23.1	2.1	27.3	18.0	-9.26
	35-44	16.6	16.7	0.2	15.3	15.1	-0.23
	45-54	19.2	17.5	-1.7	15.8	21.3	5.43
	55-64	16.9	17.2	0.3	10.2	19.5	9.27
	Over 65	18.4	18.9	0.5	16.2	17.5	1.29

Source: Federal Reserve Bank of Boston. Notes: All values shown above are percentages. For year-to-year comparability and to avoid holiday effects, the data for this report is restricted to respondents participating between October 16 and October 31 in each year. Results from the 2012 and 2015 DCPC are preliminary and subject to change.

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		Full Sample			Did not make a payment			
		2012	2015	Difference	2012	2015	Difference	
	Edu- cation	High school or less	41.8	40.9	-0.9	70.0	48.2	-21.86*
		Some college	28.8	28.5	-0.3	20.9	32.6	11.65
		Bachelor's degree	17.3	18.0	0.6	5.0	5.9	0.98
		Graduate degree	12.1	12.6	0.6	4.1	13.3	9.22*
	Race	Black	12.6	13.7	1.0	19.3	27.6	8.29
		Other Race	10.8	8.1	-2.7	11.0	11.4	0.42
		White	76.5	78.0	1.4	69.8	61.1	-8.71
	Gender	Female	51.5	52.5	1.0	54.4	55.9	1.49
		Male	48.5	47.5	-1.0	45.6	44.1	-1.49
	Employ- ment Status	Employed	56.9	60.4	3.5	35.3	39.6	4.29
		Unem- ployed	7.7	7.7	0.0	20.9	21.1	0.25
		Out of Labor Force	35.4	31.9	-3.5	43.8	39.3	-4.54

panels differ in the percentage of respondents who report making no payments during their diary days. In 2012, 7.8 percent unweighted (10.0 percent weighted) of respondents reported making no payments, compared to 12.6 percent unweighted (12.0 percent weighted) in 2015. This difference impacts the number of payments, and possibly their composition as well.

To evaluate the effect of a change in the share of the number of respondents with zero payments, we conduct the following exercise. Assuming that the 2015 sample is more representative of consumers with zero payments, we can adjust the share of consumers making zero payments in 2012 to equal the share in 2015, 12.0 percent.¹⁴ The simulated increase in the 2012 share of zero-payment consumers causes a decrease in the 2012 average number of transactions per month (to 56.7) and the 2012 average number of cash transactions per month (to 22.8). Under this simulation, the 2012 share of cash transactions would have been 40.3 percent instead of 40.7 percent (**Table 4**) and the percentage point decline from 2012 to 2015 would have been 7.8 percentage points instead of 8.2.¹⁵

**Effect of adjusting 2012 share of DCPC respondents
with zero transactions to 2015 level**

Table 4

	Actual	Adjusted*	Difference
Total Number of Transactions	57.8	56.7	-1.2
Number of Cash Transactions	23.5	22.8	-0.7
Share of Cash	40.7%	40.3%	-

Source: Authors' calculation. Note: * Adjustment makes the 2012 share of diaries with zero transactions equivalent to the 2015 share.

¹⁴ These percentages are weighted for the 2012 and 2015 diary respectively. This simulation was also conducted for the 2015 diary, but the magnitude of the results were similar.

¹⁵ These percentages are weighted for the 2012 and 2015 diary respectively. This simulation was also conducted for the 2015 diary, but the magnitude of the results were similar.

2.4 Changes in Economic Conditions

In addition to changes in survey methodology, the U.S. economic expansion matured from 2012 to 2015 so consumers faced different economic conditions in which to make their payment choices. Without a structural economic model of consumer choice of the number of payments, it is not possible to identify exactly how these economic changes affected the DCPC estimates. However, there are some general economic conditions reported in the DCPC that can be used to control for the economic changes in an approximate, reduced-form manner when estimating models of consumer payment choices.

Perhaps the clearest and most easily measured change was the decline in the unemployment rate of nearly 3 percentage points (from 7.8 percent in October 2012 to 5.0 percent in October 2015). Evidence suggests that consumers are less likely to have bank accounts and credit cards when unemployed (Cole 2016). Therefore, an increase in employment likely would lead to increased access to additional payment instruments (credit cards and the payment instruments linked to a bank account [paper checks, debit cards, BANP, and online banking bill payment]). Consumers with more choices are less likely to choose any individual option for a given payment. That is, consumers with only two or three choices of payment instrument are that much more likely to choose cash in any given situation. Thus, lower unemployment could be related to a decline in the shares of payments made in cash.

A second potential influence of economic activity is that economic expansion and growth changes the opportunity cost of time for consumers. In theory, if it takes a substantial amount of time for consumers to shop and make payments, then so-called “shopping time” competes with consumers’ time at work earning wages and time from leisure. So, if the value of work or leisure rises, consumers might be more inclined to spend less time shopping, which could manifest itself in the form of fewer shopping trips (and payments) with larger average payment values. It is unclear, however, how large an effect the opportunity cost might have on the

number and average value of payments.

Other types of economic changes may also have influenced the 2012 and 2015 DCPC estimates in ways that are harder to identify and explain. As economic growth stabilized and utilization of resources increased, it is likely that risk declined and distress (bankruptcy, foreclosure, etc.) also eased. But it also became more evident that trend productivity growth was lower, which may have affected expectations of future income. Both risk and trend growth could affect saving and credit decisions, which may influence payment choices in complex ways. Finally, innovations in payment services are a key part of fintech, and these innovations almost surely are affecting payment choices.

2.5 Implications for Measurement of Payment Choices

Taken together, some of these changes in survey methodology and in economic conditions could have affected the measurement of payment behavior in 2015. Table 5 provides qualitative assessments of the possible effects of these measurement changes. Many of the questionnaire improvements in 2015 were related to collecting deeper information about accounts and preferences. These changes were unrelated to the reporting of the total number of payments, small-dollar-value payments, shares of bill payments, and shares of payments by merchant category. Two changes – the new way of collecting the payee type and the new bill payment module – could have affected some of the measures listed in Table 5, in particular, the number and percentage share of bill payments and the change in the distribution of payee types.

As noted above, requiring consumers to indicate whether or not they had paid any of 42 types of bills would be expected to result in a larger number of bills being reported compared to the number reported in 2012. If the number of nonbills reported remained constant, this would have the effect of increasing the share of bills payments and, presumably, decreasing the share of cash payments (because a

**Factors that could affect changes in estimates,
2012–2015**

Table 5

Observed	2012-15 change	Possible factors in change		
		Questionnaire	Sampling frame	Economic change
Total payments	↑	○	●	?
Zero payments	↑	?	●	○
Bills (#, share)	↑	●	◐	●
Small-value payments (#)	↓	?	●	●
Total value of payments: nominal	–	○	●	●
Total value of payments: real	↓	○	●	●
Merch categories (share of # in cash intensive)	↓	?	?	●

Source: Authors' analysis.

Likelihood of influence: ● High. ◐ Medium. ○ Low. ? Unknown.

relatively small share of bills are paid with cash).

As a result of the changes to the payee classification method, some popular categories of retail purchases were less prominently displayed in the online questionnaire. These included fast food, grocery stores, pharmacies, liquor stores, restaurants, bars, and gas stations—payees where cash is often used. Therefore, it is possible that these changes, while enabling other innovations, could have depressed the number of cash transactions reported. Compared to 2012, the 2015 DCPC finds fewer transactions in these cash-popular categories.

The change in the sampling frame appears likely to have been more influential. A more representative sample—composed of larger shares of respondents who are not necessarily interested in personal finance or regular survey-takers—could result in a different estimate of the total number of payments, the share of respondents with zero payments, the number and share of bill payments, the number of small-dollar-value payments, the total value of payments, and the distribution of payee types. In addition, changes in economic conditions also could affect many of these measures.

To summarize, there are reasons to suspect that changes in survey methodology and economic conditions affected the comparability of the 2012 and 2015 DCPC estimates. However, precise identification of these effects requires considerably more research and modeling of consumer payment behavior. Furthermore, the relative imprecision of the 2015 estimates due to smaller sample sizes makes it difficult to identify statistically significant differences from 2012.

3 Aggregate Time Series Data

This section compares and contrasts aggregate data from the SCPC and DCPC over time.¹⁶ We focus on estimates of the number of payments per consumer and total value of payments per consumer (both per month, the latter in constant 2015 dollars). For each measure, we also present shares of payment instrument use by number (volume shares) and value (value shares). Finally, we examine the average dollar value of payments, which equals the value of all payments divided by the total number of payments. The analysis focuses on total payments and cash payments, but debit and credit cards are included in some comparisons.

3.1 Number of Payments

Time series estimates of the number of payments per consumer are plotted in **Figure 2**. The solid lines indicate the DCPC estimates; the dashed lines are the SCPC estimates. As indicated by the vertical line, data through 2014 are estimated from the ALP, and data from 2015 and 2016 are from the UAS panel. **Tables 6 and 7** provide detailed estimates of the number, value, and average value of payments for 2012 and 2015 during their common sample period (October 16–31), converted to a monthly rate. These tables include all of the estimates in Figures 1 through 5 for total and cash payments, as well estimates for all other payment instruments.

DCPC estimates of the number of total payments per consumer are notably lower than the SCPC estimates. For 2008 to 2016, the estimated SCPC number of payments fluctuated in the range of 66 to 71 payments per month without any apparent major trend. In 2012, the DCPC estimate (57.8) was about 11 payments per

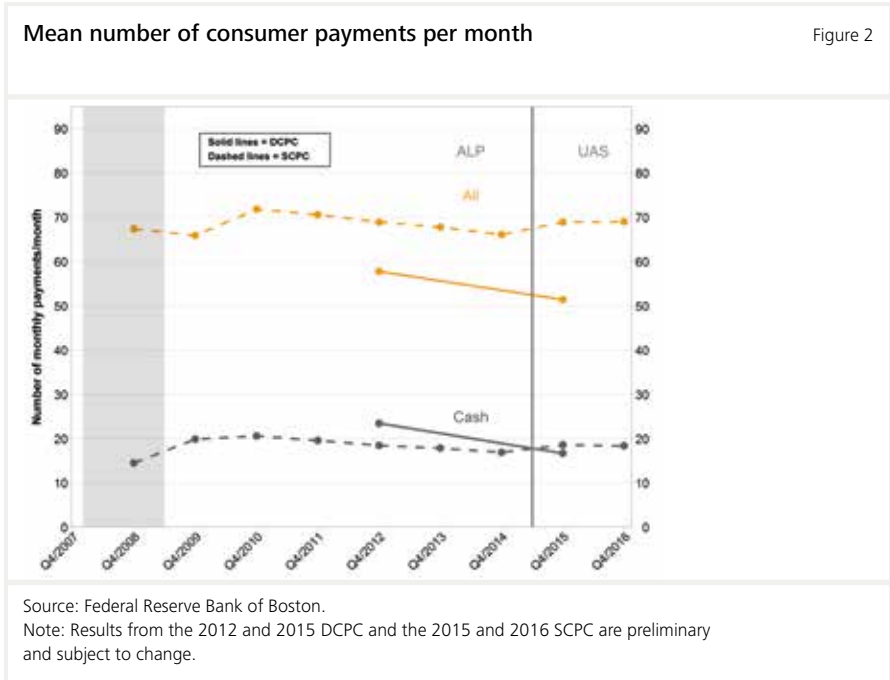
16 The Fed Banks also conducted pilot studies of the DCPC in 2010 and 2011, but we do not include the data from them here. Although the basic focus on the number and value of payments by instrument was the same, the 2010 and 2011 questionnaires were earlier, less complete versions of the 2012 questionnaire. And although the sample was administered to the ALP, the sample sizes were much smaller (less than 400) and much less representative than 2012.

month lower than the SCPC estimate. In 2015, the DCPC estimate (51.4) was about 18 payments per month lower than the SCPC. The relative magnitudes of the DCPC and SCPC estimates are surprising given that daily recording of payments in the DCPC is expected to provide a more accurate estimate than the SCPC's recall method of reporting. One possible explanation of these results is that the SCPC data cleaning procedure may not be handling unusually large numbers of payments properly.¹⁷

In contrast, the DCPC and SCPC estimates of the number of cash payments are more similar. Following a large increase in 2009, the SCPC estimate of cash payments was relatively steady at 18 to 20 payments per month. The 2012 DCPC estimate (23.5) was above the SCPC, and the 2015 DCPC estimate (16.7) was below. This result implies that the gap between SCPC and DCPC estimates of the number of total payments primarily occurred in the estimates for all noncash payments.

Comparing 2012 and 2015, Figure 2 shows a discrepancy between the data sources over time. In contrast to the DCPC, the SCPC estimates of the total payments were about the same in 2012 and 2015 (68.9). In fact, the difference between the 2012 and 2015 DCPC estimates of the number of payments is larger than any three-year difference observed in the SCPC time series. This discrepancy remains when we look at the number of cash payments. The number of cash payments in the 2015 DCPC was 28.9 percent lower than the 2012 DCPC estimate, while the 2012 and 2015 SCPC estimates were the same (18.6). Again, the difference between 2012 and 2015 DCPC cash estimates was larger than any three-year period in the SCPC. Perhaps the SCPC's measurement of "typical" payments may smooth higher frequency fluctuations that could be affecting consumer payments in the DCPC. However, the fact that the SCPC estimates of total payments did not decline in 2015 relative to 2012 raises doubts that the change in sampling frame or

¹⁷ For details of the SCPC data cleaning procedure, see Angrisani, Foster, and Hitczenko (2017)



economic conditions can explain the result because both types of changes occurred equally for the SCPC and DCPC.

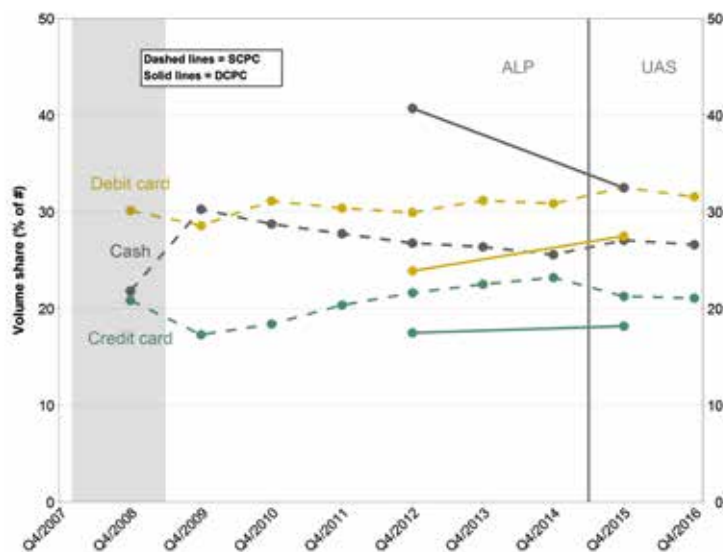
The volume shares of payments provide a complementary perspective on the number of payments (**Figure 3**). The SCPC data indicate that U.S. consumers made three-fourths or more of their payments in 2008–2015 using three instruments: debit cards, cash, and credit cards.¹⁸ The most notable fluctuation in the SCPC shares occurred after the financial crisis, when the cash share increased and the credit card share decreased. As the economy recovered, these shares have moved back toward their pre-crisis levels, although the cash share in 2016 remains above

¹⁸ For more details, see Greene, Schuh and Stavins (2016) and its predecessor reports cited therein.

the share in 2008. The DCPC estimates of volume shares indicate the same three instruments account for most consumer payments. However, the cash share is considerably higher in the DCPC than in the SCPC, and the debit and credit card shares are higher. Perhaps this higher ordering of cash estimates reflects better measurement from recording smaller cash payments in the DCPC than relying on recall estimates in the SCPC. In any case, the implied changes in cash estimates from 2012 to 2015 are quite different: the 2015 DCPC cash share is 8.2 percentage points lower than in 2012 (40.7 versus 32.5 percent); the 2015 SCPC cash share was 0.3 percentage points higher than in 2012 (26.8 versus 27.1 percent).

**Share of consumer payments per month (number),
by type of payment instrument**

Figure 3



Source: Federal Reserve Bank of Boston.

Note: Results from the 2012 and 2015 DCPC and the 2015 and 2016 SCPC are preliminary and subject to change.

3.2 Value of Payments

Estimates of the real (inflation-adjusted) value of payments per consumer from the DCPC for 2010–2015 are plotted in **Figure 4** (constant 2015 dollars); recall that the SCPC does not collect payment values. In 2012 and 2015, the average real value of total payments was approximately \$4,000 per consumer per month, which implies average annual *household* spending of roughly \$96,000.¹⁹ This estimate is roughly comparable to average household income from the Survey of Consumer Finances, and is close to estimates of personal disposable income from the National Income and Product Accounts (see Schuh [2017]). However, the estimated 2015 real value of total payments was 2.2 percent lower than it was in 2012, while real disposable income increased 6.2 percent during this same period.²⁰ The real value of cash payments is about one-eighth as large (\$450–\$500 per month) as the value of total payments and moves similarly to total payments, with the 2015 real value of cash payments being 10.0 percent lower than in 2012.

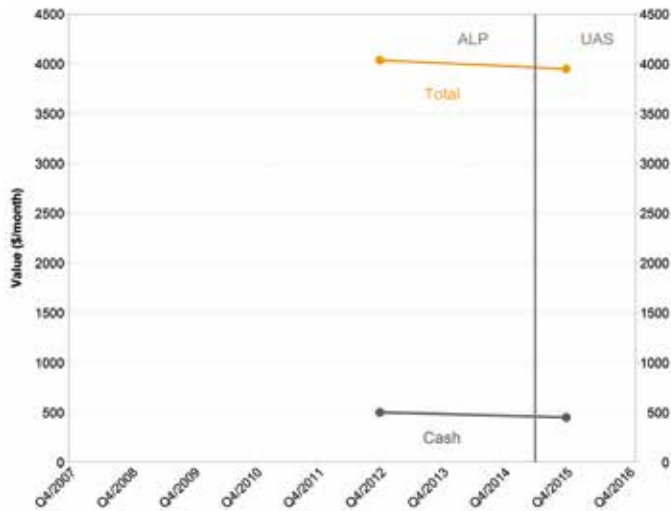
The value shares of payments for cash, debit, and credit are roughly similar in magnitude, as seen in **Figure 5**, but lower than their corresponding volume shares. The three value shares range from about 11 to 20 percent in 2012 and 2015 and are relatively stable throughout time. In contrast to the corresponding volume shares, where these three instruments accounted for the vast majority of the number of payments, their value shares sum to less than half of the total value of consumer payments. The cash share in 2015 was 11.4 percent, only 1.0 percentage point less than in 2012, which is not surprising given the stability and correlation of the levels of the real values of total and cash payments. The credit card share also was moderately lower in 2015, while the debit share was about 5 percentage points

¹⁹ This calculation assumes October is an average month in terms of seasonal factors, which it appears to be, and that there are approximately 2.01 consumers per household in the United States.

²⁰ The payments and income measures have not been adjusted for comparability yet, and the DCPC payments estimate does not include a portion of the personal saving part of income. Consequently, moderate deviations in the growth rates of these two estimates do not necessarily indicate error but do warrant further analysis.

Dollar value of consumer payments per month, for all and cash

Figure 4

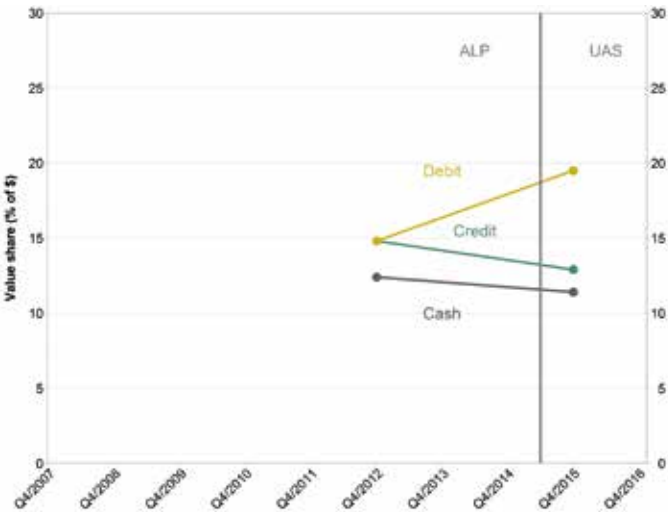


Source: Federal Reserve Bank of Boston. Notes: Expressed in 2015 dollars. Results from the 2012 and 2015 DCPC are preliminary and subject to change.

higher – more than accounting for the lower shares of cash and credit.

Share of consumer payments per month (dollar value),
by type of payment instrument

Figure 5



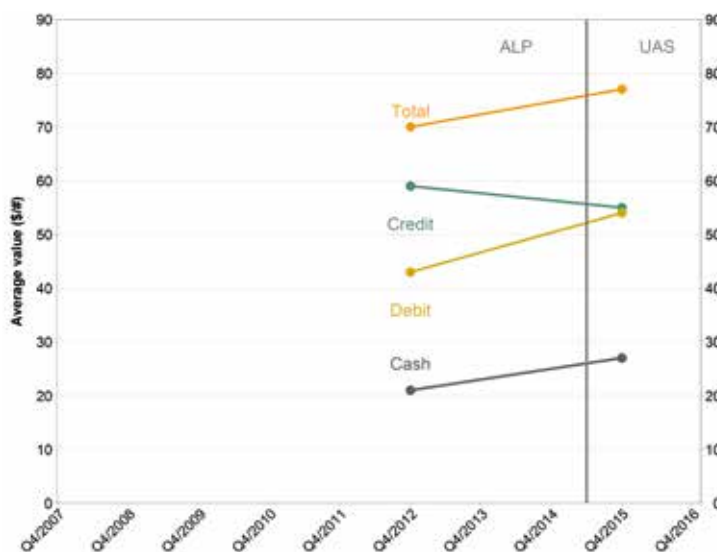
Source: Federal Reserve Bank of Boston. Notes: Expressed in 2015 dollars. Results from the 2012 and 2015 DCPC are preliminary and subject to change.

3.3 Average Payment Values

Estimates of the average payment value, defined as the total value of payments divided by the total number of payments, for 2010-2015 are plotted in **Figure 6**. Given that the number of total payments was lower in 2015 than in 2012, and that the value of total consumer payments was about the same in both years, it is not surprising that the average payment value was higher in 2015. The average value of all payments in 2015 was \$77, 13.2 percent higher than in 2012 (\$70). Similarly, the average value of cash payments in 2015 was \$27, or 28.6 percent higher than in 2012 (\$21); in contrast, the average value of credit payments was lower in 2015.

**Average dollar value of consumer payments,
for all and by type of payment instrument**

Figure 6



Source: Federal Reserve Bank of Boston. Notes: Expressed in 2015 dollars. Results from the 2012 and 2015 DCPC are preliminary and subject to change.

4 Individual Consumer Data

This section reports and analyzes the underlying payment choices of individual consumers in 2012 and 2015. As noted earlier, the aggregate results may be influenced by changes in survey methodology (questionnaires or sampling frames), changes in the U.S. economy between 2012 and 2015 that influenced consumer economic behavior, or both.

4.1 Diary-period Observations

To evaluate changes in individual consumer payment behavior, we constructed the total number of payments made by each respondent (consumer) during his or her respective three-day diary period and the sum of the dollar values of those payments, as well as the three-day average payment for each respondent (three-day value divided by three-day number). These individual diary-period observations are unique to the consumer for whom they are constructed and, thus, summarize the behavior of one consumer over three days. An individual's three-day observed behavior, however, is not necessarily representative of his or her behavior during the remaining days of the month.²¹ Nevertheless, random sampling of diary respondents based on demographic characteristics throughout the month should produce estimates that reflect the average behavior of consumers for the entire month properly, as explained in Schuh (2017).

Another reason to examine three-day behavior is to isolate and highlight important differences across consumers. For each individual payment, the dollar values may range from one cent (\$0.01) to an extremely large value (say \$40,000 for a new

21 For at least two reasons, three days may not be representative of the month: 1) seasonal effects during a respondent's three-day period may influence his or her payment behavior, and these seasonal effects may vary across consumers; and 2) infrequent events, such as cash deposits (rare among consumers) or buying a new car (large-value purchases), lead to small samples that do not reveal the full extent of consumer behavior

car, \$500,000 to pay off a mortgage, or even larger amounts). In contrast, the number of transactions for each individual payment is one (1). Thus, there is wide cross-section variation in the value of individual payments but no variation in the number. Hence, adding up all payments by an individual consumer over three days generates meaningful cross-section heterogeneity in the number of payments. At the same time, adding up the value of all payments by an individual consumer over three days actually reduces cross-section heterogeneity by combining large- and small- value payments to smooth out spending by individual consumers in a meaningful way. For example, consumers with very high income and very low income both make small-value payments, for example, a \$2 cup of coffee, but their incomes probably have little bearing on that particular payment choice. High-income consumers, however, are more likely to make payments with a higher total value over a three-day period.

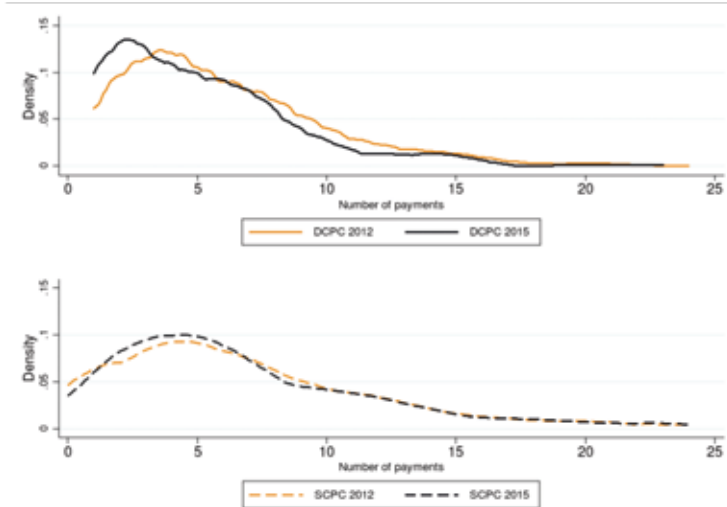
The average consumer made between 5 and 6 payments during a three-day period (5.6 in 2012 and 5.0 in 2015), or slightly less than 2 payments per day (1.9 versus 1.7) (see **Tables 6 and 7**). It is difficult to assess the economic plausibility of these estimates, because the number of payments is not included in basic economic theories about consumer expenditures and the economics literature has little or no research addressing this topic.

4.2 Number of Payments

Distributions of the estimated three-day number of payments for individual consumers from the SCPC and DCPC in 2012 and 2015 are plotted in **Figure 7**. Comparing the SCPC and DCPC estimates of the number of payments has two purposes here. First, consistent with the aggregate results in Figure 2, **Figure 7** shows that the distributions of estimated payments in the SCPC (bottom panel) are shifted to the right of the distributions in the DCPC (top panel); thus, the SCPC estimates are higher than the DCPC for reasons that are hard to explain. Second, **Figure 7** shows that the distributions of estimated payments in 2015 relative to their analogous

Distribution of the number of consumer
payments per three-day period

Figure 7



Source: 2012 and 2015 SCPC; 2012 and 2015 DCPC. Notes: Consumers with zero transactions for their three days are omitted. Results from the 2012 and 2015 DCPC and the 2015 and 2016 SCPC are preliminary and subject to change.

distributions in 2012 differ significantly between the SCPC and DCPC. The SCPC distributions in 2012 and 2015 (bottom panel) are quite similar in mean and variance. Conversely, the DCPC distribution in 2015 is shifted to the left of the 2012 distribution, reflecting a lower number of payments *even conditional on omitting the zero-payment respondents*. The 2015 DCPC distribution also reflects a greater proportion of lower value payments (higher peak at low values) in addition to the reduction (leftward shift) in the number of payments.

The disparity in the SCPC and DCPC relative estimates of the number of payments in 2015 versus 2012 suggests that the change in the 2015 sampling frame may have a greater impact on the DCPC since, as noted in section 2, respondents may smooth higher frequency fluctuations that are not affecting payments reported in the SCPC. Although it is conceivable that changes in economic conditions could have led to consumers reducing their number of payments, one might have expected to see this reduction in both the DCPC and the SCPC. However, this expectation relies on the assumption that the SCPC and DCPC measure the number of payments equally well, which may not be true for several reasons, including differences between the recall and recording methods of reporting payments (see Section 2.2).

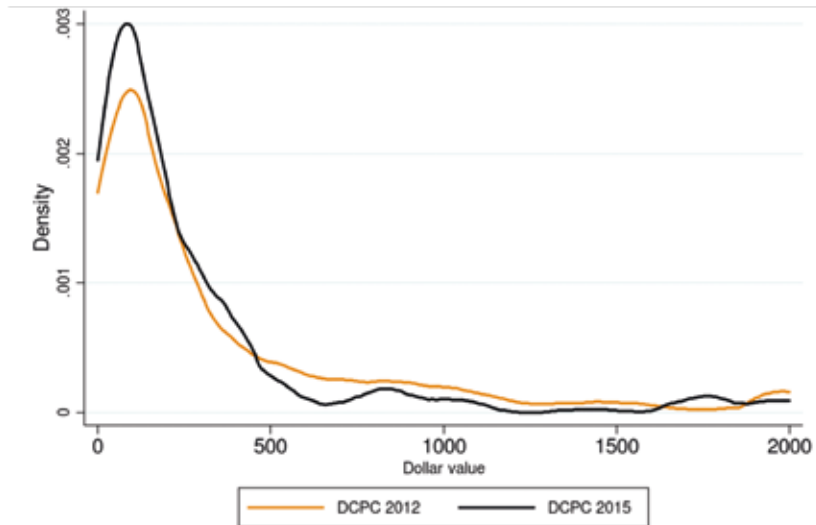
4.3 Value of Payments

Distributions of the estimated three-day value of payments for individual consumers from the DCPC in 2012 and 2015 are plotted in **Figure 8** (recall that there are no estimates of payment value in the SCPC). Unlike the DCPC distributions of number of payments, the distributions of payment values did not shift in 2015 relative to 2012, again conditional on omitting the zero-payment respondents. This finding is consistent with the fact that the total value of payments increased only 0.8 percent in 2015 from 2012, as noted above. However, the 2015 distribution of payment values is different from 2012 in the frequency of low- versus high-value payments. In 2015, the share of consumers making payments of less than about \$500 during the three-day period was higher than in 2012, especially for exceptionally low values (\$100 or less). Conversely, the share of consumers making higher value payments was lower in 2015 than in 2012, especially in the range of about \$500 to \$1,500.

To summarize, **Figure 8** indicates that while the estimated total value of payments was about unchanged between 2012 and 2015, the composition of payment values across consumers shifted. This change in composition also may be explained

Distribution of the three-day dollar
value of consumer payments

Figure 8



Source: 2012 and 2015 DCPC. Notes: Expressed in 2015 dollars. Consumers with zero transactions for their three days are omitted. Results from the 2012 and 2015 DCPC are preliminary and subject to change.

by the change in the 2015 sampling frame and sample. Again, if the UAS panel is more representative frame of U.S. consumers, it may reflect a larger proportion of consumers who make smaller total values of payments during three-day periods. It is much harder to imagine how the changes in the 2015 DCPC questionnaire might have produced this kind of shift in the composition of payment values across consumers. Likewise, there is no obvious economic model or even intuition that might explain this mean-preserving distributional shift, nor any obvious economic development that might suggest such a shift.

4.4 Average Payment Values

Finally, the distribution of average payment values shifted to the right (increased) in 2015, as seen in **Figure 9**, consistent with the increase the aggregate average payment value from \$70 to \$77. Generally speaking, this aggregate average increase resulted from fewer consumers making average payments less than \$25 and more consumers making average payments greater than \$25. However, the changes are not monotonic; more consumers made average payments between \$25 and \$75, but fewer made average payments between \$75 and \$150. It is difficult to provide further economic interpretation of these changes without a model and better identification of the effects of changes in survey methodology.

5 Individual Payment Data

This section deepens our analysis of the DCPC data by moving from the three-day estimates for each diarist (plotted in **Figures 6-8**) to the level of each individual payment. The literature provides empirical analyses of individual payments culled from various sources, such as merchants' checkout scanner data, that give some guidance about how to analyze payment choices of different types and values. Using similar econometric models to characterize consumer payment preferences from the DCPC data, we quantify (1) the change in the number of payments and (2) the effects of changes in the distribution of individual payments in dollar values on the volume share of cash between 2012 and 2015.²²

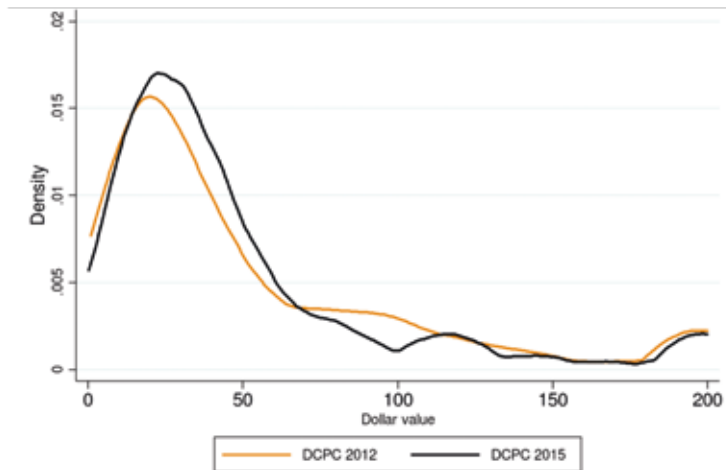
5.1 Correlation between Payment Instrument and Amount

Numerous studies have documented unconditional correlations between the values of individual payments and consumer choices of the payment instruments for

²² In principle, one could also conduct analogous simulations of the effects of changes in the actual distribution of the number of payments on the values share of payments. This exercise would require more models and estimation, which we leave for future research.

Distribution of the average dollar value
per payment per consumer

Figure 9



Source: 2012 and 2015 DCPC. Notes: Expressed in 2015 dollars. Consumers with zero transactions for their three days are omitted. Results from the 2012 and 2015 DCPC are preliminary and subject to change.

each value. Using scanner data from grocery stores, Klee (2008) showed that the probability of choosing cash was negatively correlated with payment value, and the probability of choosing debit and credit cards was positively correlated with payment value. This result was replicated by Briglevics and Schuh (2014) using 2012 DCPC data and by Wang and Wolman (2016) using scanner data from a non-grocery discount retailer. Cohen and Rysman (2013) used combined scanner and survey data for a longitudinal panel of consumers and showed that negative correlation between cash probability and payment value remained even with fixed effects. Using 2012 DCPC data, O'Brien (2014) and Stavins (forthcoming) find the

same relationship across all transaction types, even when individuals are sorted into self-identified payment preferences.

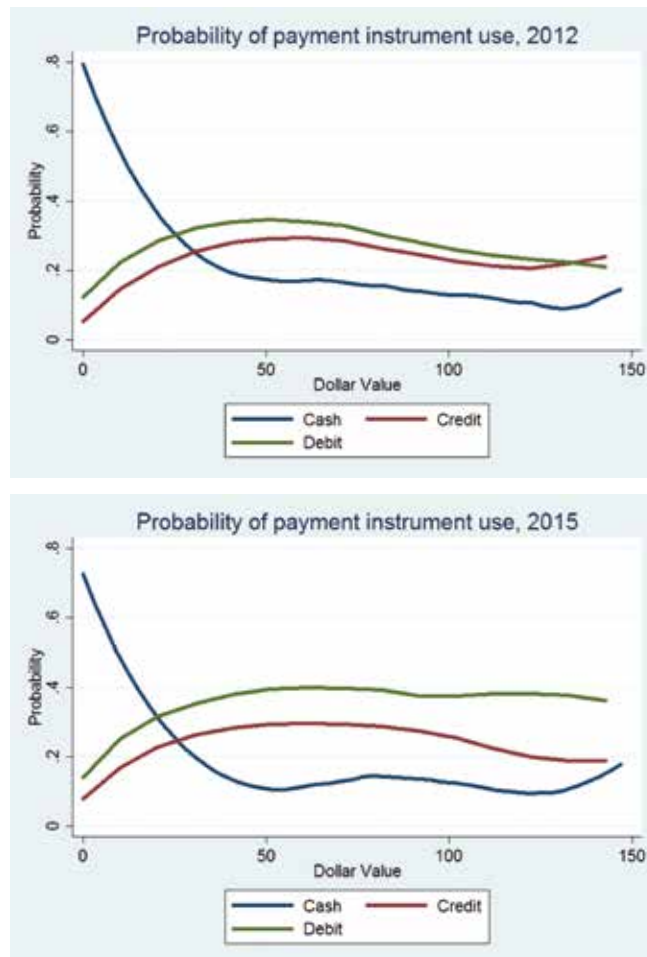
Similar unconditional correlations between payment value and instrument appear in both the 2012 and 2015 DCPC, as shown in **Figure 10**. The probability of using cash for very small-value payments is very high in both years (about 0.7 to 0.8), and it declines sharply up to about \$50, where it settles at less than 0.2. Conversely, the probabilities of using debit cards and credit cards are well below 0.2 for very small-value payments and rise notably up to about \$25. Note that these results are qualitatively similar to prior results from grocery and other retail scanner data, but are not quantitatively the same due to the inclusion of bills and other payments in addition to payments to retail stores. Comparing the 2012 and 2015 empirical probabilities, it is apparent that 2015 is qualitatively similar to 2012 but the probabilities of cash use observed in the data are lower in 2015, by about 0.1 in the smaller values (up to about \$50) and less different for larger values. Naturally, the debit and credit probabilities are higher in 2015.

Following prior empirical studies, we use a multinomial logit regression model to estimate the probabilities of consumer choices of payment instruments for each DCPC year. The specification of the model is shown in equation (1), where the probability of choosing each payment instrument, j , in a year, t , is represented by the term P_{jt} .

$$Pr (P_{jt} = 1) = f(X_t ; \beta_{jt}) \quad (1)$$

Probability of payment instrument use by
dollar value of consumer payment, 2012 and 2015

Figure 10



Source: 2012 and 2015 DCPC. Notes: The charts above show the fitted probability from a multinomial logit model of using each respective payment instrument. Both 2012 and 2015 models include Cash, Check, Credit, Debit, Electronic, and Other as payment options. Results from the 2012 and 2015 DCPC are preliminary and subject to change.

Subscript j represents each payment instrument included in the regression model: cash, check, credit card, debit card, electronic payment or other payment.²³ Subscript t represents each year, 2012 and 2015. The variable X denotes all the set of independent explanatory variables for consumer payment choices including the log of the dollar value for each payment and the term β represents the set of coefficients corresponding to each explanatory variable. In addition, X includes variables that control for economic conditions and, to the degree possible, survey characteristics that might reflect the influence of changes in methodology, as described in Section 2. Economic variables include a comprehensive suite of demographic variables plus employment status, whether debit or credit cards were carried, and whether the person carried enough cash to make the purchase. Variables potentially related to changes in survey methodology include merchant- and transaction-specific variables (such as bill payments).²⁴

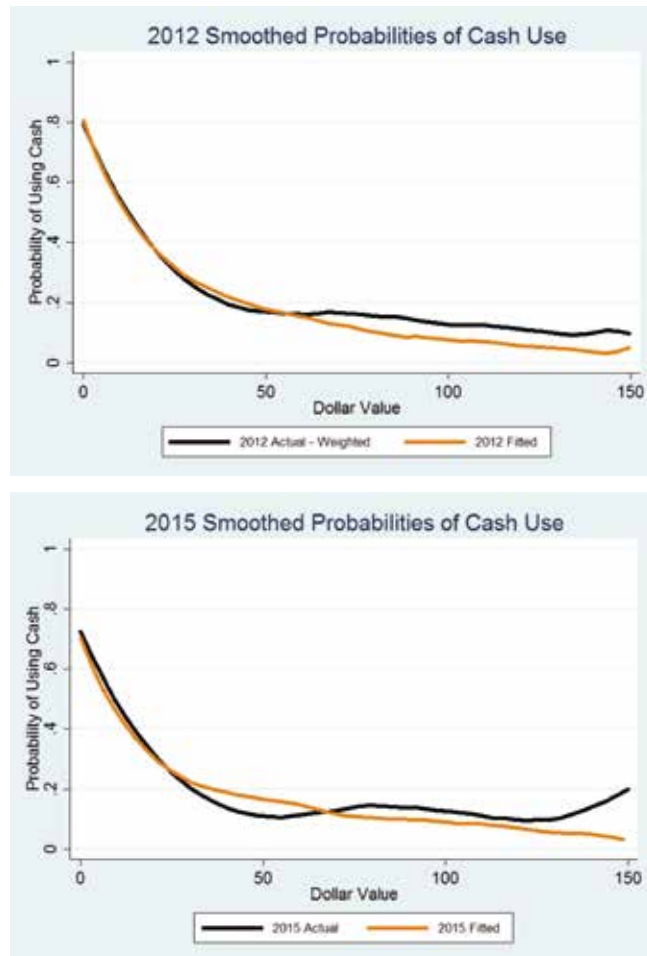
Overall, these econometric models fit the payments data reasonably well, as can be seen by comparing the fitted probabilities of cash payments from the econometric models with the smoothed probabilities in the actual data (**Figure 11**). The regression fitted values are especially good at fitting the smaller value payments (under \$25), which account for a large number of cash transactions. The model fits the 2012 data slightly better than 2015, where the data wiggles around more as the payment value changes and there are fewer observations. Nevertheless, there are

23 Electronic payments are defined as those using an automated clearinghouse (ACH) to make the payment. These transactions typically involve providing a bank account number to or using a financial institution's online banking bill payment system. Other payments are defined as all payments that do not fall into any of the other categories. These include prepaid cards, money orders, traveler's checks, text message payments, and mobile payments.

24 The list of explanatory variables is located in the appendix along with the cash coefficients from the model output. Purchases are grouped into three categories. Merchant category 1 contains purchases at food and personal care supplies. Merchant category 2 contains purchases at auto and vehicle related, general merchandise, entertainment and transportation, medical, education, and personal service, government and non-profit, and gifts and transfers to people. Merchant category 3 contains purchases at housing related, financial, professional, miscellaneous services, and purchases or payments labeled as other.

Actual and fitted probabilities of cash use
by dollar value of consumer payment, 2012 and 2015

Figure 11



Source: Federal Reserve Bank of Boston. Notes: Expressed in 2015 dollars. Results from the 2012 and 2015 DCPC are preliminary and subject to change.

no obvious large differences in the model fit between years. **Appendix Tables A.1 and A.2** report the estimated coefficients from the models, with the demographics separated from the economic and survey-related variables.

Qualitatively, the estimated coefficients are quite similar but there are quantitative differences and the statistical significance is not always consistent across years. In general, the economic variables in the model tended to be statistically unchanged from 2012 to 2015, though there are exceptions. For example, the coefficient on the (log) payment value for cash is slightly less negative in 2015 (-0.67 , compared with -0.82), suggesting that the correlation with value weakened (conditional on controlling for economic and survey conditions). In addition, the coefficient indicating whether or not an individual carried enough cash to make the observed payment slightly increased, suggesting that those who select to carry cash are likely to use it, conditional on have enough cash to make the purchase. There are more statistically significant differences between the demographic variables included in the model than there are between the economic variables (10 demographic variables and 2 economic variables are statistically different), but these differences in demographic coefficients do not follow a consistent pattern. For example, the probability of using cash does not change monotonically with age. Also, cash use by age is significantly different from the reference group (35 to 44) for some but not all age groups.

These econometric results provide one way of characterizing changes in consumer preferences for cash. Although not a structural economic model that incorporates optimizing consumer choices, the probability estimates implicitly take into account the economic conditions and survey methodology specifications that might have influenced the DCPC estimates of the volume and value shares of cash. Therefore, we interpret the relative stability of the estimated coefficients as an approximate indication that underlying consumer preferences for payment instruments were relatively stable between 2012 and 2015.

However, the explanatory variables (X) changed between 2012 and 2015, for the reasons described earlier, and these changes would have influenced the predicted probabilities of cash use. In particular, changes in the distribution of individual payment values could play a central role in observed changes in the probabilities of cash use given their relative importance among the coefficients. To control for these distribution differences, the next step is to create a set of counterfactual simulations.

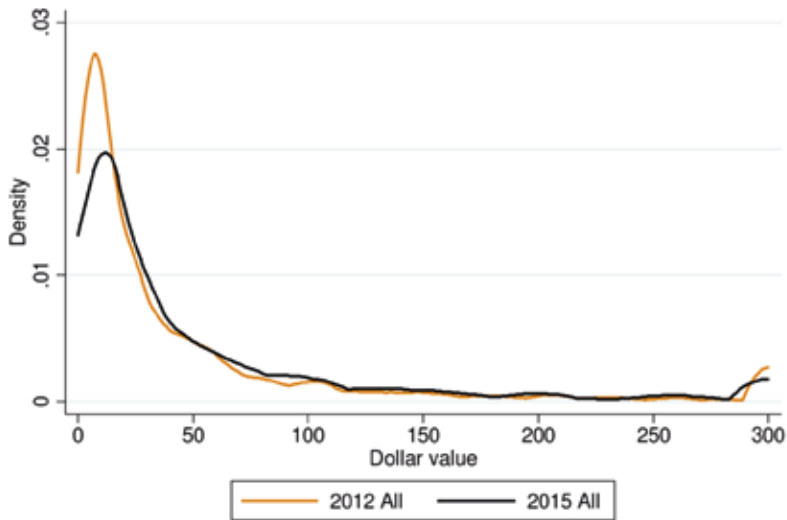
5.2 Distributions of Individual Payment Values

The distribution of individual payment values shifted considerably between 2012 and 2015, as shown in **Figure 12**. The most striking feature of these distributions is a large decline in small-value (less than \$25) payments in 2015 relative to 2012. As previously discussed, the probability of cash use is much higher for small-value payments, so a decline in the number of small-value payments implies a decline in the volume share of cash payments. Indeed, more disaggregated data (not presented) shows that the decline in small-value individual payments was concentrated in cash payments.

It is difficult to identify reasons for the shift in payment values from 2012 to 2015. A comprehensive economic model is required to explain why consumers might change the volume, value, and average value of their payments, in the absence of more specific identification of the possible results of changes in survey methodology. Nevertheless, it is certainly plausible that changes to survey methodology or economic conditions discussed previously could have contributed to the observed change in the distribution, over and above any changes in consumer preferences estimated by the econometric model. Therefore, to quantify the effects of the change in the distribution of payment values on observed consumer payment choices, we can use the estimated econometric models and observed distributions of payment values to conduct counterfactual simulations that separate the effects of unidentified economic and survey factors, as a whole, from the estimated

Distribution of the dollar value of payments
per month per consumer

Figure 12



Source: Federal Reserve Bank of Boston, authors' calculations. Notes: Expressed in 2015 dollars. Results from the 2012 and 2015 DCPC are preliminary and subject to change.

consumer preferences.

5.3 Counterfactual Simulations

To obtain a better understanding of how the share of payments would have changed if the same distribution of payment values were used for the 2012 and 2015 DCPC, we construct two sets of counterfactual simulations. Each counterfactual provides an estimate of the volume share of cash payments due to changes in consumer payment preferences, assuming that only one distribution was used.²⁵ These counterfactual simulations hold all variables related to the individual and the payment constant between the two years. The only variables that change with the simulations are the coefficients used to predict the probabilities of using each payment instrument. Because both survey methodology and economic conditions changed between 2012 and 2015, this simulation technique does not attempt to separate effects of economic change from effects of changes in survey methodology. The simulations, however, provide one way to measure how consumer preference for choosing a payment instrument may have changed over the three-year period.

The precise methodology underlying our counterfactual simulations is shown in equations (2) and (3) below:

$$Pr(\tilde{P}_{j15} = 1) = g(X_{12}; \hat{\beta}_{j15}) \quad (2)$$

$$Pr(\tilde{P}_{j12CF} = 1) = g(X_{15}; \hat{\beta}_{j12}) \quad (3)$$

²⁵ That is, the 2015 payment value distribution for both 2012 [counterfactual] and 2015, or the 2012 payment value distribution for both 2012 and 2015 [counterfactual].

A caret (^) indicates an econometric estimate. Multiplying the 2012 explanatory variables for each payment, X_{12} , by the 2015 coefficients, $\hat{\beta}_{j15}$, creates an estimated 2015 counterfactual probability for each payment instrument for each payment made in the 2012 diary.²⁶ The 2012 counterfactual probabilities for the 2015 diary payments are calculated using the same method, multiplying the 2015 explanatory variables, X_{15} , by the 2012 coefficients, $\hat{\beta}_{j12}$, as shown in equation (3). The simulated change in the share of cash payments for the 2012 panel is the difference between the sum of fitted probabilities (estimated from equation 1) and the sum of the corresponding counterfactual probabilities, equation (2). Then the simulated change in the aggregate probability of using cash for 2012 is shown by equation (4) for 2015 by equation (5):

$$\Delta Pr(P_{h,12}) = \left[\sum f(X_{12}; \hat{\beta}_{h,12}) - \sum g(X_{12}; \hat{\beta}_{h,12}) \right] \quad (4)$$

$$\Delta Pr(P_{h,15}) = \left[\sum g(X_{15}; \hat{\beta}_{h,12}) - \sum f(X_{15}; \hat{\beta}_{h,15}) \right] \quad (5)$$

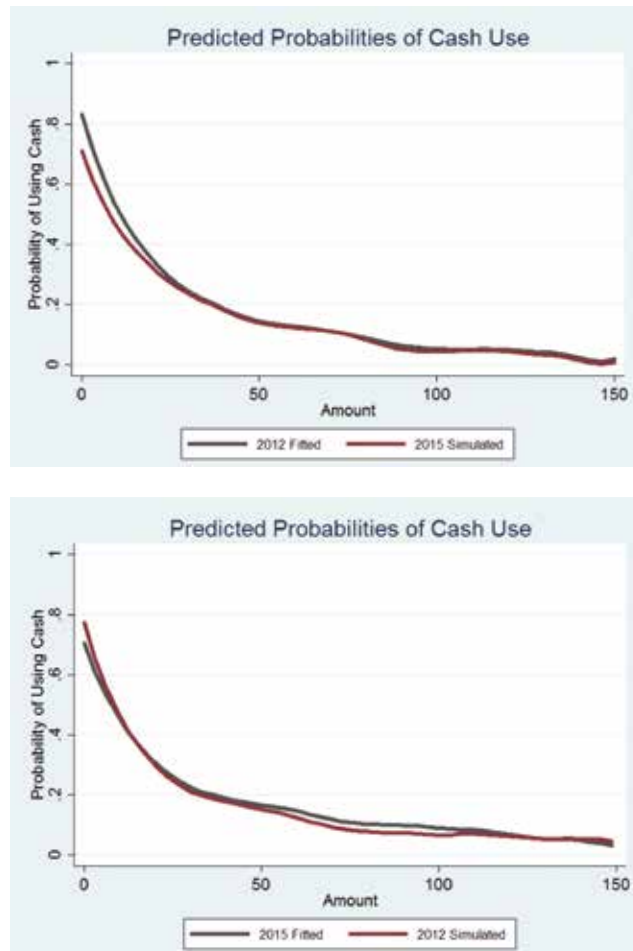
Here, the subscript h denotes cash as the payment instrument.

The fitted and counterfactual probability estimates for 2012 and 2015 panel are similar, as seen in **Figure 13**. The similarity of the probability plots suggest that the difference between cash's share of payments in 2012 and the share in 2015 was not the result of demographic, merchant, and payment characteristics. If these variables had been responsible for the difference between the volume shares of

²⁶ While the explanatory variables are multiplied by the coefficients, the actual probabilities are calculated using the multinomial logit equation, which is shown in the appendix. Rather than describing the complete function, the replacement of the coefficients for 2012 (2015) with those from 2015 (2012) is the most important aspect in estimating the counterfactual probabilities.

Predicted and counterfactual probabilities of cash use
by dollar value of consumer payment, 2012 and 2015

Figure 13



Source: authors' calculations. Notes: The chart on the left shows the 2012 fitted probability from a multinomial logit model as well as the simulated counterfactual results for 2015. The chart on the right shows the simulated counterfactual results for 2012 along with the fitted probability from a multinomial logit model for 2015. Results from the 2012 and 2015 DCPC are preliminary and subject to change.

cash payments in the two years, the differences would have manifested in two ways. First, the plots of counterfactual probabilities would not have been as similar to the plots of the fitted probabilities, and, second, the estimates of coefficients for the 2012 and 2015 data would have produced more coefficients that were statistically different.

Table 8 reports the actual, fitted, and simulated cash shares. The fitted model captures only about three-quarters of the difference in cash share between the two years (6.3 percentage points estimated out of 8.2 percentage points actual). The simulated counterfactual differences range from –2.6 percentage points for the 2012 data to 0.4 percentage points for the 2015 data. To account for the difference between the estimated model and actual data, we scale up the simulated changes to –3.4 percentage points (that is, $(0.4/6.3)*8.2$) for 2012 and –0.5 percentage points (that is, $(2.6/6.3)*8.2$) for 2015. Therefore, we conclude that the most likely estimate of the change in consumer preferences for cash use from 2012 to 2015 is a decline of approximately 1 to 3 percentage points in the volume share.²⁷

While these counterfactual simulations do not provide an exact measure of the change in the share of cash payments, they do provide guidance on how consumer preferences for cash use changed with demographic and transaction-specific characteristics. The simulated change in the share of cash payments is conservative, since it only accounts for the change in consumer preferences and not for the economic changes as well (which could be a combination of cyclical and trend forces); this limitation is a byproduct of the technique used. However, these simulations are more in line with the estimates from the SCPC, +0.3 over the three-year

²⁷ In principle, we could conduct counterfactual simulations for the value shares of cash as well. However, this exercise would require more modeling and joint treatment of volume and value, which we leave for future research.

period. In general, the DCPC suggests share of cash payments declined between 2012 and 2015, but the consistent level of the value share of cash and the results of the counterfactual simulations implies that cash use remained more stable than a direct comparison would initially indicate.

Simulated estimate of change in consumers' preference for using cash, 2012 to 2015

Table 8

	2012	2015	Change
Actual Share	40.7	32.5	-8.2
Fitted Model Share	39.4	33.1	-6.3
2012 Counter Factual Share	–	36.8	-2.6
2015 Counter Factual Share	33.5	–	-0.4

Source: authors' analysis. Notes: Included in model: sample and questionnaire improvement, economic change. Simulations applying 2015 probabilities by value to 2012 value distribution and vice versa.

6 Conclusion

Results in this paper demonstrate that reports of the death of cash in the United States are exaggerated. Data from the 2012 and 2015 DCPC and the 2008-2015 SCPC together, show clear evidence that cash is still one of three most common means of payment by consumers by volume. However, consumer cash payments are relatively small value on average, so the total value of cash payments is relatively low despite consumers using cash to make a relatively large number of payments. The value share of cash estimated in the DCPC also shows no evidence of a decline in cash share from 2012 to 2015, but the DCPC raw data suggest that cash use as a share of the number of consumer payments was much lower in 2015.

Unfortunately, evaluating the change in U.S. consumer cash use between 2012 and 2015 is more difficult because of changes in survey methodology and economic conditions that affected the DCPC implementation in these two years. We cannot identify and explain all of the specific economic forces underlying the differences in the number, value, and average value of consumer payments because the literature does not offer an adequate model of consumer choices of these payment variables. However, DCPC data confirm prior evidence that consumer choices of payment instruments are correlated with individual payment values, with cash being used most often for small-value payments, and these data do not show evidence of large changes in consumer preferences for cash. Nevertheless, changes in observed consumer payment behavior resulting from changes in survey methodology and economic conditions manifest themselves through changes in the distributions of individual payment values. Counterfactual simulations suggest that the best estimate of the change in cash volume shares from 2012 to 2015 that is attributable to changes in consumer preferences for cash use is about -1 to -3 percentage points. This estimate is reasonably close to the analogous one from the SCPC ($+0.3$ percentage points) during the same period.

Estimates of consumer payment choices from the DCPC for 2016 (and beyond) should be more comparable with the 2015 DCPC estimates because of fewer changes in survey methodology (same sampling frame) and some additional improvements (fewer changes to the questionnaire and limitations were addressed). However, two factors will remain a challenge for interpreting DCPC data in the short run until satisfactory structural models of consumer payment choices are developed. First, it will be more difficult to identify separate cyclical and long-run trend components from the DCPC data than the SCPC data; the latter is likely to produce smaller year-to-year changes due to its measurement approach (recall based on typical periods). Second, there is insufficient guidance about how to jointly interpret of consumer choices of the number and value of payments, so divergence in volume and value shares for an instrument will be puzzling.

In light of these challenges, it seems prudent to continue collecting data on consumer payment use from both the SCPC and DCPC for now. The SCPC has a longer time series and may give greater clarity on trends in payment use until much more data are available to rely on the DCPC estimates. On the other hand, the DCPC estimates provide potentially more accurate measurement of consumer payment choices, and it has the significant advantage of collecting data on payment values in addition to numbers. In terms of economic research, much more effort is needed to develop structural models of consumer payment choices that can be estimated with the SCPC and DCPC data.



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Appendix

**Economic and Survey-related Variables,
Probability of Using Cash**

Table A.1

	(2012) Payment instrument	(2015) Payment instrument	Difference	
Cash Coefficients Log Amount	-0.820 (0.0391)***	-0.667 (0.0726)***	0.153 1.86*	
Carried Credit	-3.142 (0.137)***	-2.665 (0.313)***	0.477 1.40	
Carried Debit	0.724 (0.0934)***	1.009 (0.211)***	0.285 1.24	
Carried Enough Cash	2.231 (0.118)***	2.729 (0.264)***	0.498 1.72*	
Unemployed	0.320 (0.223)	0.723 (0.406)*	0.403 0.87	
Out of Labor Force	-0.170 (0.108)	-0.166 (0.205)	0.004 0.02	
In-Person	2.779 (0.213)***	3.312 (0.405)***	0.533 1.16	
Bill	1.319 (0.291)***	0.805 (0.308)***	-0.514 1.21	
Tuesday	0.281 (0.148)*	0.417 (0.319)	0.136 0.39	

Standard errors in parentheses * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

		(2012) Payment instrument	(2015) Payment instrument	Difference
	Wednesday	0.419 (0.146)***	0.192 (0.285)	-0.227 0.71
	Thursday	0.263 (0.152)*	0.250 (0.289)	-0.013 0.04
	Friday	0.371 (0.152)**	0.505 (0.263)*	0.134 0.44
	Saturday	0.271 (0.162)*	0.475 (0.275)*	0.204 0.64
	Sunday	0.211 (0.152)	0.156 (0.281)	-0.055 0.17
	Payment at Merch Group 1	-0.0246 (0.0879)	0.135 (0.165)	0.1596 0.85
	Payment at Merch Group 3	0.261 (0.204)	0.695 (0.330)**	0.434 1.12
	Observations	8049	1886	
	Pseudo R-squared	0.424	0.396	

Demographic Variables, Probability of Using Cash

Table A.2

	(2012) Payment instrument	(2015) Payment instrument	Difference
Cash Coefficients			
Income Less Than 25k	0.527 (0.174)***	0.765 (0.347)**	0.238 0.613
Income 25k to 49k	0.0774 (0.128)	0.0279 (0.257)	-0.0495 0.172
Income 75k to 99k	-0.286 (0.141)**	0.256 (0.266)	0.542 1.800*
Income 100k to 124k	-0.390 (0.152)**	0.126 (0.322)	0.516 1.449
Income Greater Than 125k	-0.308 (0.137)**	0.266 (0.267)	0.574 1.913*
Age Under 25	-0.513 (0.290)*	0.845 (0.571)	1.358 2.120**
Age 25 to 34	-0.0924 (0.149)	-0.603 (0.290)**	-0.5106 1.566
Age 45 to 54	0.187 (0.145)	-0.0809 (0.265)	-0.2679 0.887
Age 55 to 64	0.274 (0.152)*	0.602 (0.274)**	0.328 1.047
Age 65 and Over	-0.185 (0.181)	1.069 (0.310)***	1.254 3.493***
High School & Lt. High School	0.904 (0.158)***	1.161 (0.320)***	0.257 0.720
Some College	0.450 (0.107)***	0.715 (0.216)***	0.265 1.099
Graduate School	-0.161 (0.113)	-0.440 (0.208)**	-0.279 1.179

Standard errors in parentheses * p<0.10 ** p<0.05 *** p<0.01

		(2012) Payment instrument	(2015) Payment instrument	Difference
	Black	0.293 (0.164)*	0.407 (0.446)	0.114 0.240
	Other Race	-0.555 (0.150)***	-0.0441 (0.272)	0.5109 1.645*
	Female	0.179 (0.0901)**	0.644 (0.196)***	0.465 2.156**
	Married	0.153 (0.109)	0.139 (0.230)	-0.014 0.055
	No Bill Responsibility	-0.237 (0.185)	1.408 (0.382)***	1.645 3.876***
	Some Bill Responsibility	-0.499 (0.188)***	1.208 (0.438)***	1.707 3.581***
	Most Bill Responsibility	-0.422 (0.207)**	1.333 (0.405)***	1.755 3.859***
	All Bill Responsibility	-0.383 (0.146)***	1.002 (0.302)***	1.385 4.129
	No Shopping Responsibility	0.175 (0.238)	-0.109 (0.374)	-0.284 0.641
	Some Shopping Responsibility	-0.160 (0.144)	-0.520 (0.303)*	-0.36 1.073
	Most Shopping Responsibility	-0.0292 (0.140)	-0.217 (0.307)	-0.1878 0.557
	All Shopping Responsibility	0.0940 (0.129)	-0.180 (0.263)	-0.274 0.935
	Observations	8049	1886	
	Pseudo R-squared	0.424	0.396	

Multinomial Logit Model Used to Construct Counterfactual Estimates

The functional form of the counterfactual simulations were included in the body of the paper, but a more detailed explanation of how the multinomial logit model was used to construct the counterfactual estimates is included here. The right hand side variables in equation (6) are represented by the $N \times K$ matrix, X_t , which contains the transaction amount, payment specific variables, and demographic variables for each year, t , in which the diary took place. The $K \times 1$ coefficient matrix, β_{jt} , and contains the estimated coefficients for each payment instrument, j . The estimated probability of using a specific payment instrument is denoted as $P_{jt} = 1$, where j represents the payment instruments used in the regression: cash, check, debit, credit, electronic, and other.

$$Pr(P_{jt} = 1) = \frac{e^{x_t \hat{\beta}_{jt}}}{\sum_{j=1}^{J-1} e^{x_t \hat{\beta}_{jt}}} \quad (6)$$

The estimated probabilities for each payment instrument j in 2012 would be denoted:

$$Pr(P_{j12} = 1) = \frac{e^{x_{12} \hat{\beta}_{j12}}}{\sum_{j=1}^{J-1} e^{x_{12} \hat{\beta}_{j12}}} \quad (7)$$

The estimated probabilities for each payment instrument j , in 2015 would be denoted:

$$Pr(P_{j15} = 1) = \frac{e^{x_{15} \hat{\beta}_{j15}}}{\sum_{j=1}^{J-1} e^{x_{15} \hat{\beta}_{j15}}} \quad (8)$$

The 2015 counterfactual probability estimates are calculated by replacing all of the 2012 coefficients in both the numerator and denominator with the estimated coefficients from 2015 and then re-estimating the probabilities. The equation is shown in equation (9).

$$Pr(\tilde{P}_{j12} = 1) = \frac{e^{x_{12} \hat{\beta}_{j15}}}{\sum_{j=1}^{J-1} e^{x_{12} \hat{\beta}_{j15}}} \quad (9)$$

The 2012 counterfactual probability estimates are calculated the same way by replacing all of the 2015 coefficients in both the numerator and denominator with the estimated coefficients from 2012 and then re-estimating the probabilities. The equation is shown in equation (10).

$$Pr(\tilde{P}_{j12} = 1) = \frac{e^{x_{15} \hat{\beta}_{j12}}}{\sum_{j=1}^{J-1} e^{x_{15} \hat{\beta}_{j12}}} \quad (10)$$

Simulation: Respondents with Zero Payments, 2012

The simulation aims to re-estimate the number of payments reported in 2012 by presuming that, if the 2012 sample completely matched the 2015 sample, more respondents in 2012 would have made no payments over their 3-day reporting period.

The following are the steps in the simulation:

- (1) Divide the 2012 sample into two groups: those who made at least one payment over their 3 reporting days and those who made none.
- (2) Divide each of these groups into 6 categories by income (3 categories) and age (2 categories) (Table A.3):

Percent of Population within each Group, 2012 DCPC

Table A.3

	Percent that Made at Least One Payment		Percent that Made No Payments	
	(1) 45 and Under	(2) Over 45	(3) 45 and Under	(4) Over 45
HH Income Under \$35,000	14%	17%	41%	23%
HH Income Between \$35,000 and \$75,000	16%	17%	7%	14%
HH Income Over \$75,000	16%	21%	10%	5%

- (3) For the group that made at least 1 payment, calculate the average number of transactions per month and the average number of cash transactions per month for each of the 6 income/age combinations Table A.4). The distribution of the

individuals removed from the group who made at least 1 payment over their 3 reporting day were chosen to closely match the population from the group who made no payments (columns 3 and 4 of the table above). For example, 41 percent of the average individuals who were moved from the group who made at least 1 payment over their 3 reporting days and those who made none were 45 and younger and had household incomes of less than \$35,000.

Transactions per Person per Day, 2012 DCPC				Table A.4
	Percent that Made at Least One Payment		Percent that Made No Payments	
	45 and Under	Over 45	45 and Under	Over 45
HH Income Under \$35,000	1.7	1.7	1.1	1.1
HH Income Between \$35,000 and \$75,000	2.2	2.1	1.2	1.1
HH Income Over \$75,000	2.2	2.4	1.0	1.2

(4) To adjust the number of respondents who made payments in 2012, for each of the 6 income/age combinations, remove the number of average transactions per person per month and the number of average cash transactions per month attributable to that group.

For example, in the “45 and Under” and “Income Under \$35,000” category, the average individual made 1.7 payments per day and 11 individuals were removed from that group, then (11×1.7) payments per day are removed from the total number of payments made by those who took the 2012 diary and 11 “average” individuals were moved from the payment to the non-payment population.



Hiroshi Fujiki¹, Migiwa Tanaka (Charles River Associates) Choice of payment instrument for low-value transactions in Japan²



Hiroshi Fujiki
Chuo University, Japan

Abstract

In this paper, we examine the determinants of the choice of payment instrument for low-value day-to-day transactions. Using Japanese household data from 2007 to 2014, we find that three payment instruments, namely, cash, electronic money, and credit cards, comprise the major payment choices for transactions with values less than 1,000 yen (about 8.7 euros). We also find that high-income, financially

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² While working on this research, the author participated in the Research Group on the Survey of Household Finances and received permission from the Central Council for Financial Services Information (CCFSI) to use data from the Survey of Household Finances. The author would like to thank the CCFSI for providing the data. The author acknowledges the financial support of a Japan Society for the Promotion of Science Kaken Grant (No. 15K03551). The author thanks Fumiko Hayashi for her helpful comments to the companion paper.

sophisticated households in urban areas tend to use both electronic money and cash. Further, family households choosing electronic money and cash do not have higher cash holdings compared with family households exclusively choosing cash, holding all other variables constant. We obtain weak evidence that single-person households choosing electronic money and cash have higher cash holdings compared with single-person households exclusively choosing cash, holding all other variables constant.

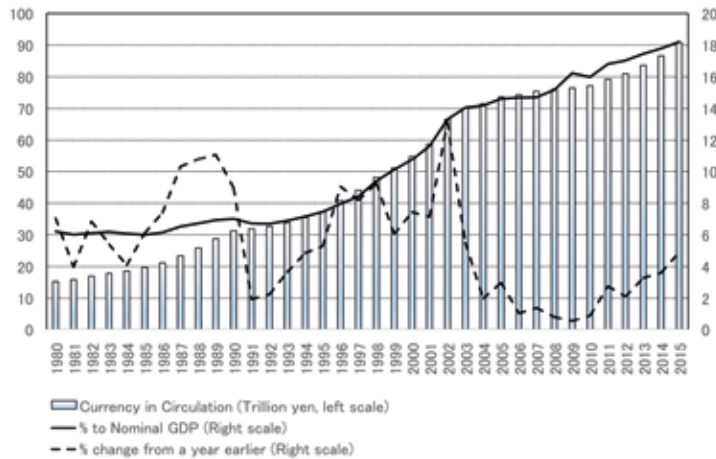
1 Introduction

The Japanese have long depended on cash transactions for one-off, low-value payments, as Humphrey (2010) has observed. The gray bars in Figure 1 display the increasing demand for currency in Japan. Specifically, in 2015, total Japanese currency in circulation (the annual average of the monthly average outstanding) was 91 trillion yen (or 790 billion euros at 1 euro = 115 yen), a sixfold increase from the 15 trillion yen (132 billion euros) in circulation in 1980. Can we explain this continuing increase in the demand for currency as a result of the growth of Japanese economy? The answer is no, because as shown by the solid line in Figure 1, the ratio of the currency in circulation to nominal GDP in Japan was about 6% to 8% before 1995. However, since then the ratio has continued to increase, reaching about 18% of GDP in 2015.

We can identify several reasons underpinning the accelerating demand for currency beyond the nominal economic growth rate after 1995. The dashed line in Figure 1 illustrates the yearly change in Japanese currency in circulation. As shown, this has accelerated on several occasions: the Japanese stock and real estate bubble of the late 1980s, the Japanese banking crisis from 1997 to 1998, the removal of the blanket guarantee of Japanese bank time deposits in 2003 and that of bank ordinary deposits in 2005, and the rapid growth of foreign tourism in Japan after 2014. Additionally Japanese nominal interest rates have been very low since 1995.

Currency in circulation in Japan

Figure 1

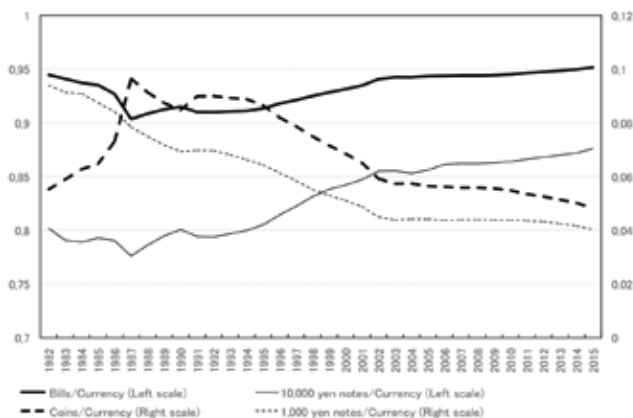


Source: Own Calculations.

The suggestive evidence shown in Figure 1 may be well known to many readers. However, less well known is the small but continuing shift from the use of low-denomination to high-denomination bills. In Figure 2, the thin solid line plots the ratio of 10,000 yen (87 euros) bills in circulation (the highest-denomination bill available in Japan) to overall bills in circulation. As shown, this denomination represented about 80% of bills in circulation in the early 1980s, but its circulation has increased since 1995, and it accounted for about 88% of bills in circulation in 2015. By contrast, the thin dashed line shows that the share of the 1,000 yen (8.7 euro) bill (the lowest-denomination bill in circulation) has dramatically declined, falling from 10% in 1982 to just 4% in 2015. However, note that the evidence does not imply a drastic shift from coins to bills, because the share of notes in circulation (the thick solid line) has been stable at about 95%, and the share of coins in circulation (the thick dashed line) has been stable at around 5%, except for the period between

Share of bills and coins in circulation in Japan

Figure 2



Source: Own Calculations.

1987 and 2000, which contained a one-off event relating to the insurance of high-denomination special coins. However, the ratio of coins in circulation gradually fell from 2002 to 2015, from about 6% to about 5%. The question is whether the upward trend in the use of high-denomination bills suggests a decrease in the number of lower-denomination bills in circulation (as distinct from their share in overall bill circulation, which we know has declined). The answer is no because the number of bills in circulation, including the lowest-denomination 1,000 yen bill, has continued to increase after 2007. Another question is whether the gradual shift from coins to bills represents a decrease in the number of low-denomination coins in circulation? The answer is yes because the number of coins in circulation, especially low-denomination coins with face values between 1 and 10 yen, decreased from 2008 to 2014 (See details in in our working paper version, Fujiki and Tanaka (2016b), Figures 3 and 4).

In this paper, we take as given the evidence discussed above suggesting a small but continuing shift toward the infrequent use of low-denomination coins or banknotes. We then investigate whether the increasingly frequent use of electronic money since 2007 has been one of the reasons behind this continuing shift. Underpinning this question, between 2008 and 2015, the value of transactions made by credit card increased 1.5 times, from 33 trillion yen to 49 trillion yen, while the value of those made by electronic money increased about six times, from 0.8 trillion yen to 4.6 trillion yen. During this time, the number of credit cards per person has been stable at around two. However, the number of electronic money cards per person has increased from 0.77 in 2008 to 2.32 in 2015. The value per transaction using electronic money has also increased, from 720 yen (6.3 euros) in 2008 to 993 yen (8.6 euros) in 2015. According to Nikkei PB (2015), if consumers use major brands of Japanese electronic money, average transaction values are between 300 and 800 yen (2.6 to 6.9 euros). This could lead to some decrease in the use of coins after 2008 (See details in our working paper version Fujiki and Tanaka (2016b), section 1).

Based on this evidence, it is reasonable to ask the following two questions. First, what are the determinants of the choice of payment instrument for low-value, one-off, day-to-day transactions of less than 1,000 yen? Second, does the use of electronic money for these transactions reduce the demand for cash by households?

To respond, we use the same data and methodology as Fujiki and Tanaka (2016a). They use repeated cross-sectional data sets on Japanese family and single-person households from the Survey of Household Finance (SHF) conducted by the Central Council for Financial Services Information from 2007 to 2014. While the focus of Fujiki and Tanaka (2016a) is the payment method for day-to-day transactions with values between 10,000 and 50,000 yen, with special attention to the shift from cash to credit cards, we focus on day-to-day transactions with values less than

1,000 yen to examine the shift from cash to electronic money. The major findings in this paper are as follows.

First, the major payment choices for low-value day-to-day transactions, typically those less than 1,000 yen, comprise three payment instruments: cash, electronic money, and credit card. Second, high-income, financially sophisticated, and well-educated family households living in urban areas tend to use both electronic money and cash. Similarly, high-income, financially sophisticated, and well-educated single-person households also tend to use both electronic money and cash. Finally, family households choosing electronic money and cash do not have greater cash holdings than households exclusively choosing cash, with all other characteristics held constant. We obtain weak evidence that single-person households choosing electronic money and cash have greater cash holdings compared with households exclusively choosing cash, holding all other variables constant.

Before discussing the details of our data sets and estimations, we summarize two strands of the literature related to our study. First, our study relates to work on consumer payment method choices and their determinants; recent contributions include Ching and Hayashi (2010), Cohen and Rysman (2013), Koulayev et al. (2016), Arango et al. (2012), and Wakamori and Welte (2016). Second, our study also relates to empirical studies on changes in the demand for cash as financial technology evolves using individual data sets; Fujiki and Tanaka (2014, 2016a) by a Japanese data, Stix (2004) by an Austrian data, Attanasio, Guiso, and Jappelli (2002) and Lippi and Secchi (2009) by an Italian data, Chen, Felt, and Huynh (2014) by a US panel data, Fung, Huynh, and Sabetti (2012) by a Canadian data (See the details of those papers in our working paper, Fujiki and Tanaka (2016b)).

The organization of the rest of this paper is as follows. Section 2 documents our data. Section 3 reports our model. Section 4 reports the data used for the regressions. Section 5 provides the results of our regressions for the choice of payment

method. Section 6 reports the results of our regression concerning the demand for cash. Section 7 concludes.

2 Survey of Household Finance (SHF) data

We use the individual household data from the Survey of Household Finance (SHF) conducted by the Central Council for Financial Services Information from 2007 to 2014, as in Fujiki and Tanaka (2016a).³ The SHF questions respondents about their household financial assets and liabilities, their selection of financial products, the amount (to the nearest 10,000 yen) and average cash holdings (in units of 10,000 yen). The SHF also asks survey respondents for details about various household characteristics, including annual disposable income, area of residence, and the age, gender, education, and employment status of household members.

In each survey year, the SHF data consist of a family household data set and a single-person household data set. For the family household data sets, the SHF used a stratified two-stage random sampling method to select a total of 8,000 samples in each survey year. The valid samples were eventually reduced to between 3,300 and 4,000 samples. For the single-person household data sets, some 2,500 respondents were selected from a pool of individuals registered with a survey company through the Internet in each survey year. The distribution of respondents' ages was from 20 to 69 years.

The SHF asks about the survey respondent's choice of payment method for transactions: Which payment method would you (or your family members) use to make a day-to-day transaction of (1) less than 1,000 yen, (2) between 1,000 yen and 5,000 yen, (3) between 5,000 yen and 10,000 yen, (4) between 10,000 yen and 50,000 yen, and (5) more than 50,000 yen? Choose from cash, credit card,

³ The following discussion draws heavily on Section 2 in Fujiki and Tanaka (2016a).

electronic money (including debit card), and other.

Note that the SHF defines electronic money as noncontact integrated circuit (IC) forms based on Near Field Communication (NFC) technology as well as debit cards for this question. We follow the definition of the SHF for electronic money for the remainder of this paper. We assume that the SHF data more effectively capture the use of electronic money rather than the use of debit cards, because the value of transactions made by J-Debit, the major brand of Japanese debit card, has been steadily falling from a peak of 0.8 trillion yen in 2005 to just 0.5 trillion yen in 2014, while the value of transactions made by electronic money has increased from 0.8 trillion yen in 2008 to 4 trillion yen in 2014. Even adding the transactions made by international debit cards to those made by J-Debit, the value of transactions made by debit card are only 16% of those made by electronic money (see Bank of Japan [2017], Chart 12).

We detail the choice of payment method for day-to-day transactions by the value of the transaction. In the SHF, survey respondents can select from 10 choices of payment method, but they usually select at most seven choices. We compare the popularity of the different payment methods for day-to-day transactions over the period 2007 to 2014 for family households in Table 1 and for single-person households in Table 2. We list those payment methods that were chosen by at least 1% (i.e., a proportion of 0.01) of the survey respondents, in descending order of popularity. Red type denotes that the payment method was chosen by at least 10% (i.e., a proportion of 0.1) of survey respondents.

Table 1 shows three things. First, for transactions of less than 1,000 yen, while the proportion of respondents that chose cash only decreased over time, this group still comprised 76% of all respondents in 2014. Meanwhile, the proportion of respondents that chose electronic money and cash increased from 2% of respondents in 2007 to 8% of respondents in 2014. Second, for transactions of between

1,000 and 5,000 yen in 2014, 65% of respondents chose cash only, 10% chose card and cash, 7% chose card only, and 6% chose electronic money and cash. Third, for transactions of between 5,000 yen and 10,000 yen, between 10,000 yen and 50,000 yen, and exceeding 50,000 yen, the major payment choices comprise three payment instruments: cash only, card only, and card and cash. The proportion of respondents that chose credit card only outweighed the proportion of respondents that chose cash only for transaction values more than 50,000 yen in 2010.

Table 2 shows qualitatively similar results to Table 1. However, on average, a single-person household is more likely to choose credit cards and electronic money than a family household for the same transaction value. The construction of the survey data set could help explain why we obtain these results. First, the single-person household data are obtained from a pool of individuals registered with a survey company through the Internet. These individuals must be familiar with the Internet, and therefore they are also likely to be familiar with Internet shopping using credit cards for payment. Second, the single-person household data set includes individuals aged from 20 to 69 years only, while the family household data set includes heads of households aged 20 to 69 years and those aged 70 years and older. One may reasonably surmise that the chances of using electronic money, say, in railway stations in downtown areas, are higher for workers (typically aged less than 70 years) than for retired persons (typically aged more than 70 years).

Overall, the above evidence suggests that we should focus on the choice of payment methods for transactions with values less than 1,000 yen to examine whether the frequent use of electronic money could affect the demand for cash in Japan.

For the sake of later analysis, we construct a dummy variable for the following five aggregated choices of payment method for day-to-day transaction values less than 1,000 yen: cash (respondents chose cash exclusively), card (respondents chose

credit card exclusively, cash and credit card, or credit card and other), emoney (respondents chose emoney exclusively, cash and emoney, or emoney and other), other (respondents chose other exclusively or cash and other), and card and emoney (respondents chose credit card and emoney). The aggregation of choices is motivated by the fact that the major payment choices by survey respondents comprise three payment instruments for day-to-day transaction values below 1,000 yen: cash only, electronic money and cash, and card and cash.



**Choice of payment method for day-to-day transactions:
Family household data**

Table 1

	2007	2008	2009	2010	2011	2012	2013	2014
< 1,000 yen								
cash only	0.827	0.862	0.869	0.839	0.800	0.806	0.776	0.766
em and cash	0.021	0.021	0.025	0.046	0.049	0.061	0.072	0.087
card and cash	0.023	0.022	0.023	0.030	0.031	0.032	0.032	0.039
em only	0.002	0.003	0.003	0.005	0.009	0.008	0.012	0.013
card only	0.005	0.005	0.006	0.007	0.008	0.009	0.011	0.011
N.A.	0.118	0.083	0.069	0.066	0.096	0.079	0.091	0.074
1,000 - 5,000 yen								
cash only	0.752	0.791	0.775	0.747	0.713	0.723	0.696	0.658
card and cash	0.084	0.072	0.084	0.090	0.096	0.090	0.103	0.102
card only	0.036	0.044	0.051	0.053	0.056	0.058	0.060	0.078
em and cash	0.010	0.010	0.016	0.029	0.028	0.042	0.043	0.062
em and card	0.001	0.003	0.003	0.005	0.007	0.006	0.009	0.014
em only	0.001	0.003	0.003	0.006	0.006	0.007	0.010	0.013
5,000 - 10,000 yen								
cash only	0.665	0.708	0.689	0.664	0.624	0.645	0.596	0.573
card only	0.094	0.102	0.109	0.121	0.130	0.132	0.145	0.159
card and cash	0.114	0.098	0.124	0.124	0.124	0.122	0.139	0.137
em and cash	0.005	0.004	0.008	0.012	0.010	0.016	0.016	0.030
em only	0.000	0.002	0.003	0.004	0.004	0.004	0.008	0.012
N.A.	0.113	0.079	0.061	0.064	0.093	0.070	0.083	0.072
N	3,248	3,814	3,978	3,976	3,750	3,867	3,836	3,900

Notes: em = electronic money; card = credit card. Red type denotes that the payment method was chosen by at least 10% (i.e., a proportion of 0.1) of survey respondents.

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		2007	2008	2009	2010	2011	2012	2013	2014
	10,000 - 50,000 yen								
	cash only	0.491	0.510	0.499	0.485	0.439	0.448	0.408	0.388
	card only	0.248	0.263	0.266	0.279	0.290	0.306	0.319	0.341
	card and cash	0.146	0.130	0.156	0.149	0.153	0.161	0.167	0.166
	em and cash	0.002	0.001	0.003	0.004	0.006	0.003	0.006	0.010
	other only	0.009	0.014	0.009	0.011	0.006	0.008	0.012	0.010
	N.A.	0.093	0.071	0.054	0.060	0.089	0.062	0.075	0.066
	< 50,000 yen								
	card only	0.337	0.352	0.375	0.383	0.381	0.411	0.419	0.436
	cash only	0.392	0.408	0.389	0.380	0.354	0.359	0.315	0.317
	card and cash	0.120	0.110	0.117	0.123	0.124	0.119	0.130	0.122
	other only	0.028	0.032	0.032	0.028	0.021	0.022	0.026	0.024
	N.A.	0.101	0.075	0.064	0.064	0.097	0.069	0.088	0.074
	N	3,248	3,814	3,978	3,976	3,750	3,867	3,836	3,900

**Choice of payment method for day-to-day transactions:
Single-person household data**

Table 2

	2007	2008	2009	2010	2011	2012	2013	2014
< 1,000 yen								
cash only	0.668	0.648	0.622	0.578	0.546	0.502	0.503	0.467
em and cash	0.175	0.189	0.204	0.222	0.230	0.262	0.227	0.250
card and cash	0.078	0.085	0.080	0.092	0.103	0.111	0.116	0.107
card only	0.031	0.026	0.027	0.031	0.038	0.042	0.050	0.058
em only	0.023	0.021	0.030	0.031	0.033	0.032	0.034	0.040
em and card	0.011	0.010	0.016	0.021	0.024	0.026	0.029	0.032
1,000 - 5,000 yen								
cash only	0.540	0.506	0.502	0.475	0.434	0.423	0.380	0.370
card and cash	0.202	0.214	0.202	0.210	0.209	0.225	0.228	0.211
card only	0.130	0.134	0.137	0.135	0.159	0.145	0.180	0.169
em and cash	0.071	0.086	0.089	0.096	0.104	0.124	0.110	0.117
em and card	0.031	0.030	0.034	0.046	0.043	0.042	0.044	0.061
other only	0.011	0.010	0.013	0.017	0.020	0.017	0.024	0.034
em only	0.012	0.015	0.020	0.014	0.022	0.019	0.029	0.032
N	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500

Notes: em = electronic money; card = credit card. Red type denotes that the payment method was chosen by at least 10% (i.e., a proportion of 0.1) of survey respondents.

[illegible]

Table 3 provides the details of our aggregate dummy variables for family and single-person households. It is clear that cash and emoney are two major choices, followed by card. The proportion of survey respondents that chose cash decreased and the proportion of survey respondents that chose emoney generally increased over time, by about 8-9 percentage points between 2007 and 2014. In constructing Table 3, we dropped those respondents who did not report their choice of payment method (2,561 respondents in the family household data) and those whose cash holdings exceeded 9 million yen (78 thousand euros) (five responses each among the 30,369 family household and 20,000 single-person household sample responses), which appear to be outliers. As a result, we have 27,803 observations for our family household data set and 19,995 observations for our single-person household data set. The next section explains our model.

Proportions of observations for aggregated payment method choices for day-to-day transactions less than 1,000 yen

Table 3

	2007	2008	2009	2010	2011	2012	2013	2014	Total
Family household data									
cash	0.938	0.940	0.934	0.900	0.886	0.875	0.854	0.828	0.893
card	0.031	0.030	0.032	0.039	0.043	0.045	0.047	0.054	0.040
emoney	0.026	0.026	0.031	0.055	0.065	0.074	0.093	0.108	0.060
other	0.004	0.003	0.002	0.004	0.005	0.003	0.004	0.007	0.004
card+em	0.000	0.001	0.002	0.002	0.002	0.003	0.002	0.004	0.002
N	2,861	3,498	3,699	3,707	3,384	3,561	3,487	3,606	27,803
Single-person household data									
cash	0.668	0.648	0.622	0.577	0.546	0.502	0.503	0.467	0.567
card	0.111	0.112	0.108	0.124	0.141	0.153	0.168	0.166	0.135
emoney	0.200	0.214	0.236	0.257	0.268	0.298	0.266	0.296	0.254
other	0.011	0.016	0.018	0.020	0.021	0.020	0.034	0.038	0.022
card+em	0.011	0.010	0.016	0.021	0.024	0.026	0.029	0.032	0.021
N	2,500	2,499	2,499	2,499	2,500	2,498	2,500	2,500	19,995

Notes: Cash (card) is the proportion of respondents who chose cash exclusively (credit card, cash and credit card, or credit card and other); emoney (other) is the proportion of respondents who chose emoney exclusively, cash and emoney, or emoney and other (other and cash and other); card + em is the proportion of respondents who chose credit card and emoney.

3 Model

We consider the same theoretical and empirical model of consumer demand for cash and choice of payment method as Fujiki and Tanaka (2016a).⁴

We assume consumers will solve the following two-step decision problem.

In the first step, a consumer considers a portfolio choice model, as Merton (1992, Ch. 4) explains, to maximize his or her lifetime expected utility, and then uses this to determine the proportion of liquid assets (such as cash holdings or bank deposits) held among total financial assets (which also include stocks, bonds, and life insurance). After 1995, Japanese households have been facing extremely low levels of interest rates. We can safely assume that their bank deposits and cash holdings, which are both included in liquid assets, are perfect substitutes. In the second step, given the proportion of liquid assets that maximizes the consumer's lifetime expected utility, the consumer chooses the levels of cash holdings and bank deposits, and the payment method, such as electronic money or credit card. The consumer's choice depends on consumer characteristics, payment method attributes, and transaction characteristics.

For the sake of the empirical investigation, we focus on the second step. We assume that the utility to a consumer i at time t from using a given payment method for some transaction with characteristic j (for example, the value of the transaction), U_{ijt} , is defined as follows:

$$U_{ijt} = X_{it} \delta + Z_{ijt} \theta + v_{it} \quad (1)$$

where X_{it} is a vector of consumer characteristics; Z_{ijt} is the consumer's chosen

⁴ The following discussion draws heavily on Section 3 in Fujiki and Tanaka (2016a).

payment method (say, cash, cash and electronic money, cash and credit card, and so forth), which will depend on the transaction's characteristics; and δ and θ are vectors of parameters. v_{it} are unobserved factors that affect consumer choice, and independent and identically extreme-value distributed variables. Hence we can estimate equation (1) using a multinomial logit model.

Regarding the consumer demand for cash, we assume that C_{it} , consumer i 's demand for cash at time t , depends on the following: the usual determinants of the demand for cash, X_{it} , such as income or age; the consumer's chosen payment method when the transaction has characteristic j , Z_{ijt} , measured by dummy variables indicating the choice of payment method; and some random i.i.d. shocks ε_{it} , as shown below.

$$C_{it} = X_{it}\beta + Z_{ijt}\gamma + \varepsilon_{it} \quad (2)$$

Given the proportion of liquid assets that maximizes the consumer's lifetime expected utility, the consumer's decision concerning demand for cash depends not only on the usual determinants of the demand for cash but also on the consumer's use of electronic money (Remember that the consumer needs to charge cash in advance to use electronic money). The consumer's decision concerning demand for cash determines the amount of bank deposits as the remainder of the liquid assets.

We are most interested in whether the use of electronic money on average reduces the demand for cash, compared with the demand for cash by consumers that prefer to use cash exclusively. For this purpose, we estimate equation (2) by adding some variables to X_{it} to ensure consistency with the first step of the model. To address the endogeneity between the demand for cash and the choice of payment methods, we assume that ε_{ijt} , the error term for the demand for cash if the person chooses an alternative Z_{ijt} , is identical to ε_{it} , the error term for the actual demand

for cash. We estimate equation (1) using a multinomial logit model, and use the fitted value as the instrumental variable for Z_{ijt} in equation (2).

4 Data used for the regressions

Table 4 (1) reports the means and standard errors (S.E.) of the selected variables in the SHF from 2007 to 2014.

The first row of Table 4 (1) shows that the mean cash holdings of a family household are 135.80 thousand yen (1,180 euros), and those of a single-person household are 175.48 thousand yen (1,520 euros). From the second row to the sixth row report the average cash holdings by choice of payment method for day-to-day transactions of less than 1,000 yen. On average, respondents who choose emoney (emoney users) tend to have lower cash holdings compared with those who choose cash (cash users) in both data sets.

The seventh row provides the means and standard errors of a dummy variable for respondents who made mattress deposits (mattress) to cope with the financial crisis. We use this dummy variable because cash holdings for savings, such as money stored under a mattress, especially among the elderly, could amount to a substantial sum in Japan, as explained in Otani and Suzuki (2008).

From the eighth row, we report the means and standard errors for the five groups of independent variables used in the regressions in turn.

First, we use disposable income (income), financial assets (FA), annual debt payments (debtpay), and the ratio of liquid assets to total financial assets (liqratio). These variables correspond to the structural model we proposed in the previous subsection.

Summary statistics for the SHF from 2007 to 2014

Table 4.1

	Family household		Single-person household	
	Mean	S.E.	Mean	S.E.
cash	13.580	39.228	17.548	60.298
cash user	13.676	39.709	17.927	60.856
card user	14.618	41.888	19.436	64.860
emoney user	11.047	19.931	15.517	55.509
other user	23.261	94.002	19.059	65.662
card+em user	7.851	14.571	18.142	63.875
mattress	0.013	0.115	0.013	0.114
income	446.276	367.477	283.559	485.083
FA	1081.821	2050.009	726.999	2556.910
debtpay	32.544	96.516	15.968	292.536
liqratio	0.721	0.334	0.667	0.299
DI no	0.194	0.395	0.285	0.451
cheapbk	0.092	0.289	0.183	0.386
intbk	0.075	0.264	0.370	0.483
account	0.782	0.413	0.965	0.184
noincome	0.006	0.078	0.066	0.248
nosaving	0.242	0.429	0.340	0.474
Dep	558.721	1169.942	326.585	1212.707
homeowner	0.721	0.448	0.250	0.433
PKM	85152.970	86158.910	110689.600	91465.220

Notes: cash, income, FA, debtpay and Dep are in units of 10,000 yen. PKM is in units of billion passengers per kilometer.

Second, we specify dummy variables for respondents who had never heard of the Deposit Insurance Corporation of Japan (DI no), who placed an emphasis on lower service charges when selecting a financial institution (cheapbk), and who placed an emphasis on online banking services offered via the Internet when selecting financial institutions (intbk). These variables should correlate with respondents' knowledge of financial products, which generally should help them select their preferred financial product.

Third, we use dummy variables indicating whether a survey respondent has an account in a financial institution (account), has no income (noincome), has not made any savings from his/her disposable income (nosaving), is a homeowner (homeowner), and is male (male), as well as the amount of the respondent's deposits (Dep). To control for the supply of electronic money, we use passenger kilometers (PKM), which is the sum of kilometers traveled by all passengers by major railway companies in Japan within a year. The reason is that major electronic money suppliers in Japan include public transportation service providers. The PKM data series has breakdowns by nine regions.

Fourth, we specify dummy variables indicating a survey respondent's job situation: whether a household head is a full-time worker (works11), a part-time worker (works12), self-employed (works13), a student (works14), or has no job and does not attend school (works15). For a family household, we also use a dummy variable indicating whether the spouse of the survey respondent is a full-time worker (works21), a part-time worker (works22), self-employed (works23), a student (works24), or has no job and does not attend school (works25).

Table 4 (2) reports the means of dummy variables to indicate the educational attainment of a survey respondent: junior high school (edu1), senior high school (edu2), vocational college (edu3), junior college (edu4), university (edu5), graduate school (edu6), and other (edu7), and the means of dummy variable indicating the

Summary statistics for the SHF from 2007 to 2014
(continued)

Table 4.1

	Family household		Single-person household	
	Mean	S.E.	Mean	S.E.
male	0.924	0.266	0.593	0.491
works11	0.531	0.499	0.566	0.496
works12	0.062	0.242	0.097	0.296
works13	0.136	0.342	0.092	0.289
works14	0.003	0.057	0.088	0.283
works15	0.219	0.413	0.157	0.363
works21	0.148	0.355		
works22	0.243	0.429		
works23	0.049	0.216		
works24	0.001	0.034		
works25	0.393	0.488		
N	27,803		19,995	

Notes: cash, income, FA, debtpay and Dep are in units of 10,000 yen. PKM is in units of billion passengers per kilometer.

Summary statistics for the SHF from 2007 to 2014

Table 4.2

	Family household				
	Mean				
		age_25	0.003		
		age25_29	0.022		
edu1	0.116	age30_34	0.052		
edu2	0.390	age35_39	0.081	REGION1	0.053
edu3	0.072	age40_44	0.095	REGION2	0.082
edu4	0.036	age45_49	0.097	REGION3	0.271
edu5	0.261	age50_54	0.107	REGION4	0.053
edu6	0.026	age55_59	0.118	REGION5	0.150
edu7	0.004	age60_64	0.129	REGION6	0.156
edu21	0.086	age65_69	0.108	REGION7	0.071
edu22	0.394	age70_74	0.086	REGION8	0.032
edu23	0.086	age75_79	0.055	REGION9	0.133
edu24	0.133	age80_84	0.030	citi1	0.232
edu25	0.102	age85_89	0.011	citi2	0.399
edu26	0.005	age90_94	0.002	citi3	0.252
edu27	0.004	age95_	0.006	citi4	0.117
N	27,803				

		Single-person household			
		Mean			
			age_25	0.139	
			age25_29	0.194	
edu1	0.020	age30_34	0.106		
edu2	0.243	age35_39	0.108	REGION1	0.053
edu3	0.099	age40_44	0.073	REGION2	0.055
edu4	0.094	age45_49	0.051	REGION3	0.399
edu5	0.444	age50_54	0.096	REGION4	0.029
edu6	0.091	age55_59	0.056	REGION5	0.121
edu7	0.009	age60_64	0.122	REGION6	0.160
edu21		age65_69	0.054	REGION7	0.051
edu22		age70_74		REGION8	0.026
edu23		age75_79		REGION9	0.106
edu24		age80_84		citi1	
edu25		age85_89		citi2	
edu26		age90_94		citi3	
edu27		age95_		citi4	
N	19,995				

educational attainment of the spouse: junior high school (edu21), senior high school (edu22), vocational college (edu23), junior college (edu24), university (edu25), graduate school (edu26), and other (edu27). For the sake of empirical investigation, we add edu7 to edu1 and edu27 to edu21, because the number of households where edu7 and edu27 are one are very small.

Table 4 (2) also reports the means of dummy variables to indicate the age of the household head (25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80-84, 85-89, 90-94, and over 95 years for family households, and 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, and 65-69 years for single-person households), and the means of dummy variables for the survey respondent's residential area to indicate nine regions (Hokkaido, Tohoku, Kanto, Hokuriku, Chubu, Kinki, Chugoku, Shikoku, and Kyushu). We also report the means of dummy variables to denote four size categories for cities based on their population for the family data set. City sizes are classified into: (1) the 20 largest cities, (2) cities with more than 40,000 households, (3) cities with between 20,000 and 40,000 households, and (4) cities with under 20,000 households and villages. We use dummy variables to indicate city sizes, citi1, citi2, citi3 and citi4. We also specify dummy variables denoting the survey year.

5 Choice of payment method

We detail the results for the estimation of equation (1) by the multinomial logit regression using the STATA 13 command `mlogit`. Columns 2 to 5 and columns 8 to 11 in Tables 5 (1) through 5 (4) provide the results. We regard respondents that chose cash as the base group for our estimation, and thus the parameter estimates for this group are normalized to one. As the choice of cash, the choice of emoney, and the choice of card accounted for more than 90% of respondents' choices, we focus on the results for the choices of emoney and card, which are reported in the columns labeled emoney and card.

Regarding the statistically significant parameter estimates for the first group of independent variables, from our family household data, Table 5 (1) shows that the log of income ($\ln y$) and the square of the log of income ($\ln y^2$) are negatively and positively correlated with the choice of emoney. The parameter estimates for $\ln y$ and $\ln y^2$ suggest that an increase in $\ln y$ leads to a greater likelihood of choosing emoney if $\ln y$ is greater than 4.14 (or above the 14th percentile of the distribution of $\ln y$, 630 thousand yen). The log of financial assets ($\ln FA$) is negatively correlated, and the square of $\ln FA$ ($\ln FA^2$) is positively correlated, with the choices of card and emoney. The parameter estimates for $\ln FA$ and $\ln FA^2$ suggest that an increase in $\ln FA$ leads to a greater likelihood of choosing card if $\ln FA$ is greater than 6.83 (or above the 67th percentile of the distribution of $\ln FA$, 9.25 million yen). The parameter estimates for $\ln FA$ and $\ln FA^2$ suggest that an increase in $\ln FA$ leads to a greater likelihood of choosing emoney if $\ln FA$ is greater than 14.7, but the maximum of $\ln FA$ is 11.1, and thus the results mean that higher $\ln FA$ leads to a lower probability of choosing emoney. The log of annual debt payments ($\ln debtpay$) is positively correlated with the choices of emoney and card, and the ratio of liquid assets to total financial assets ($liqratio$) is negatively correlated with the choice of card and emoney.

For the results from our single-person household data, Table 5 (1) shows that the log of income ($\ln y$) is positively correlated and $\ln y^2$ is negatively correlated with the choice of card. The parameter estimates for $\ln y$ and $\ln y^2$ suggest that an increase in $\ln y$ leads to a greater chance of choosing card if $\ln y$ is less than 7.28, or below the 99.73 percentile of $\ln y$, namely, for almost all single-person households. The parameter estimate for $\ln y^2$ is weakly statistically significant at the 7% level for the choice of emoney. The log of annual debt payments ($\ln debtpay$) is positively correlated with the choice of emoney, and the ratio of liquid to total financial assets ($liqratio$) is negatively correlated with the choices of card and emoney.

Regarding the statistically significant parameter estimates for the second group of

independent variables, the dummy variable for respondents who had never heard of the Deposit Insurance Corporation of Japan (DI no) is negatively correlated with the choices of card and emoney, while those indicating whether a survey respondent placed an emphasis on lower service charges (cheapbk) or on online banking services offered via the Internet (intbk) when selecting financial institutions are positively correlated with the choices of card and emoney for the results using both data sets. These results show that respondents who have better knowledge of financial products tend to use both electronic money and credit cards.

Regarding the statistically significant parameter estimates for the third group of independent variables, the dummy variable indicating whether a survey respondent held an account in a financial institution (account) is positively correlated with the choice of emoney for the results using the single-person household data set. The dummy variable indicating no income (noincome) is positively correlated with the choices of emoney and card for the results using the family household data. The dummy variable for a survey respondent that had not made any savings from his/her disposable income (nosaving) is negatively correlated with the choice of emoney for the results using both data sets. The log of deposits (lnDep) is positively correlated with the choice of emoney for the results using the family household data set. The dummy variable indicating whether a survey respondent was a homeowner (homeowner) is positively correlated with the choice of card for the results using the family data set, and negatively correlated with the choice of emoney for the results using both data sets. PKM is positively correlated with the choice of card and emoney in the results for both data sets. We did not use the dummy variables for regions in this regression to avoid multicollinearity because PKM is measured by regions.

Table 5 (2) reports the estimates of the dummy variables for the age of the household head. Old household heads tend to correlate negatively with the choice of emoney (ages 55-59 to 90-94 years in the family household data set and ages 45-

49 to 65-69 years in the single-person household data set). Young household heads tend to correlate positively with the choice of card (for ages 25-29 and 30-34 years in the single-person household data set) and old household heads tend to correlate negatively with the choice of card (ages 55-59 to 65-69 years in the single-person household data set).

Table 5 (3) shows that among the statistically significant parameter estimates for the fourth group of independent variables, the dummy variable indicating whether a survey respondent was male is negatively correlated with the choice of emoney for the results from the family household data and positively correlated with the choice of card for the results from the single-person household data. Regarding the dummy variables indicating a survey respondent's job situation, the self-employed (works23) dummy is negatively correlated with the choices of emoney and card in the family household data set. Regarding the dummy variables indicating educational attainment, the dummy variable for university (edu5) and that for graduate school (edu6) are positively correlated with the choice of emoney, for the results using both data sets. In the single-person family data set, the dummy variable for senior high school (edu2) is positively correlated with the choice of emoney. Two dummy variables indicating the educational attainment of the spouse of a survey respondent are positively correlated with the choice of emoney for the family household data set: university (edu25) and graduate school (edu26). These results appear to show that family households with a female household head with higher educational attainment and who is not self-employed tend to use emoney.

Table 5 (4) reports that family households living in the 20 largest cities (citi1) tend to choose emoney and card, family households living in cities with more than 40,000 households (citi2) tend to choose card, and the dummy variables for the survey year show that an increasing number of survey respondents have selected the choices of emoney and card over time.

Results of the multinomial logit regressions and demand for cash regression: Day-to-day transactions < 1,000 yen

Table 5.1

	Family household data					
	Multinomial logit				Currency demand	
	card	emoney	other	card+em	OLS	IV
card					-0.0282 (-0.80)	-1.222 (-1.19)
emoney					0.0197 (0.68)	0.137 (0.48)
other					-0.177 (-1.32)	-0.00668 (-0.00)
card+em					-0.0887 (-0.77)	-2.339 (-1.13)
mattress					0.539*** (6.92)	0.531*** (6.56)
lny	0.111 (1.73)	-0.124* (-2.18)	0.141 (0.80)	-0.130 (-0.44)	-0.0887*** (-6.11)	-0.0832*** (-5.22)
lny2	-0.0142 (-1.34)	0.0299** (3.22)	-0.0156 (-0.52)	0.0165 (0.32)	0.0290*** (11.72)	0.0281*** (10.41)
lnFA	-0.138* (-2.42)	-0.218*** (-4.43)	-0.0650 (-0.41)	-0.0903 (-0.40)	-0.0752*** (-5.60)	-0.0794*** (-5.54)
lnFA2	0.0202*** (3.76)	0.0148** (3.15)	0.0178 (1.06)	0.00312 (0.13)	0.0242*** (19.33)	0.0250*** (16.95)
lndebtpay	0.0273 (1.91)	0.0612*** (5.20)	-0.127* (-2.16)	0.00365 (0.06)	-0.0132*** (-3.79)	-0.0125*** (-3.32)
liqratio	-0.260 (-1.53)	-0.781*** (-5.12)	-0.229 (-0.42)	-0.829 (-1.08)	0.328*** (8.42)	0.321*** (7.78)
DI no	-0.457*** (-4.49)	-0.696*** (-7.94)	0.0763 (0.31)	-0.384 (-0.97)	-0.150*** (-7.24)	-0.160*** (-6.90)

Notes: T-statistics are in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

		Single-person household data					
		Multinomial logit				Currency demand	
		card	emoney	other	card+em	OLS	IV
	card					-0.0111 (-0.38)	-1.460 (-1.02)
	emoney					-0.0522* (-2.40)	1.367 (1.79)
	other					-0.107 (-1.65)	-8.330*** (-5.01)
	card+em					-0.196** (-2.91)	0.757 (0.75)
	mattress					0.559*** (5.89)	0.726*** (4.85)
	lny	0.285* (1.97)	-0.0418 (-0.36)	-0.572** (-2.85)	-0.221 (-0.67)	-0.402*** (-5.81)	-0.558*** (-4.53)
	lny2	-0.0391* (-2.52)	0.0214 (1.77)	0.0463 (1.92)	0.0333 (0.99)	0.0628*** (7.89)	0.0677*** (4.84)
	lnFA	0.0871 (1.14)	-0.0494 (-0.86)	-0.448** (-3.06)	0.456* (2.00)	0.520*** (16.57)	0.463*** (9.43)
	lnFA2	0.00691 (1.09)	0.000643 (0.13)	0.0166 (1.30)	-0.0241 (-1.32)	0.0139*** (4.84)	0.0198*** (4.08)
	Indebtpay	-0.00839 (-0.61)	0.0206* (1.98)	-0.109** (-3.09)	0.0533 (1.83)	-0.0375*** (-7.18)	-0.0632*** (-6.97)
	liqratio	-0.350** (-3.12)	-0.451*** (-4.91)	-0.725** (-2.66)	-0.742** (-2.78)	2.758*** (46.87)	2.711*** (26.75)
	DI no	-0.228*** (-4.00)	-0.413*** (-9.19)	0.546*** (4.78)	-0.190 (-1.40)	-0.0167 (-0.73)	0.209** (2.92)

Results of the multinomial logit regressions and demand for cash regression: Day-to-day transactions < 1,000 yen (continued)

Table 5.1

	Family household data					
	Multinomial logit				Currency demand	
	card	emoney	other	card+em	OLS	IV
cheapbk	0.425*** (4.81)	0.447*** (6.14)	-0.664 (-1.29)	0.718* (2.24)	-0.0931*** (-3.95)	-0.0683* (-2.25)
intbk	0.778*** (8.96)	0.804*** (11.36)	-0.577 (-0.97)	1.472*** (4.96)	0.104*** (3.79)	0.162** (3.22)
account	0.156 (0.79)	-0.165 (-1.01)	0.0691 (0.13)	-1.476 (-1.45)	0.474*** (9.14)	0.474*** (8.85)
noincome	0.791* (2.02)	0.804* (2.06)	1.795** (2.99)	-13.68 (-0.01)	-0.0365 (-0.35)	-0.0169 (-0.15)
nosaving	-0.0141 (-0.06)	-0.410* (-2.28)	0.171 (0.28)	-1.842 (-1.81)	0.0709 (1.24)	0.0661 (1.12)
lnDep	0.0401 (1.18)	0.0980** (3.21)	-0.0984 (-1.15)	-0.0271 (-0.20)	0.0126 (1.52)	0.0132 (1.54)
homeowner	0.192* (2.37)	-0.183** (-2.82)	-0.106 (-0.45)	0.329 (0.98)	0.0843*** (4.51)	0.0958*** (4.58)
PKM	1.977*** (5.48)	1.694*** (5.49)	2.888** (2.58)	4.035** (2.59)		

Notes: T-statistics are in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

Single-person household data							
		Multinomial logit				Currency demand	
		card	emoney	other	card+em	OLS	IV
	cheapbk	0.324*** (5.79)	0.381*** (8.41)	-0.000176 (-0.00)	0.670*** (5.89)	-0.126*** (-5.43)	-0.204** (-3.09)
	intbk	0.373*** (7.97)	0.541*** (14.38)	-0.0431 (-0.36)	0.718*** (6.78)	0.0695*** (3.56)	-0.0686 (-0.83)
	account	0.0290 (0.21)	0.409*** (3.45)	-0.598*** (-3.77)	0.981 (1.65)	0.106* (2.44)	-0.400** (-3.10)
	noincome	0.567 (1.24)	0.192 (0.52)	-1.308* (-2.28)	-0.327 (-0.30)	-0.897*** (-4.47)	-1.353*** (-3.67)
	nosaving	0.314 (1.23)	-0.397* (-2.20)	-0.529 (-1.46)	1.553 (1.93)	0.624*** (7.15)	0.662*** (4.16)
	InDep	0.0164 (0.60)	0.0301 (1.29)	0.206* (2.10)	0.0590 (0.89)	-0.413*** (-23.02)	-0.396*** (-18.17)
	homeowner	0.118 (1.93)	-0.110* (-2.12)	0.209 (1.57)	0.0601 (0.41)	0.232*** (8.60)	0.325*** (6.74)
	PKM	1.284*** (5.24)	2.270*** (11.52)	0.771 (1.42)	4.163*** (7.17)		

Results of the multinomial logit regressions and demand for cash regression: Day-to-day transactions < 1,000 yen

Table 5.2

	Family household data					
	Multinomial logit				Currency demand	
	card	emoney	other	card+em	OLS	IV
age25_29	0.593 (0.57)	-0.507 (-1.01)	-1.206 (-0.97)	-1.633 (-1.36)	-0.104 (-0.81)	-0.112 (-0.83)
age30_34	0.932 (0.92)	-0.221 (-0.46)	-1.559 (-1.33)	-1.718 (-1.52)	-0.0989 (-0.81)	-0.0931 (-0.72)
age35_39	0.911 (0.90)	-0.399 (-0.83)	-1.470 (-1.32)	-1.620 (-1.46)	-0.102 (-0.84)	-0.0906 (-0.70)
age40_44	0.753 (0.74)	-0.401 (-0.83)	-1.725 (-1.54)	-1.973 (-1.75)	-0.0776 (-0.64)	-0.0784 (-0.61)
age45_49	0.704 (0.69)	-0.464 (-0.96)	-1.255 (-1.15)	-2.138 (-1.87)	-0.0651 (-0.53)	-0.0678 (-0.53)
age50_54	0.463 (0.46)	-0.725 (-1.50)	-0.922 (-0.86)	-2.931* (-2.42)	-0.00685 (-0.06)	-0.0211 (-0.16)
age55_59	0.487 (0.48)	-0.979* (-2.02)	-1.174 (-1.09)	-4.298** (-2.88)	0.101 (0.82)	0.0893 (0.69)
age60_64	0.306 (0.30)	-1.221* (-2.50)	-1.169 (-1.09)	-4.289** (-2.86)	0.226 (1.85)	0.210 (1.63)
age65_69	-0.108 (-0.11)	-1.630** (-3.27)	-1.978 (-1.77)	-3.342* (-2.48)	0.274* (2.22)	0.245 (1.88)
age70_74	-0.0595 (-0.06)	-2.007*** (-3.90)	-1.198 (-1.10)	-2.507 (-1.89)	0.328** (2.64)	0.303* (2.33)
age75_79	-0.453 (-0.44)	-1.899*** (-3.60)	-1.938 (-1.68)	-3.070 (-1.95)	0.259* (2.06)	0.222 (1.66)
age80_84	-0.896 (-0.84)	-3.117*** (-4.45)	-0.958 (-0.85)	-15.96 (-0.02)	0.359** (2.78)	0.315* (2.32)

Notes: T-statistics are in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

Single-person household data							
		Multinomial logit				Currency demand	
		card	emoney	other	card+em	OLS	IV
	age25_29	0.345*** (3.63)	0.0400 (0.56)	0.174 (0.90)	0.560* (2.29)	-0.0396 (-1.12)	0.0385 (0.51)
	age30_34	0.408*** (3.79)	0.0979 (1.19)	0.370 (1.67)	0.737** (2.80)	-0.0760 (-1.85)	0.0230 (0.26)
	age35_39	0.141 (1.28)	0.0206 (0.25)	0.255 (1.13)	0.358 (1.32)	-0.0253 (-0.59)	0.0270 (0.37)
	age40_44	-0.00469 (-0.04)	0.0905 (1.00)	-0.126 (-0.46)	0.177 (0.60)	-0.0612 (-1.32)	-0.116 (-1.48)
	age45_49	-0.0753 (-0.57)	-0.228* (-2.23)	-0.132 (-0.44)	-0.194 (-0.59)	-0.0870 (-1.66)	-0.0407 (-0.47)
	age50_54	-0.149 (-1.26)	-0.410*** (-4.44)	0.365 (1.59)	-0.285 (-0.92)	0.0424 (0.92)	0.219* (2.39)
	age55_59	-0.310* (-2.32)	-0.606*** (-5.57)	0.0616 (0.22)	-0.560 (-1.53)	0.109* (2.08)	0.259* (2.27)
	age60_64	-0.668*** (-5.40)	-0.850*** (-8.65)	0.0974 (0.42)	-0.885* (-2.56)	0.153** (3.22)	0.304* (2.14)
	age65_69	-0.985*** (-6.45)	-1.240*** (-9.45)	0.243 (0.87)	-1.853*** (-3.41)	0.278*** (4.69)	0.491* (2.55)
	age70_74						
	age75_79						
	age80_84						

Results of the multinomial logit regressions and demand for cash regression: Day-to-day transactions < 1,000 yen (continued)

Table 5.2

	Family household data						
	Multinomial logit				Currency demand		
	card	emoney	other	card+em	OLS	IV	
age85_89	-1.083 (-0.92)	-2.488** (-3.26)	-0.976 (-0.80)	-1.331 (-0.83)	0.553*** (3.86)	0.514*** (3.45)	
age90_94	-14.36 (-0.02)	-2.208* (-1.96)	-14.89 (-0.01)	-16.22 (-0.00)	0.287 (1.45)	0.230 (1.11)	
age95_	-0.591 (-0.48)	-1.027 (-1.53)	-0.588 (-0.46)	-1.117 (-0.74)	0.0852 (0.52)	0.0579 (0.35)	

Notes: T-statistics are in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

		Single-person household data					
		Multinomial logit				Currency demand	
		card	emoney	other	card+em	OLS	IV
	age85_89						
	age90_94						
	age95_						

Results of the multinomial logit regressions and demand for cash regression: Day-to-day transactions < 1,000 yen

Table 5.3

	Family household data					
	Multinomial logit				Currency demand	
	card	emoney	other	card+em	OLS	IV
male	-0.244 (-1.71)	-0.306* (-2.45)	-0.537 (-1.47)	-0.0634 (-0.10)	0.0251 (0.76)	0.0178 (0.51)
works11	-0.192 (-1.69)	0.0628 (0.56)	-0.371 (-1.16)	0.728 (1.08)	0.00755 (0.29)	0.00272 (0.10)
works12	-0.230 (-1.43)	0.0248 (0.16)	-0.876 (-1.60)	0.549 (0.61)	-0.0816* (-2.38)	-0.0895* (-2.42)
works13	-0.231 (-1.71)	-0.206 (-1.53)	-0.112 (-0.32)	-0.750 (-0.81)	0.249*** (8.30)	0.241*** (7.74)
works14	0.188 (0.41)	-1.105 (-1.48)	-14.22 (-0.01)	-11.97 (-0.01)	0.229 (1.33)	0.251 (1.44)
works21	-0.138 (-1.44)	-0.0806 (-1.05)	-0.0887 (-0.25)	-0.142 (-0.38)	-0.0371 (-1.63)	-0.0436 (-1.83)
works22	-0.0808 (-0.99)	-0.0605 (-0.89)	0.0936 (0.34)	-0.752 (-1.89)	-0.0890*** (-4.65)	-0.0963*** (-4.82)
works23	-0.444* (-2.25)	-0.348* (-2.03)	0.504 (1.19)	0.644 (0.98)	0.0398 (0.99)	0.0304 (0.72)
works24	0.00360 (0.00)	-0.802 (-0.77)	-13.39 (-0.00)	-12.89 (-0.01)	-0.253 (-1.06)	-0.251 (-1.07)
edu2	0.0108 (0.09)	-0.0743 (-0.67)	-0.913** (-3.22)	-0.694 (-1.26)	0.0556* (2.18)	0.0542* (1.97)
edu3	0.123 (0.77)	0.138 (1.02)	-1.416* (-2.51)	-0.568 (-0.81)	-0.0149 (-0.42)	-0.0138 (-0.36)
edu4	0.216 (1.16)	0.130 (0.79)	-0.684 (-1.22)	0.149 (0.20)	0.106* (2.38)	0.115* (2.47)

Notes: T-statistics are in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

Single-person household data						
	Multinomial logit				Currency demand	
	card	emoney	other	card+em	OLS	IV
male	0.150** (3.12)	0.00358 (0.09)	0.397*** (3.66)	0.588*** (4.76)	0.185*** (9.66)	0.274*** (7.08)
works11	-0.105 (-1.28)	0.0852 (1.19)	0.126 (0.76)	0.195 (0.85)	-0.0836* (-2.40)	-0.119* (-2.02)
works12	-0.0382 (-0.40)	0.0339 (0.41)	0.0985 (0.51)	0.0977 (0.35)	-0.0246 (-0.65)	-0.0377 (-0.61)
works13	-0.105 (-1.07)	-0.0679 (-0.79)	0.0352 (0.17)	-0.747* (-2.27)	0.117** (2.81)	0.127 (1.94)
works14	-0.197 (-1.62)	0.131 (1.36)	-0.333 (-1.47)	0.393 (1.26)	-0.00700 (-0.16)	-0.202* (-2.19)
works21						
works22						
works23						
works24						
edu2	-0.140 (-0.98)	0.285* (2.22)	-0.442* (-2.12)	0.116 (0.29)	-0.0668 (-1.20)	-0.341** (-3.04)
edu3	-0.0629 (-0.41)	0.215 (1.58)	-0.438 (-1.83)	-0.265 (-0.61)	-0.0498 (-0.83)	-0.280* (-2.46)
edu4	-0.116 (-0.76)	0.207 (1.51)	-0.810** (-3.00)	-0.260 (-0.58)	-0.0103 (-0.17)	-0.307** (-2.62)

Results of the multinomial logit regressions and demand for cash regression: Day-to-day transactions < 1,000 yen (continued)

Table 5.3

	Family household data					
	Multinomial logit				Currency demand	
	card	emoney	other	card+em	OLS	IV
edu5	0.228 (1.74)	0.230* (1.97)	-1.036** (-2.79)	0.0102 (0.02)	0.0246 (0.84)	0.0343 (1.08)
edu6	0.338 (1.72)	0.417** (2.60)	-0.623 (-0.78)	0.260 (0.36)	-0.0308 (-0.60)	-0.0132 (-0.23)
edu22	-0.0218 (-0.19)	0.0842 (0.79)	0.574 (1.92)	0.390 (0.74)	-0.00596 (-0.24)	-0.00724 (-0.28)
edu23	0.200 (1.39)	0.142 (1.11)	0.861* (2.04)	0.224 (0.35)	0.0143 (0.42)	0.0230 (0.62)
edu24	0.0727 (0.54)	0.0652 (0.55)	0.298 (0.63)	-0.00114 (-0.00)	0.0282 (0.89)	0.0305 (0.93)
edu25	0.196 (1.39)	0.327** (2.69)	0.667 (1.33)	0.375 (0.63)	0.0318 (0.92)	0.0416 (1.11)
edu26	-0.228 (-0.54)	0.615* (2.40)	-14.52 (-0.00)	0.335 (0.28)	-0.0582 (-0.54)	-0.0971 (-0.80)

Notes: T-statistics are in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

Single-person household data							
		Multinomial logit				Currency demand	
		card	emoney	other	card+em	OLS	IV
	edu5	-0.0293 (-0.21)	0.380** (3.00)	-0.501* (-2.41)	0.0529 (0.13)	-0.0396 (-0.71)	-0.334** (-2.95)
	edu6	0.237 (1.54)	0.511*** (3.71)	-0.940** (-3.08)	0.496 (1.20)	-0.0664 (-1.03)	-0.419** (-3.19)
	edu22						
	edu23						
	edu24						
	edu25						
	edu26						

Results of the multinomial logit regressions and demand for cash regression: Day-to-day transactions < 1,000 yen

Table 5.4

	Family household data					
	Multinomial logit				Currency demand	
	card	emoney	other	card+em	OLS	IV
REGION2					0.0928* (2.31)	0.0892* (2.18)
REGION3					0.184*** (5.37)	0.197*** (5.21)
REGION4					0.0490 (1.11)	0.0476 (1.05)
REGION5					0.112** (3.11)	0.134** (3.06)
REGION6					0.225*** (6.24)	0.231*** (5.84)
REGION7					0.106** (2.62)	0.0892* (2.12)
REGION8					0.157** (2.96)	0.147** (2.72)
REGION9					0.0656 (1.78)	0.0570 (1.50)
citi1	0.432*** (3.40)	0.343** (3.12)	-0.416 (-1.13)	-0.0152 (-0.03)	0.0190 (0.71)	0.0343 (1.12)
citi2	0.258* (2.12)	0.185 (1.74)	-0.0549 (-0.17)	0.183 (0.34)	-0.00701 (-0.29)	0.00133 (0.05)
citi3	0.0599 (0.46)	0.0464 (0.41)	0.0730 (0.23)	-0.650 (-1.00)	-0.00493 (-0.19)	-0.00611 (-0.24)
year2007	-0.761*** (-5.67)	-1.720*** (-12.80)	-0.642 (-1.75)	-2.726** (-2.62)	0.00512 (0.17)	-0.0192 (-0.46)

Notes: T-statistics are in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

Single-person household data							
		Multinomial logit				Currency demand	
		card	emoney	other	card+em	OLS	IV
	REGION2					0.0155 (0.31)	-0.0302 (-0.35)
	REGION3					0.0611 (1.58)	-0.0591 (-0.70)
	REGION4					0.0962 (1.50)	0.111 (0.99)
	REGION5					0.0717 (1.61)	0.0734 (0.87)
	REGION6					0.122** (2.90)	0.175* (2.09)
	REGION7					0.0540 (1.05)	-0.0413 (-0.46)
	REGION8					0.0668 (1.01)	0.111 (0.99)
	REGION9					0.0418 (0.94)	-0.0632 (-0.79)
	citi1						
	citi2						
	citi3						
	year2007	-0.992*** (-10.92)	-1.130*** (-15.15)	-1.165*** (-5.09)	-1.950*** (-8.34)	-0.184*** (-4.87)	-0.182 (-0.98)

Results of the multinomial logit regressions and demand for cash regression: Day-to-day transactions < 1,000 yen (continued)

Table 5.4

	Family household data					
	Multinomial logit				Currency demand	
	card	emoney	other	card+em	OLS	IV
year2008	-0.794*** (-6.26)	-1.713*** (-13.88)	-0.774* (-2.15)	-1.772** (-2.75)	-0.00466 (-0.16)	-0.0284 (-0.68)
year2009	-0.698*** (-5.71)	-1.476*** (-13.04)	-1.511** (-3.28)	-0.942* (-1.99)	-0.0578* (-2.04)	-0.0771 (-1.88)
year2010	-0.414*** (-3.60)	-0.842*** (-8.87)	-0.710* (-2.03)	-0.594 (-1.36)	-0.0546 (-1.92)	-0.0666 (-1.92)
year2011	-0.358** (-3.11)	-0.681*** (-7.31)	-0.358 (-1.12)	-0.886 (-1.79)	0.0575 (1.93)	0.0449 (1.33)
year2012	-0.273* (-2.43)	-0.473*** (-5.36)	-0.826* (-2.25)	-0.517 (-1.19)	0.0411 (1.41)	0.0324 (0.98)
year2013	-0.187 (-1.68)	-0.235** (-2.79)	-0.534 (-1.57)	-0.622 (-1.38)	0.0329 (1.12)	0.0239 (0.76)
_cons	-3.742*** (-3.49)	-0.767 (-1.36)	-2.720 (-1.91)	-1.366 (-0.71)	-0.316* (-2.12)	-0.259 (-1.55)
N	27,803				27,803	27,803
Log-likelihood	-10,624.018					
Pseudo R ²	0.1192					
R ²					0.2398	0.2051
F-value					131.15	124.15

Notes: T-statistics are in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

		Single-person household data					
		Multinomial logit				Currency demand	
		card	emoney	other	card+em	OLS	IV
	year2008	-0.945*** (-10.50)	-1.027*** (-14.03)	-0.801*** (-4.04)	-1.982*** (-8.31)	-0.0211 (-0.57)	-0.00594 (-0.03)
	year2009	-0.905*** (-10.02)	-0.810*** (-11.31)	-0.723*** (-3.78)	-1.347*** (-6.65)	-0.0543 (-1.48)	-0.0946 (-0.60)
	year2010	-0.650*** (-7.42)	-0.590*** (-8.34)	-0.546** (-2.97)	-0.936*** (-4.99)	-0.0741* (-2.05)	-0.119 (-0.97)
	year2011	-0.422*** (-4.94)	-0.434*** (-6.17)	-0.529** (-2.92)	-0.630*** (-3.50)	0.0472 (1.26)	-0.00812 (-0.08)
	year2012	-0.274** (-3.25)	-0.235*** (-3.38)	-0.496** (-2.71)	-0.502** (-2.84)	0.0229 (0.61)	-0.0664 (-0.86)
	year2013	-0.106 (-1.28)	-0.238*** (-3.38)	-0.0736 (-0.46)	-0.245 (-1.43)	-0.0456 (-1.23)	-0.00562 (-0.08)
	_cons	-1.942*** (-4.30)	-1.144** (-3.15)	0.251 (0.41)	-6.157*** (-4.84)	-1.548*** (-8.14)	-0.120 (-0.23)
	N	19,995				19,995	19,995
	Log-likelihood	-20,455.327					
	Pseudo R ²	0.0764					
	R ²					0.2896	-0.7143
	F-value					143.45	57.85

6 Demand for cash

Columns 6 to 7 and columns 12 to 13 in Tables 5 (1) through 5 (4) summarize the results for the demand for cash equation (2) using ordinary least squares (OLS) and instrumental variable methods (IV) using the STATA 13 commands `reg` and `ivreg2`, respectively, where the reported t-test statistics are robust to heteroskedasticity. In addition to the variables used to estimate equation (1), we specify dummy variables for the four aggregate choices of payment method for day-to-day transaction values less than 1,000 yen (namely, card, emoney, other, and card and emoney) for respondents that chose cash as the base group for our estimation. We use the fitted value of the regression equation (1) as the instrumental variable for the four aggregate payment methods for the IV estimation. We also use a dummy variable for respondents who made mattress deposits (mattress) to cope with the financial crisis, to control for the large amount of cash holdings intended as savings, and dummy variables for regions instead of PKM.

The first to eighth rows in the columns 6 to 7 and 12 to 13 in Table 5 (1) show the parameter estimates for the dummy variable for the choice of payment method for day-to-day transaction values less than 1,000 yen. First, columns 6 to 7 show that using the family household data set, the parameter estimates for the dummy variable for the choice of emoney from the OLS regression and from the IV regression are both positive but not statistically significantly different from zero. Second, columns 12 to 13 show that using the single-person household data set, the parameter estimate for the dummy variable for the choice of emoney from the OLS regression is negative and statistically significantly different from zero. This suggests that emoney users have 5% lower cash holdings than cash users. However, the parameter estimate for the dummy variable for the choice of emoney from the IV regression is positive, with the probability value that the estimates are different from zero being 0.073, consistent with Fujiki and Tanaka (2014). As we believe that the choice of payment method is endogenous, we adopt the results using the IV

regressions as our benchmark results. Overall, we conclude that a family household that chooses emoney does not generally have greater cash holdings than a household that chooses cash, when all other household characteristics are held constant. We also obtain weak evidence that a single-person household that chooses emoney does have greater cash holdings than a household that chooses cash, holding all other variables constant.

As the choice of payment method is endogenous, we focus on the results obtained from the IV regressions below. The parameter estimates for mattress deposit dummies are statistically significant and positively correlated with average cash holdings in both data sets. The parameter estimates for $\ln y$ and the square of $\ln y$ are significant in both data sets. The parameter estimates for $\ln y$ and $\ln y^2$ suggest that an increase in $\ln y$ leads to an increase in demand for money if $\ln y$ exceeds 2.96 (193 thousand yen) or is above the 14th percentile of $\ln y$ in the family household data set, and that an increase in $\ln y$ leads to a decrease in demand for money for all values of $\ln y$ in the single-person household data set. The parameter estimates for $\ln FA$ and $\ln FA^2$ are significant in both data sets. The parameter estimates for $\ln FA$ and $\ln FA^2$ suggest that an increase in $\ln FA$ leads to an increase in demand for money if $\ln FA$ exceeds 3.17 (240 thousand yen) or is above the 33rd percentile of $\ln FA$ in the family household data set, and for all values of $\ln FA$ in the single-person household data set.

The remaining rows in the columns 6 to 7 and columns 12 to 13 in Table 5 (1) show that a respondent with lower debt payments, more liquid assets, and home ownership tends to have greater cash holdings in both data sets, and that a respondent who is more sensitive about service charges tends to have lower cash holdings in both data sets. A respondent who places an emphasis on online banking services offered via the Internet when selecting financial institutions tends to have higher cash holdings for the results from the family data set. The effects of knowledge of the Deposit Insurance Corporation of Japan and the dummy variables on the

demand for cash vary between the two data sets. The dummy variables indicating no income (noincome) and the log of deposits (lnDep) are negatively correlated with the demand for cash, and the dummy variable for not saving money from income (nosaving) is positively correlated with the demand for cash for the single-person household data.

The columns 6 to 7 and 12 to 13 in Table 5 (2) show that older household heads tend to have greater cash holdings (from 70-74 and 80-89 years for the family household data and from 50-54 to 65-69 years for the single-person household data) in the IV regressions. This is consistent with the result that an older household head tends to choose cash, holding all other variables constant.

Columns 6 to 7 and 12 to 13 in Table 5 (3) show that a family household with a self-employed (works13) household head who has completed senior high school (edu2) or junior college (edu4) tends to have greater cash holdings, while a family household in which the spouse of the household head is a part-time worker (works22) tends to have lower cash holdings. The table also shows that a single-person household with a male household head tends to have greater cash holdings, while a single-person household consisting of a full-time worker (works11) or a student (works14) with an educational attainment other higher than junior high school (edu2-edu6) tends to have lower cash holdings.

Columns 6 to 7 and 12 to 13 in Table 5 (4) show that family households living in REGION2, 3, 5, 6, 7 and 8 tend to hold large amounts of cash. It also shows that single-person households living in REGION6 have greater cash holdings.

7 Conclusion

What are the determinants of the choice of payment method? Would the use of electronic money for day-to-day transactions with values less than 1,000 yen

reduce the demand for cash by households?

To respond to these questions, we used repeated Japanese cross-sectional data sets obtained from the Survey of Household Finance conducted by the Central Council for Financial Services Information from 2007 to 2014. We first estimated the probability that a consumer would choose a particular payment method, such as cash, credit card, or electronic money, using a multinomial logit model. We then estimated the demand for cash to test whether the use of electronic money for day-to-day transactions with values less than 1,000 yen reduced the demand for cash. We obtained the following results.

First, the major payment choices for low-value day-to-day transactions, typically those less than 1,000 yen, comprise three payment instruments: cash, electronic money, and credit card. Second, high-income, financially sophisticated, and well-educated family households living in urban areas tend to use both electronic money and cash. High-income, financially sophisticated, and well-educated single-person households tend to use both electronic money and cash. Third, a family household that chooses electronic money and cash does not generally have greater cash holdings than a household that exclusively chooses cash, holding all other household characteristics constant. We obtain weak evidence that a single-person household that chooses electronic money and cash generally has greater cash holdings than a comparable household that exclusively chooses cash.

These findings should be interpreted in light of the following reservations. We should not take these estimates as representative of the overall impact of developments in noncash payments on the Japanese demand for cash, as they do not include the demand for cash by firms, or mattress savings by households because our model excludes samples with cash holdings greater than 9 million yen from the estimations.

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Nicole Jonker, Lola Hernandez (De Nederlandsche Bank), Renate de Vree (Dutch Payments Association), Patricia Zwaan (Dutch Payments Association) From cash to cards: how debit card payments overtook cash in the Netherlands



Nicole Jonker
De Nederlandsche Bank

Abstract

In this study, we present and discuss the results of a longitudinal survey on consumers' payment behaviour carried out yearly during the period 2010 to 2016. We have collected data among 119,117 Dutch consumers aged 12 years and older using single day payment diaries. Between 2010 and 2013 the field work was carried out in September, whereas from 2014 onwards the field work has taken place during the whole year. The results reveal a gradual substitution of cash by debit card payments between 2010 and 2016. Between 2012 and 2013, the substitution process slowed down, probably due to the economic crisis. In 2015 Dutch consumers for the first time made more payments with debit cards than with cash.

1 Introduction

Central banks and other stakeholders in the payments market have a need to be informed about which payment instruments consumers use at physical points-of-sale (POS) and the underlying reasons. It helps them to monitor the developments in the retail payments market, to assess the future need of cash and electronic payment instruments by consumers and retailers and to identify which factors drive changing payment behaviour. Stakeholders use this information to assess the efficiency and safety of the retail payment system as a whole and to forecast the future need of electronic payment instruments and cash. The latter is especially important for central banks as they issue banknotes and are responsible for the quality of the cash circulation.

During the past decade, the need for information about payment behaviour at the POS has become stronger in the Netherlands due to the continuing decline in cash usage, fuelled by the widespread acceptance of electronic payment instruments and the introduction of new payment methods such as contactless card and mobile payments.

This study by De Nederlandsche Bank (DNB) and the Dutch Payment Association (DPA) is the first to report and discuss the results of a longitudinal survey on consumers' payment behaviour carried out yearly during the period 2010 to 2016. We have collected data on payment transactions using single day payment diaries among a large sample of 119,117 Dutch speaking residents in the Netherlands aged 12 years and older. From 2014 onwards we have collected data during the entire year in collaboration with research company GfK. The contribution of this study to the existing payment literature is fourfold. First, it allows us to estimate cash usage on a continuous base, enabling us to track the cash by cards substitution process on a yearly base. Second, continuous data collection provides us the unique opportunity to identify seasonal patterns in payment behaviour. Third, we

provide information on the differences in the cash substitution between industries and consumer segments. Fourth, due to the length of the research period, we can track the adoption of a new payment method from its introduction in the Dutch payment market among different consumer segments

The results show a gradual substitution of cash by debit card payments from 65% in the total number of POS payments in 2010 to 45% in 2016. The substitution process had a hick-up between 2012 and 2013, probably due to the economic crisis. However, from 2014 onwards the substitution process continued. In 2015 Dutch consumers made for the first time more debit card payments than cash payments. There are clear seasonal patterns in cash and card usage. Consumers make relatively few cash and card payments in February and relatively many in May and during the summer holiday months July and August. Debit card usage is relatively high in December, but the opposite holds for cash. Debit card usage is relatively low between January and March. Teenagers and the over-75s use cash relatively often. There has been a marked increase in debit card use among all consumer segments, though growth in debit card usage was strongest among people aged 34 and younger. Regarding contactless card payments, men, young adults and highly-educated people were among its early adopters. With respect to consumer payment behaviour in different types of shops, we find that consumers have used debit cards more often in all of them with card usage growing strongest in vending, followed by the catering industry, and warehouses in home products.

One of the challenges when monitoring the usage of POS payments over time concerns accurately measuring cash usage. Unlike electronic payment instruments such as debit cards and credit cards, cash payments are not centrally registered. Researchers therefore have to rely on estimating cash usage by surveying a large representative sample of consumers. Boeschoten (1992) was the first to use payment diaries sent to households in which they could register their daily payment transactions during a month, including the amount paid and payment instrument

used. Jonker and Kosse (2013) conclude that the length of the registration period influences the quality of consumers' registration of their payments negatively. Measurement errors are smallest when they do so during a single day. Recently, several researchers have employed payment diaries to estimate cash usage and its underlying drivers. However, most studies collect data once or only every three years (e.g. Deutsche Bundesbank for Germany, 2015; Henry, Huynh and Shen for Canada, 2015; Ossolinski, Lam and Emery for Australia, 2014) or use a 1-week or 1-month payment diary (e.g. Bounie and François for France, 2006; Deutsche Bundesbank, 2016; Jakobsen and Nielsen for Denmark, 2011; Ossolinski et al., 2014; The Payments Council for the UK, 2011). Bagnall, Bounie, Huynh, Kosse, Schmidt, Schuh and Stix (2016) compare cash usage among seven countries by harmonising the payment diary surveys. They find that although the level of cash usage differs across countries, there are also similarities with respect to the factors influencing consumers' payment choice, such as transaction size, consumer characteristics and merchant characteristics.

This study proceeds as follows: chapter 2 discusses the scope, the research methodology and the samples used, as well as weighting and validation procedures. Chapter 3 describes the main findings relating to the use of cash and payment cards by consumers at the point-of-sale (POS) in the Netherlands between 2010 and 2016. In particular, it presents the use of cash and payments cards by the amount paid, by industry and seasonal patterns. Chapter 4 describes the influence of demographic characteristics on how people pay their purchases and reveals differences in the cash by cards substitution between consumer segments. Next, it discusses how much cash people hold for making POS payments, and developments therein. Subsequently, it pays attention to the adoption of contactless payments by consumers. Then it describes consumers' preferences for cash and card usage in general and in specific situations or locations. Furthermore, it discusses the extent in which consumers experience actual constraints in the way they pay. Chapter 5 summarizes and concludes.

2 Research method and sample

2.1 Research scope and research population

The aim of this study is to analyse the development of the number and value of cash payments made in the Netherlands between 2010 and 2016. In order to bring into focus the role played by cash, we also consider other commonly used POS payment instruments such as prepaid payment cards, debit cards and credit cards. Our study is limited to payments made in the Netherlands by Dutch residents over 12 years of age. As a result, the sample population from 2010 to 2016 consists of 119,117 consumers. We exclude transactions made by Dutch consumers abroad, non-Dutch speaking residents, children below the age of 12, tourists and other non-residents.

2.2 Sample

The Survey on Consumers' Payments (SCP) was carried out between 2010 and 2016 by two different research companies. Heliview Research carried out the field work during the first three years of the study. During this period the survey was held in September, a month which we considered as fairly average with respect to POS payments made by consumers. From 2014 onwards the field work has been carried out by research company GfK and has taken place during the whole year. This means that each day of the year, a group of respondents has been asked to register their payments in a diary and report about them. We have chosen to let the respondents record their payments in a diary as for just one day in order to avoid diary fatigue (see Jonker and Kosse, 2013). Respondents can participate a maximum of four times per year, with an "in-between" pause of at least three months. In practice, however, 85% of all participants only participate once a year.

The survey sample is representative for the Dutch population aged 12 years and older based on demographic aspects: gender, age, ethnicity and education. Other items factored into the sample were region, country of origin and income bracket.

As purchasing and payment behaviour differs from day to day, the assessments were spread evenly over the days of the month. For every day of the week and every week in the month, the number of respondents was sufficiently large and representative in terms of gender, age, ethnicity, education, region, country of origin and income bracket.

Table 1 presents the number of respondents, participating in the survey each year, as well as the total number of collected payment diaries and the total number of recorded transactions. As can be seen, the annual sample size varies according to the field work method used each year: i) field work concentrated in September (2010-2013) and ii) field work distributed along the whole year (2014 onwards).

Since 2010, a total of 119,117 respondents have participated in the SCP. During the first three years, the sample size ranged from 7,499 to 8,707 participants per year. With the introduction of a new field work method implemented as of 2014, the sample size increased to more than 20 thousand participants per year. This allowed studying the use of cash and other payment instruments and having for the first time data from different consumption cycles present along a year.

Before deciding to implement the new field work method, DNB and the DPA carried out different checks to confirm the suitability of the new method as well as to explore beforehand a potential disruption in the trend of the number and value of payments. First, an experiment was carried out in order to explore for potential panel conditioning effects due to a higher frequency participation of each respondent. Findings show that participants' reporting behaviour does not change when they are approached to participate in the survey up to four times per year, see Hernandez, 't Hoen and Raat (2017). Second, in 2014 it was decided to carry out the survey using both field work methods in order to be able to compare results and avoid a break in the trend of the number and value of payments. For these reasons, the sample size for this year grew to 40,955 respondents. The results

Number of survey participants, payment diaries and transactions

Table 1

Year	Sample size	# Payment diaries	# Transactions
2010	7,499	7,499	14,447
2011	7,944	7,944	15,416
2012	8,354	8,354	14,521
2013	8,707	8,707	15,350
2014	40,955	50,740	14,892
2015	20,875	29,694	49,262
2016	24,783	29,820	50,452
Total	119,117	142,758	174,340

Note: In 2014 DNB carried out an experiment to investigate panel conditioning effects due to a higher frequency of respondents' participation. For this reason, the number of respondents in the month of March 2014 accounted to 16,652 participants. Additionally, it was decided to draw a representative sample of the Dutch population to be surveyed in the month of September in order to compare results from 2014 using two field work methodologies: i) field work concentrated in September (as implemented during 2010-2013) and ii) field work distributed along the whole year. The results under the new field work method proved to be successful and did not produce a change in the trend of the number and value of payments. Therefore, it was decided to distribute the field work along the whole year for 2015 and 2016.

under the new fieldwork method proved to be successful and did not produce a change in the trend of the number and value of payments when compared with the results coming from the fieldwork concentrated in September. Therefore, it was decided to distribute the fieldwork along the whole year for 2015 and 2016.

2.3 Research method

Although the survey was carried out by two different research companies and different field work methods, we used a unique research methodology during the whole study. The survey consisted of two parts: a 1-day payment diary and a questionnaire. The first gathered information about the characteristics of each payment or cash withdrawal carried out during the diary day. For each payment, respondents had to record the instrument used (cash, pre-paid card, debit card, credit card or other), the place of purchase (16 branches, e.g. a supermarket, street vendor, non-food retail shop, charity), the value of the purchase, and whether they were able to use their preferred payment method. For each cash withdrawal, they had to report the source (ATM, bank counter, other) and the value of the withdrawal. Usage of a diary helps respondents to register all the purchases they made during a day, also the small ones which are usually paid in cash. We have chosen to let the respondents record their payments in a diary as for just one day in order to avoid diary fatigue, see Schmidt (2011) and Jonker and Kosse (2013). The second part of the survey consisted of a questionnaire gathering information registered in the payment diary, background information on respondents' demographic characteristics as well as questions on issues that may influence their payment behaviour, for example, payment preferences, reasons to use cash or cards, et cetera.

Respondents were asked to register their payments on a predetermined day. Respondents were made clear that, even if they did not carry out any purchases on the respective day, this was still relevant information. So, respondents were asked to complete their diaries even if this was the case. They were also asked to record the amount of money that they had on them at the start of the day, how much money they had withdrawn, and/or received during the day, and how much money they had left at the end of the day. The information was used to check whether the respondents did not forget to report any cash payments in the questionnaire.

2.4 Recruitment of respondents and data collection

A combination of web-based and telephone based methods were used for recruiting survey participants and for collecting the answers to the questionnaire. Given internet penetration is very high in the Netherlands¹, it was decided to use the internet as the main interview mode. As a result, an average of 97% of the all interviews were carried out online, the rest were carried out by telephone.

To ensure the representativeness of the findings per day of the week, Heliview and GfK drew a monthly sample of its panel and evenly distributed it over the days in the month. Days to be registered in the survey were randomly selected. In this way, the representativeness of the sample on a daily basis was guaranteed. Respondents can participate a maximum of four times per year, with an 'in-between- pause of at least three months. According to Hernandez et al. (2017), the reporting behaviour of diary survey participants does not change when they are interviewed up to four times per year.

2.4.1 Online interview mode

A combination of web-based and telephone based interview methods were used by Heliview and GfK for recruiting survey participants and for collecting the answers to the questionnaire. Given internet penetration is very high in the Netherlands, it was decided to use the internet as the main interview mode. As a results, an average of 97% of the all interviews were carried out online, the rest were carried out by telephone.

The online process from sending the invitations to participate in the survey to sending reminders to non-respondents was managed by the research companies

¹ According to Statistics Netherlands (CBS), only 3% of the population does not have access to the internet.

Heliview and GfK which used similar field work processes². Invitations to register to participate in the study were sent one week before the actual diary survey took place. This included the diary as an attachment to the email invitation which the participants were encouraged to print. The following process consisted of three key days. *Day 1*, one day before the diary survey, registered participants were reminded that the next day they should keep a diary of all their purchases; this email enclosed the diary book once again. *Day 2*, one day after the actual diary survey took place, participants received an email with a link to the questionnaire. *Day 3*, participants who failed to fill in the diary survey were reminded to do so. They had the chance to confirm once more if they wanted to keep on participating in the survey. Those who did not complete the diary given that they did not carry out any purchases, were invited to answer the questionnaire nevertheless.

2.4.2 Telephone interview mode

Heliview and GfK have a group of panelists without access to the internet who can be accessed via writing and / or telephone communication. Every week, the research companies drew a sample of these panelists to be contacted by phone. Once respondents agreed to participate, a confirmation letter, included a printed diary book, was sent by written mail. Furthermore, participants had the option to choose the day they preferred to answer the diary survey. In order to ensure representativeness by day of the week, only a limited number of respondents could choose a reporting day of the week.

2.5 Weighting and validation

Because the sample is not perfectly representative as is the case in many surveys, sample weights were needed to correct differences with the research population. The key variables used for the post-stratification adjustment were gender, age,

² Jonker, Kosse and Hernandez (2012) provides a detailed description of the recruitment of respondents and the data collection method used by Heliview between 2010- 2012.

education, ethnicity, day of the week and month. In addition, a second weighting phase was considered in order to adjust the results by the actual number and value of debit card payments as reported in statistics from the Dutch Payment Association.

3 Cash and card payments in the Netherlands between 2010 – 2016

3.1 Development cash and card usage at the POS

Dutch consumers have changed the way they pay, turning the debit card into the most frequently used instrument of payment. As the use of debit card among consumers increased by on average 9% each year since 2010, the substitution of cash by cards reached its turning point in 2015. In this year, Dutch consumers made for the first time more debit card payments than payments using cash. By then, contactless payment cards were accepted by merchants and used by consumers after its introduction in 2014 following the disappearance of the Chipknip prepaid card.³

Between 2010 and 2016, the total number of cash payments has decreased by one-third, from 4,37 billion transactions to 2,95 billion, while the total value of cash payments has decreased by 27% from EUR 52 billion in 2010 to EUR 38 billion 2016. Cash remains to be primarily used for minor purchases as it used to be in 2010. However, the smallest purchases are no longer exclusively paid using cash. With the increased usage of debit card payments and the introduction of contactless cards, the average value of a cash transaction has increased by more than one euro, from EUR 11.80 to EUR 12.85.

The number of debit card payments has increased by almost one-third, from 2.15 billion transactions in 2010 to 3.57 billion in 2016. The total value, has increased by 20% from EUR 81 billion in 2010 to EUR 97 billion in 2016. The trend that

³ Chipknip was the domestic prepaid card scheme in the Netherlands.

consumers often pay smaller purchases with their debit card, still continues. The average transaction value has decreased by 27%, from EUR 37.56 in 2010 to EUR 27.25 in 2016.

The credit card continues to be the least popular instrument of payment in the Netherlands. Not much has changed since 2010. In terms of numbers, the number of credit card payments has remained stable at around 30 million transactions. The value, however, has increased by 12%, passing from EUR 3 billion to EUR 3.4 billion.

As shown in Chart 1a and 1b, the substitution of cash by cards seems to have slowed down during 2012 and 2013. Between these years, the number of cash payments remained still on 3.8 billion transactions. This could be due to the financial crisis which had the severest impact on households in 2013. According to Statistics Netherlands and the Netherlands Institute for Social Research, low-income households had to make larger sacrifices in 2013 than before. Household income largely determines POS payment preferences of consumers, with those on low incomes preferring to pay their purchases using cash, whereas high-income individuals favour debit card payments (see e.g. Bagnall et al. 2016; Hernandez, Jonker and Kosse, 2017).

Debit card payments in the Netherlands have become the prevalent instrument of payment at the POS during the last six years (see Chart 2a and 2b). Between 2010 and 2016, the proportion of POS payments accounted for by cash payments fell by 19.7 percentage points from 64.7% to 45.0%, whereas debit card payments climbed by 22.6 percentage points from 31.9% to 54.5%.

Looking at the trend in cash payments as a percentage of the total value of all POS payments, the declining rate is large however less sharp than for the number of payments, i.e. a decline of 10.5 percentage points from 37.9% in 2010 to 27.4%.

Use of payment instruments, 2010-2016

Chart 1a and 1b

Chart 1a Total number of payments
(EUR billions)

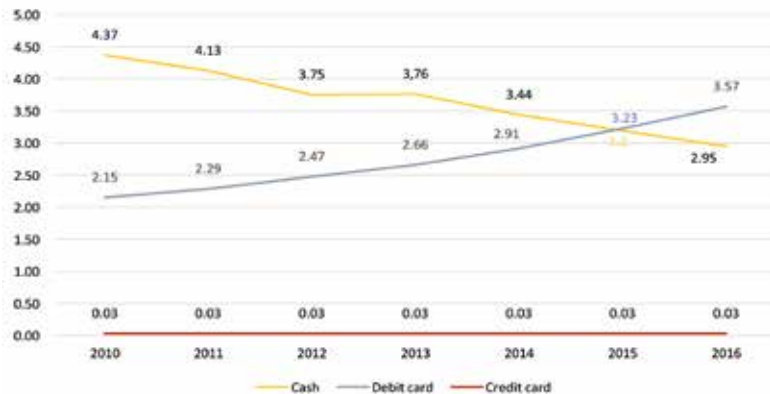
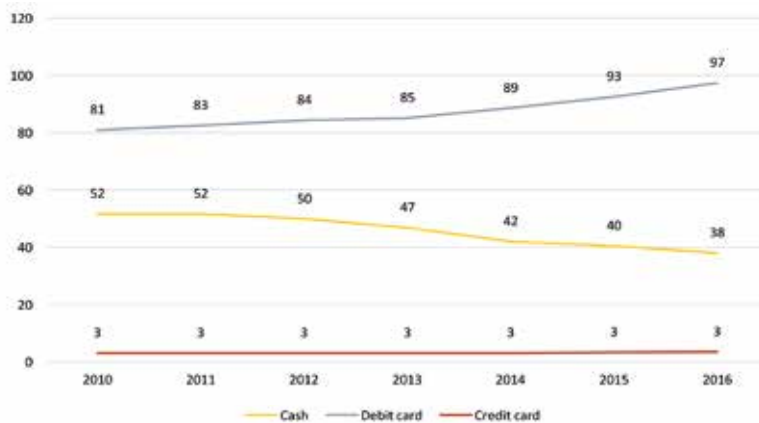


Chart 1b Total value of payments
(EUR billions)



The growth in the proportion of debit card payments is comparable, from 59.5% in 2010 to 70.2% in 2016. In the last six years, Dutch consumers have not only continued using their debit cards more frequently to pay for relatively small amounts, but also started using them for the smallest amounts up to EUR 5 which are often the most frequent daily purchases i.e. for a coffee or a sandwich at a convenience store. This was possible with the introduction of contactless payments in 2014, allowing consumers to make payments by briefly holding their debit card or smartphone against a POS terminal. Consumers do not need to enter a PIN code when using their contactless cards for amounts up to EUR 25, which makes it a very fast and convenient payment method for small purchases.

After the first year of the introduction of contactless cards, the total number of contactless payments increased by more than sixteen times, from 8 million transactions in 2014 to 135 million transactions in 2015. Between 2015 and 2016 the number of contactless payments quintupled to 630 million. One third of all contactless payments in 2016 (34 %) were for amounts under EUR 5.

3.2 Use of cash and cards by the amount paid

Although on average the proportion of POS payments accounted by debit card payments climbed, the rise in debit card usage varies by the transaction amount. Chart 3 shows the share of debit card payments has increased for all ranges of transaction values in the last six years. However, the substitution of cash by debit card has been highest for low value payments up to EUR 10. In 2010, consumers used to pay the large majority of their purchases up to EUR 10 using cash. In 2016, they mainly used cash for their purchases up to EUR 5; for purchases between EUR 5 and EUR 10 they used cash almost as often as the debit card and for purchases above EUR 10 they preferred to use the debit card.

Use of payment instruments, 2010-2016

Chart 2a and 2b

Chart 2a. Relative use of payment instruments:
total number

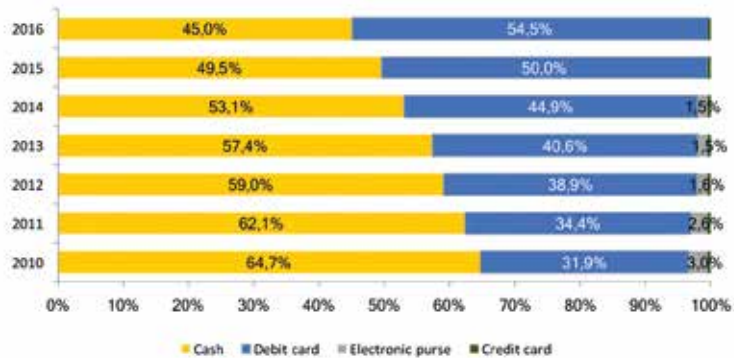
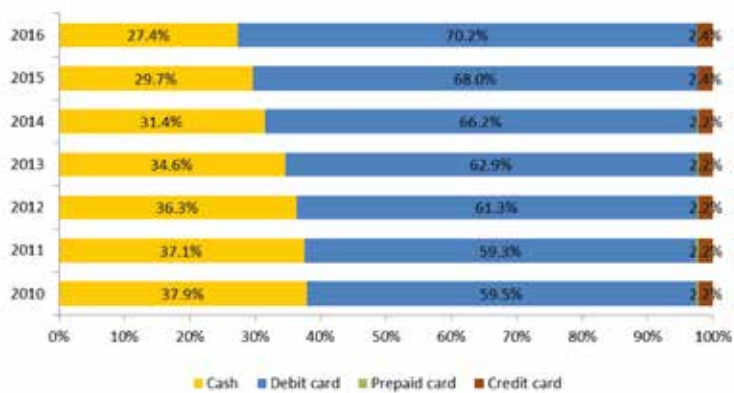


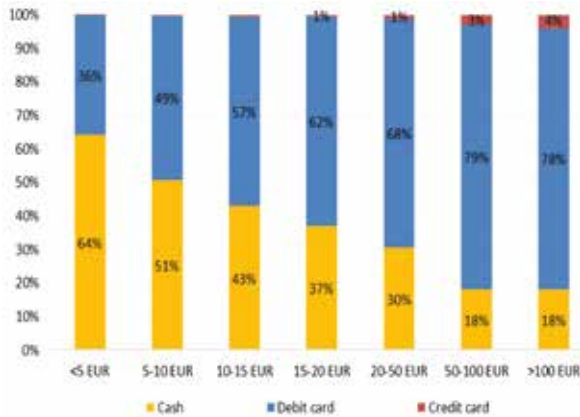
Chart 2b. Relative use of payment instruments:
total value



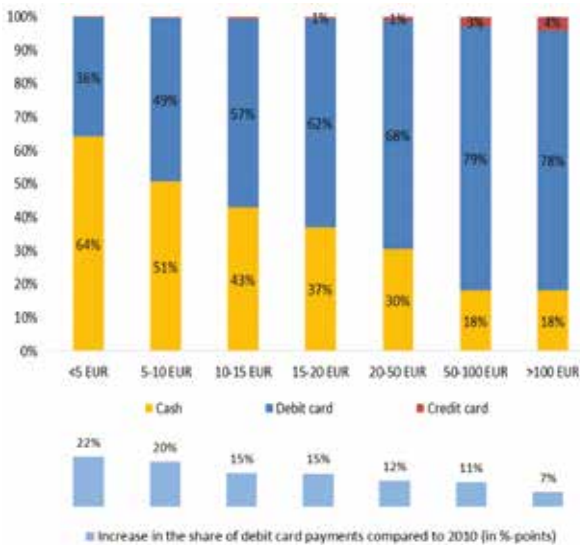
Use of payment instruments, by amount

Chart 3

2010



2016



In six years' time, debit card payments as a proportion of aggregate payments up to EUR 5 increased by 23 percentage points from 13% to 36%. On the other hand, the share of cash fell 17 percentage points for transactions up to EUR 5 from 81% to 64%.

3.3 Use of cash and debit card by market segment

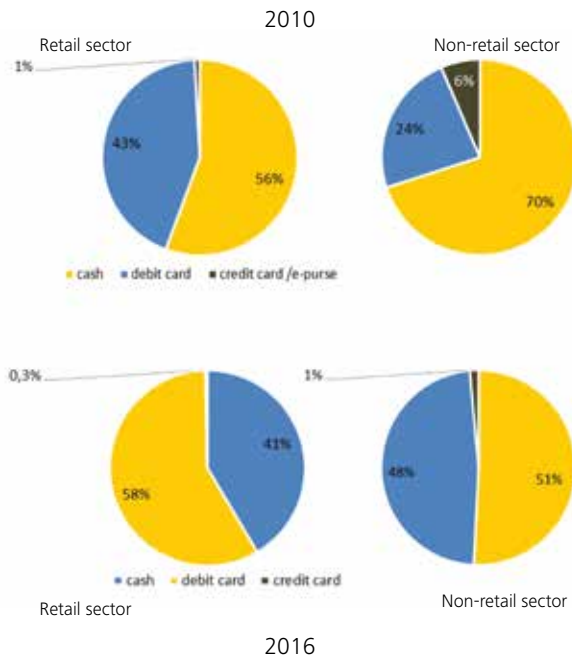
Consumers taking part in the study also specified the market segments in which they spent their money. Chart 4 shows the breakdown of all payment instruments in the retail and non-retail sectors. The retail sector holds 64% of all POS payments in terms of numbers.⁴ It is composed by sectors as supermarkets, grocery shops, department stores, among others. The non-retail sector holds 36% of all POS payments and is composed by sectors as the catering industry, service providers, vending machines, petrol stations and others.

Given its size, developments in the retail sector have a strong impact on the share of cash and cards on all POS payments. By 2010, the total share of debit card payments in this sector accounted for 43% of all payments. By then, a number of policies had already been implemented by banks and retailer organisations with the objective of increasing card acceptance among merchants as well as card usage among consumers for efficiency and safety reasons. Among other, they launched a long-term campaign in 2007 to encourage consumers to pay with debit card rather than with cash, also in case of small amounts (for a description, see Jonker, Plooi and Verburg, 2015). Since 2010, the share of debit card payments in this sector increased on average 2.5 percentage points per year. In 2016 debit card payments reached a 58% share of all payments carried out in the retail sector. On the other hand, the share of cash payments fell from 56% in 2010 to

⁴ This study considers a wide range of segments from the retail and non-retail market sectors operating at the POS only. We have grouped them in up to 16 categories with the purpose of making the survey as understandable as possible for respondents. However, it should be borne in mind that some segments have been grouped in the 'other' category due to their limited size.

Share in numbers cash and card usage, by sector,
2010 and 2016

Chart 4



41% in 2016.

Although the non-retail sector at the POS is proportionally smaller than the retail sector, it has played an important role in the ongoing substitution of cash by payment cards. The share of debit card payments in the non-retail sector has increased faster than in the retail sector, i.e. by on average 4 percentage points a year, passing from 24% of all transactions in 2010 to 48% in 2016. The share of cash payments declined by 19 percentage points from 70% of all payments in 2010, to 51% of them in 2016.

Charts 5 shows the relative use made of cash and debit cards by market segment in terms of numbers of payments in 2010 and 2016, as well as the growth in debit card usage within a sector between 2010 and 2016. Please note that the Dutch have made most debit card payments in terms of numbers in the supermarkets, which account for one-third of all POS purchases. In 2016 consumers paid 42% of their grocery purchases using cash and 58% using the debit card. Cash usage was relatively high in street vending (86%), the recreation and cultural sector (64%), food, tobacco and liquor stores (63%) and service providers, whereas debit cards were the dominant means of payment in segments like retail clothing (75%), petrol stations (72%) and home product warehouses (70%).

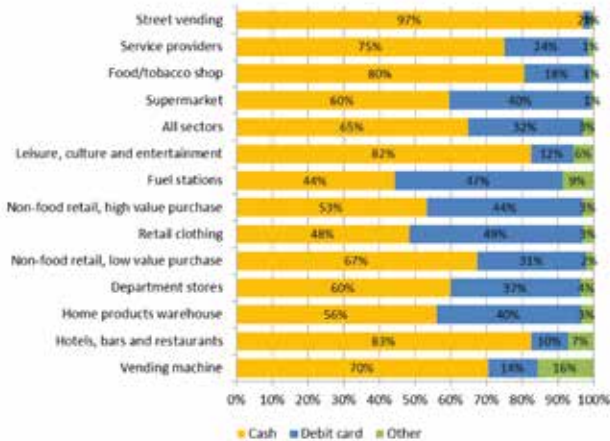
Between 2010 and 2016 the share of debit card payments has increased the most in market segments such vending machines (+ 52 percentage points), hotels, bars & restaurants (+ 34 percentage points) and home products warehouse (+ 30 percentage points). The former two belong to the non-retail sector and have traditionally been known as cash-intensive market segments. However, changes in payment infrastructure⁵, increased cost efficiency for merchants (Panteia, 2013), modification of vending machines to accept debit cards as well as the introduction of con-

5 Faster POS terminals, introduction of contactless terminals and mobile POS terminals (m-pos)

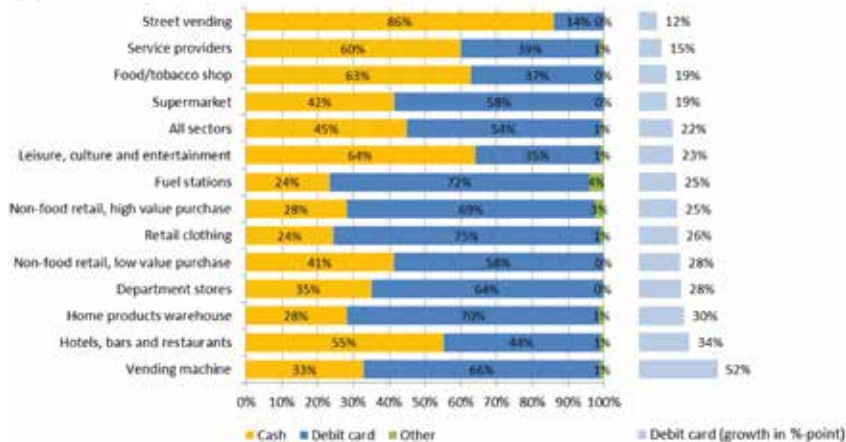
Relative use of payment instruments by market segment

Chart 5

2010



2016



tactless payments have resulted in a wider acceptance of debit card payments, increased card usage and consequently a higher share of debit cards as compared to cash.

3.5 Seasonality

From 2014, we have collected payment diary data on all days of the year, which enabled us to examine seasonal patterns in payment instrument usage. Consumers' payment behaviour is affected throughout the year by many factors such as holidays, weather, holiday bonuses and thirteenth-month pay packages. Chart 6a and 6b show seasonal patterns in cash and debit card usage. They depict the relative deviation in the number of cash respectively debit card payments compared to the annual average.

In 2014, 2015 and 2016, consumers made relatively few cash payments in February (limited number of shopping days), September and December and relatively many cash payments in April, May and August. They also seem to make relatively few debit card payments between January and March, and relatively many in the summer holiday period. Moreover, the summer holiday period is the only period of the year in which Dutch consumers carry out relatively many payments in general. This holds for both cash and debit card payments. As expected, the vast majority of consumers carry out most debit card payments in December, during the festive period when larger purchases are carried out.

Relative deviation of monthly cash payments
compared to the annual average, 2014-2016

Chart 6a



Relative deviation of monthly debit payments
compared to the annual average, 2014 – 2016

Chart 6b



4 Who pays how?

4.1 Number of daily POS payments

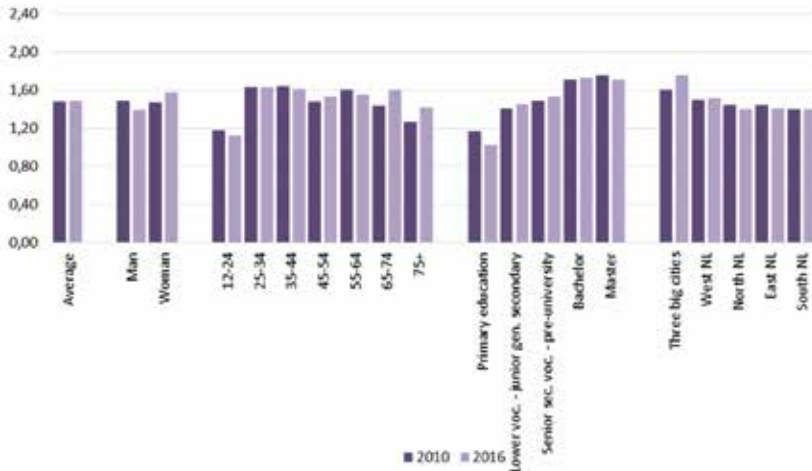
In 2016, the Dutch made on average about 1.49 payments at points-of-sale per person per day, which corresponds with about 10 POS payments a week. The number of POS payments have hardly changed. In 2010, they made almost the same number of payments a day, i.e. 1.48 payments per day.

The total number of POS payments differs by gender, age, education but also the region of residence. As chart 7 shows, in 2016 women made more purchases than men (1.58 purchases as opposed to 1.39 purchases per day respectively). People aged between 25 and 45 and people who have just retired (65-74 years) made the most purchases, i.e. about 1.6 payments a day, whereas teenagers and young adults (12-24 years) make the least, i.e. less than 1.2 payments a day. Also educational level matters, the higher one's educational level, the more POS payments (s) he makes. This probably stems from the positive correlation between education and income. The region of residence also appears to influence consumers' purchasing behaviour: people living in the three largest cities in the Netherlands made more payments a day compared to the rest of the population.

Overall, the number of POS payments made per day has remained fairly stable between 2010 and 2016. However, there are some exceptions. Women make more payments than in 2010, while men make less. Furthermore, elderly people (65+) make more payments in 2016 than six years ago, whereas the number of POS payments made by people in other age categories has remained stable. We also see that people with the lowest educational level (primary education) make less payments than in 2010, and that the number of payment made by people living in one of the three major cities have increased from 1.61 to 1.76 purchases per day.

Average number of POS payments per person per day,
2010 – 2016

Chart 7



4.2 Cash holdings

In 2016, Dutch consumers on average carried EUR 40.59. In 2010 and 2014 the average amount of cash in the wallet also hovered around EUR 40. So, despite the declining usage of cash by the Dutch at the POS, the amount of cash in their wallets has remained fairly stable. However, we see a modest increase in the share of people who do not carry any cash on them. In 2016, 9% of all consumers did not carry any cash with them, while in 2014 this share was 8% and 7.5% in 2010.

The amount of cash that consumers have with them increases with age. In 2016, people over 75 carried an average of EUR 66.82 in cash with them, while people aged between 25-34 had around EUR 32.43 with them (Chart 8). With the exception of the over 75s, the amounts of cash carried have declined in the past few years for most age groups over 35.

4.3 Relative usage of cash and cards at the POS

The increased use of debit cards in 2016 compared to 2010 is evident in all demographics groups.

On average, in 2016 Dutch consumers paid 55% of their payments with debit cards, but this does not apply to all demographic groups. Of all the groups, consumers between the ages of 25-34 made relatively least cash payments (33% of all their POS purchases) and relatively most debit card payments (66%).⁶ Children aged 12- 18, people over 65 and people with a lower educational level use cash the most, i.e. in two-thirds of their POS purchases.⁷

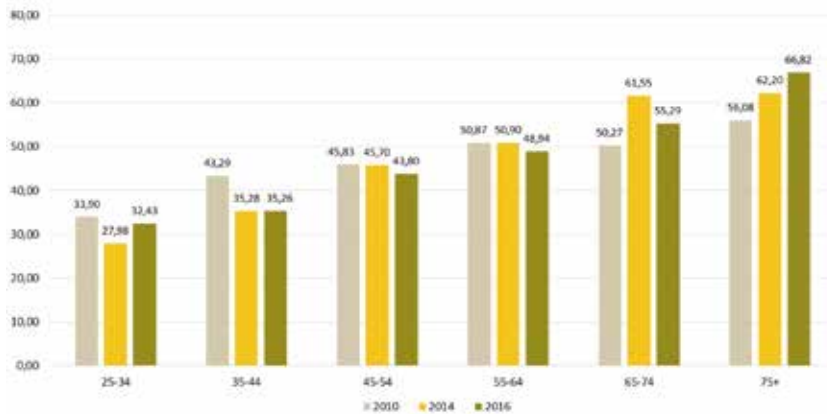
Compared to 2010, debit card use has increased the most among young people

⁶ In 2010 we could not distinguish yet between youth aged 12-18 and young adults aged 19-24. For reasons of comparability we show the payment behaviour of youth and young adults together in Chart 9. However, please note that in 2016, young adults made relatively many debit card payments, i.e. 68% of their POS payments was paid using the debit card.

⁷ In 2016, children (12-18 years old) made relatively many cash payments, i.e. 61% of all their POS payments.

Cash in wallet, 2010 – 2016
(in euro's)

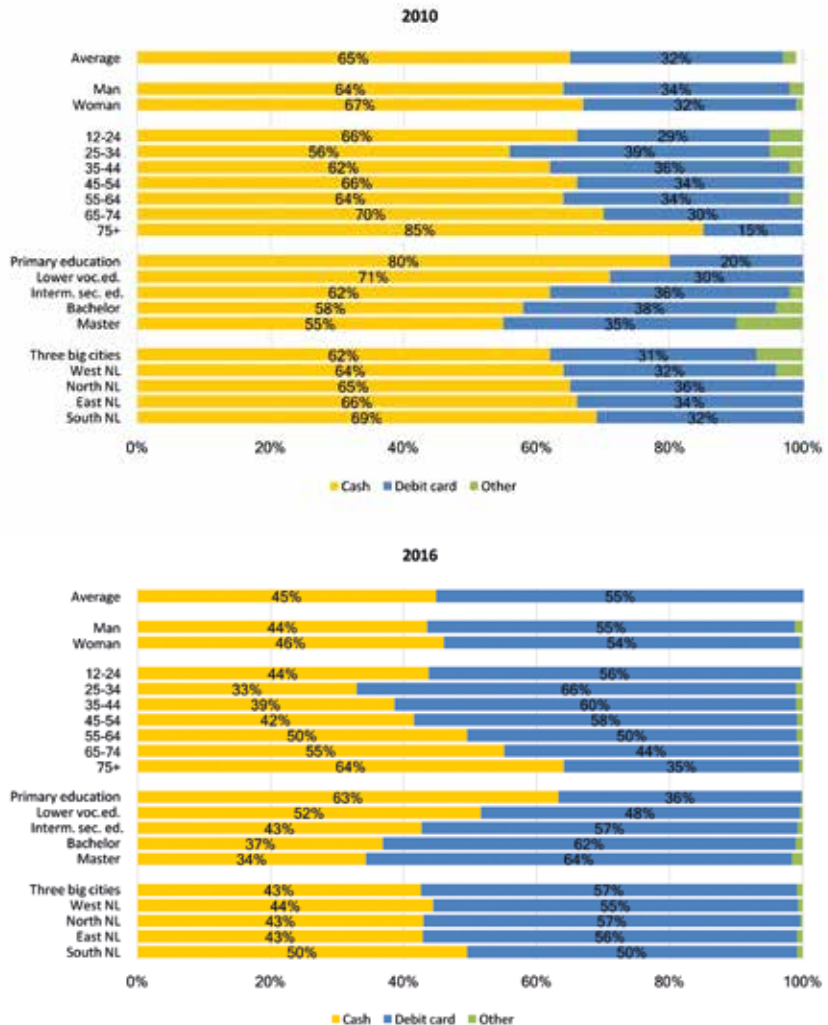
Chart 8



aged 12-34, from 29% of their POS payments to 56% (youths and young adults 12 – 24) and from 39% to 66% (people aged 25-34). In terms of educational level the largest increase in debit card usage is among college graduates, from 35% to 64% of their POS payments. As in previous years, gender appears to have virtually no influence on changes in payment behaviour. Men made 55% of all their POS payments with debit cards and women 54% in 2016, while in 2010 men used the debit card in 34% of their purchases and women 32%.

Usage of POS payment instruments,
by demographic characteristics, 2010 – 2016

Chart 9



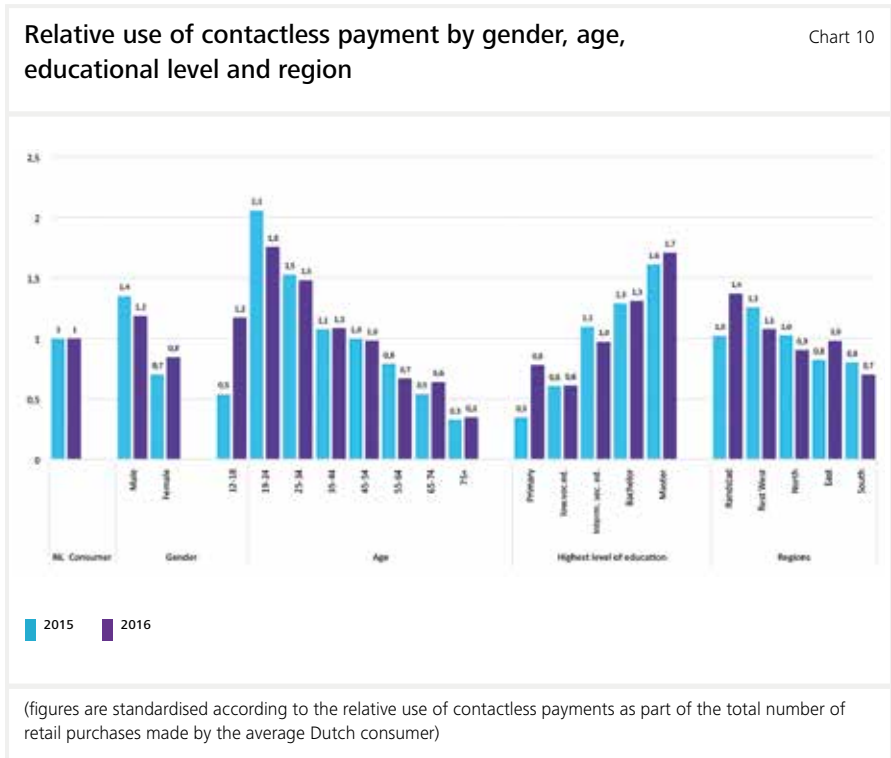
4.4 Who uses contactless payment instruments?

In 2014 contactless payments were introduced in the Netherlands. In that year the use of contactless payments was still limited, at just under 8.3 million payments. In 2015 consumers made a total of almost 135 million contactless payments. There was a strong increase in the number of payments in 2016, to approximately 630 million. Chart 10 provides an indication of the adoption of contactless payments by consumers over time. It depicts how intensively certain demographic groups make use of contactless payments compared to the average consumer. The figures in the chart represent the extent to which consumer segments groups make more or less use of contactless payments compared to the average Dutch consumer, which is represented by 1.

With respect to the adoption of contactless payments we see a pattern which is quite common for early adopters of innovations with respect to their age, gender and educational level. The adoption of contactless payments in 2016 depends on gender, age, educational level and place of residence. Men make relatively many contactless payments, almost 20% more than the average consumer, while women make relatively few contactless payments, about 20% less than the average consumer.

Also, young adults, aged 19-24, make relatively many contactless payments compared to the average consumer (+80%), as well as the college educated (+70%) and people living in one of the three largest cities in the West (+40%). Children (-50%), people over the age of 65 (-40% or more) make relatively few contactless payments.

In general, the differences in the adoption of contactless payments between demographic groups shrank between 2015 and 2016. In 2016, the share of contactless payments in total POS payments by men was 1.5 times that by women, whereas it was twice this share in 2015. People with only primary education are clearly



catching up as well from -70% to -20% of the average consumer. Also in other demographic groups the differences in contactless payment usage are narrowing down. However, for the over 75s, the use of contactless payments remains relatively low.

At the regional level there are some shifts, indicating that regional differences in the use of contactless payments have risen. In 2016, the use of contactless payments was relatively high in the three largest cities in the west of the Netherlands (+40%), while it was on average in 2015. Residents living in the east of the Netherlands made relatively little use of contactless payments in 2015 (-20%), but about

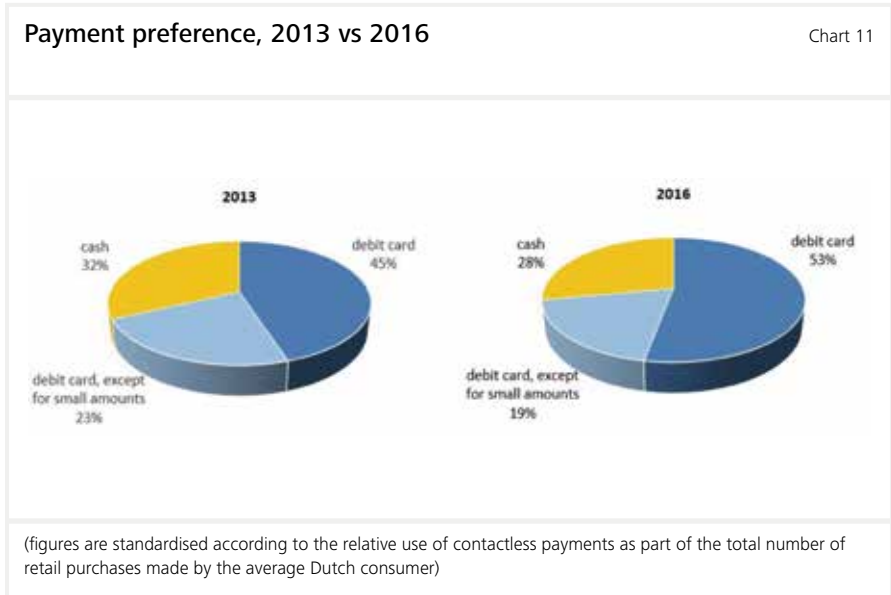
equal in 2016. People in the west (the three largest cities excluded), north and south of the Netherlands showed a different picture. In the latter two regions, consumers on average made fewer contactless payments than the average Dutch consumer in 2015, and this difference increased between 2015 and 2016.

4.5 General payment preferences

Respondents were asked in 2013 and in 2016 which means of payment they prefer to use at the POS: cash or debit card. Chart 11 shows that in 2016 most Dutch consumers (72%) prefer using their debit card for payments at the point of sale, with 53% favouring debit cards for all payments and 19% only for the 'larger' payments (over EUR 5). The general preference for debit card has grown in the last three years with 8 percentage points. This is partially at the expense of a preference for cash, which has dropped from 32% in 2013 to 28% in 2016.

Although there has been a shift in the preferred way of paying from cash to debit card, the reasons for the preference are generally the same. Reasons most given for the preference of debit card are speed (73%), always having enough money at hand (71%) and it being a habit (70%). Cash is still most preferred because of budget reasons; seeing what's still in the wallet (and what not) helps people keeping track of their spending (82%). Other frequently mentioned reasons for preferring cash are that it is a habit (68%) and that the payment feels 'more real' with cash than with debit card.

One fifth of the Dutch consumers have a general preference for debit card, but prefer to pay small amounts (up to 5 euro) using cash. Like in 2013, the main reason for this difference in preference is the idea that using a debit card is too much effort for small amounts. Paying cash feels easier and faster (71%). For other people, it is a good way to get rid of their small change (64%). Compared to 2013 less people give as reason that they think the debit card is inconvenient for the retailer (25% in 2013 vs. 21% in 2016). This might be the result of the public



campaign 'Klein bedrag, pinnen mag' (best translated as: small amount, please use your debit card), aimed at letting people know that most retailers prefer debit cards for all amounts, including small amounts.

4.6 Payment preference versus use

Consumer preference for payment methods is often not in line with actual use of payment methods at the point of sale. For example, consumers who expressed a general preference for debit cards still paid 28% of their purchases in cash in 2016. The reverse is also true; those with a general preference for cash paid 22% of their purchases with debit cards. 121 research (2010) show that actual payment behaviour of the Dutch is determined not only by preference, but also by situations, locations and constraints. This explains part of the difference in actual debit card usage and the preference to pay by debit card, with people using cash more often than they actually think. In addition, according to Crujisen, Hernandez and Jonker

(2016) the way people pay is for a large part based on habits, which are also determined by circumstances.

As shown in Chart 12 the gap between preference and use has become smaller in the last three years. The share of debit cards made by people who prefer debit cards increased by 11 percentage points, from 61% in 2013 to 72% in 2016. Remarkably, people with a preference for cash also paid a larger part of their transactions with debit card, although this increase is limited.

4.6.1 Payment use in different situations

When consumers were asked how they would pay in various situations, it appears that their preferences depend to some extent on the circumstances. For example, if there is a long queue at the point of sale, or when people want to keep track of their purchases most of them prefer to pay by debit card. However, if consumers have large amounts of cash on them or are required to split the bill with other people, over half would choose to pay by cash.

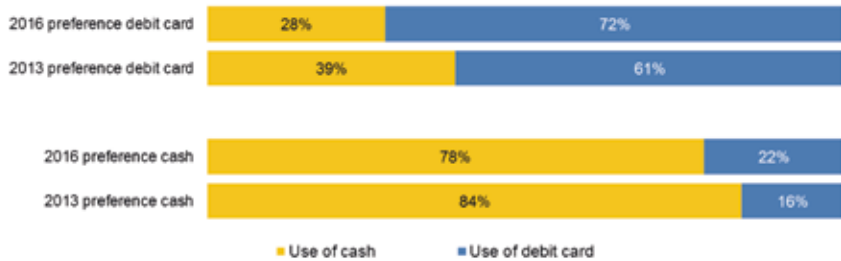
Most situations have become less of an influence in the last three years. Some more than others. For instance, compared to 2016, more people would pay with cash in 2013 when they forgot something and had to pay a second time (+9 percentage points), when they had to pay 10 or 20 cent extra for using a debit card (+8 percentage points) or when splitting a bill with others (+7 percentage points).

4.6.2 Payment use at different locations

The use of payments methods does not only depend on the situation, the location of the payment is also determinative. As shown in Chart 14 consumers are more inclined to pay with debit card at the supermarket than at the butchers or the bakery. And more likely to pay with cash at the market or the bar. Although these differences are still considerable, they have decreased in the last three years. The share of debit cards especially increased at the terrace (+12 percentage points), the

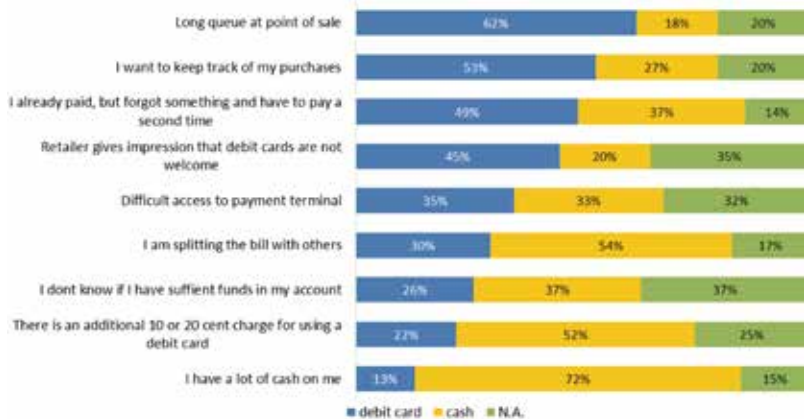
Preferred vs used payment method, 2013 vs 2016

Chart 12



Payment use in different situations, 2016

Chart 13



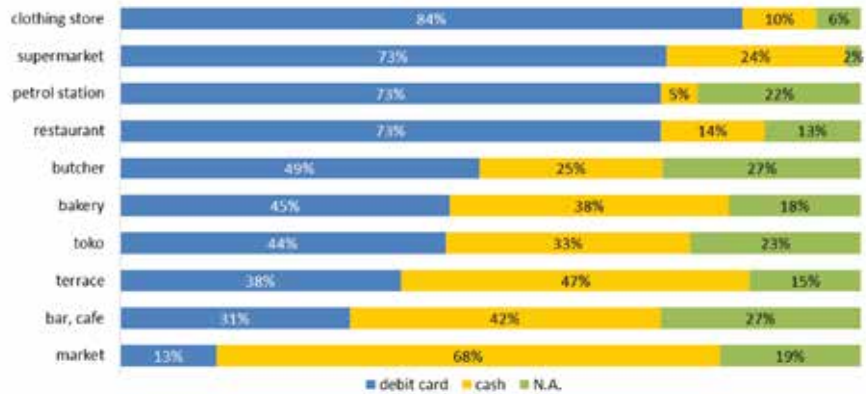
bakery (+11 percentage points), the bars (+11 percentage points), the butcher (+9 percentage points) and the toko (+8 percentage points).

4.6.3 Constraints for paying the preferred way

In some cases people experience actual constraints when they want to pay a certain way at the point of sale. Although relatively low in share, the number of transactions paid differently is considerable (80.5 million transactions in 2016). The number of transactions paid differently than preferred decreased in the last few years. In 2010 2.7% of all cash transactions would have been paid with debit card if that was possible, versus 1.6% in 2016. The reasons most often mentioned by consumers for not paying cash when they wanted to are the fact that they didn't have enough cash at hand or a lack of acceptance on the specific point of sale. With debit cards the number of constraints experienced dropped even more, from 2.1% in 2010 to 1% in 2016. Probably, increased debit card acceptance by retailers and less failures in the debit card payment chain resulted in less people being hindered to pay with the debit card (NFPS, 2017; Dutch Payments Association, 2016).

Payment use in different locations, 2016

Chart 14



5 Concluding remarks

Between 2010 and 2016 consumers' payment behaviour at the point-of-sale has undergone large changes in the Netherlands, with the debit card gradually taking over the role of cash as dominant means of payment. In this study, we present and discuss the outcomes of a longitudinal survey on consumers' payment behaviour carried out during the period 2010 to 2016. We have collected data among Dutch consumers aged 12 years and older using single day payment diaries.

The results reveal a gradual substitution of cash by debit card payments, with 2015 being the year in which the number of debit card payments exceeded the number of cash payments for the first time. In 2010 65 percent of the POS payments were effected using cash and 32 percent using the debit card, while in 2016 consumers paid 45 percent of their purchases using cash and 55 percent using their debit card. In terms of value cash and the debit card represent 27 percent respectively 70 percent of the value of all POS payments.

Regarding payment behaviour in different sectors, we find that consumers have used debit cards more often in all of them, with growth in card usage being strongest in vending, the catering industry, and in ware houses for home products.

Collecting payment data 365 days of the year allows us to examine seasonal patterns in cash and card usage. Debit card usage peaks in December, but the opposite holds for cash usage. During the first months of the year, consumers make relatively few (cash and) card payments, maybe in order to compensate for the expensive December month. They make relatively many cash and debit card payments in May and during the summer holiday season.

In 2016 debit card usage is highest among people aged between 19 – 34 years old and among people with a college education, whereas people with at most

primary education or who are aged 75 or older are among the most intensive cash users. The growth in debit card usage has been widespread. It was highest among people aged 34 and younger, but also card usage by the elderly grew considerably being twice as high in 2016 than in 2010. In 2014 contactless payments were introduced in the Netherlands. Men, young adults and highly-educated people were among its early adopters. However, the differences in usage between consumer segments is narrowing down rapidly.

Given the ongoing substitution of cash by debit cards, fueled by increased debit card acceptance, the successful adoption of contactless payments in 2014 and recent innovations such as payment apps, we expect that the usage of debit cards and other electronic means of payments will continue to rise and substitute for cash payments in the next decade.

From a social perspective the continuing substitution of cash by debit cards is beneficial. It is conducive to the safety in retail trade as retailers will have less cash in their premises, making them a less attractive target for criminals. In addition, it stimulates the higher cost efficiency in the POS payment systems as debit card payments are usually less costly for retailers and banks than cash payments. However, it is also important from both an accessibility as well as a financial stability point of view that it should remain possible for consumers to pay their purchases at the POS using cash. Some consumers have a clear preference for cash, as they do not have access to a debit card (yet), or experience difficulties in using it. This holds in particular for vulnerable consumer segments such as the visually impaired, people who choose to use cash to control their spending, and many children. Moreover, the resilience of the POS payment system is best served if cash remains available as a reliable alternative next to the electronic payment system in case of technical failures.

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Jonker, Hernandez, de Vree, Zwaan: From cash to cards:
how debit card payments overtook cash in the Netherlands

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Martina Eschelbach¹

Pay cash, buy less trash?

– evidence from German payment diary data



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Abstract

This research note empirically investigates whether cash can prevent consumers from making needless purchases in unexpected shopping situations. Cash can have a disciplinary effect on short-term consumption because it imposes a strong temporary budget constraint and also reinforces the pain of paying. I use a sample of unexpected shopping situations that were recorded by participants of the Bundesbank's study on payment behaviour. I find that the probability of a transaction subsequently being declared unnecessary is significantly lower when the consumer had paid the transaction in cash. The results are similar across different

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socioeconomic groups based on age, gender, education and income. I conclude that restricting the use of cash for transaction purposes can entail a reduction in consumer welfare.

1 Introduction

With the growing availability of electronic payment devices, doubts are emerging as to what extent the use of cash as a payment instrument is still necessary and useful. In the euro area there is a general tendency to restrict the use of cash. In 2016, the ECB decided to stop issuing the 500 euro banknote. Furthermore, several countries have introduced an upper limit for cash payments and a European-wide regulation is under debate.

In the discussion on the future of cash, economists usually focus on private and social costs. They invoke the expensive cash infrastructure, the restraints cash imposes on monetary policy, and the role of cash in the informal and criminal sectors as well as in terror financing (Schmiedel et al. 2012, Rogoff 2014).

However, recent research projects have also explored the usefulness of cash for the consumer. According to the payment behaviour study of the Deutsche Bundesbank, consumers appreciate cash because it is simple, quick, anonymous and riskless (Deutsche Bundesbank 2014, Krueger and Seitz 2017). Furthermore, for some consumers, it is a helpful means of tracking their expenditure and keeping an eye on their remaining budget (von Kalckreuth et al. 2014a, Hernandez et al. 2016).

In this short research note I investigate the usefulness of cash as a disciplinary device, especially in unexpected shopping situations. I analyse consumer diary data on unplanned purchases and payments and investigate whether the use of cash can prevent hasty and unbeneficial decisions.

The distinctive feature of cash is that payments are made physically, whereas electronic payments are digital and invisible. From this physical character, two kinds of disciplinary effects can arise. First, using cash restricts the budget temporarily to the amount of cash in one's wallet. Raising one's budget by withdrawing additional cash involves costs and can sometimes even be impossible. If cash at hand is not sufficient to settle the upcoming transaction, the consumer might miss out on some advantageous purchases. However, he is also better protected from making hasty purchasing decisions that exceed his budget and which might prove to be unreasonable afterwards. Second, using cash in an unforeseen shopping opportunity gives the consumer a stronger signal of prices. Prelec and Loewenstein (1998) argue that cash payments are transparent and immediate. Counting and handing over a physical amount of cash inflicts a stronger "pain of payment" than transferring digital money by electronic means. The stronger price signal can prove to be particularly helpful when marketing tries to make consumers focus on quality rather than on costs.

Empirical studies from marketing science have already shown that the method of payment affects consumers' assessment of a concrete shopping situation. Prelec and Simester (2001) find that consumers' willingness to pay is higher when they pay with debit cards instead of cash. Runnemark et al. (2015) show that the same holds true when comparing cash and debit cards.² Thomas et al. (2011) find that paying with cash can increase consumers' ability to control their impulsive urges.

The empirical studies cited above are controlled environment utilization experiments. With carefully designed test settings, they make it possible to learn more about the psychological mechanisms triggered by different means of payment. However, the results rely on a selective group of volunteers and are therefore not

² There is also research on the long-term effects of cash vs. card usage. See, for example, Soman (2001), Raghurir and Srivastava (2008) as well as Chatterjee and Rose (2012).

necessarily representative of the population at large. Furthermore, candidates' behaviour in a test setting might deviate from that in real life.

In this research note, I analyse the disciplinary effects of cash in short-term consumption decisions by a regression analysis of survey data. My results are based on the payment behaviour study of the Deutsche Bundesbank which is representative for the German population. I am thus able to examine whether the effects described above are relevant on a larger economic scale. Furthermore, the data also make it possible to look for heterogeneities in the effects. This is particularly important as both payment and consumption behaviour has been shown to be highly dependent on income and other socio-economic variables (see, for example, von Kalckreuth et al. 2014b).

My regression results suggest that paying with cash in unforeseen shopping situations can indeed prevent consumers from buying things they do not need: in the data, the probability of an unplanned transaction subsequently being seen as unnecessary by the consumer is significantly lower when payment was in cash. This result is robust to different endogeneity tests. Furthermore, the disciplinary effect of cash is highly homogenous across socio-economic subgroups based on gender, income, education and age. It is thus not a marginal phenomenon relevant only for special types of consumers, but applies to most parts of the population.

The results make clear that from a consumer's point of view, cash and electronic payment instruments are not perfect substitutes. In previous studies, cash has already been found to be particularly useful in terms of anonymity, convenience, risk avoidance, and budgeting. My results suggest that it can also have a correctional effect on short-term consumption, with consumers reflecting more when making unplanned purchases. I conclude that the trend to restrict the use of cash for transaction purposes, which could end in the total abolition of cash in the long run, can also entail a reduction in consumer welfare.

2 Empirical strategy

2.1 Data

The empirical analysis of this research note is based on data collected as part of the Bundesbank's study on payment behaviour. The study provides a representative sample of the German-speaking population aged 18 and above living in Germany. The study has been conducted regularly every three years since 2008. Each wave is independent and comprises around 2,000 participants. The first part of the surveys consists of a face-to-face interview on the participants' payment habits and their socio-economic background. After the interview, the participants are asked to keep a payment diary over a one-week period. For each transaction, the respondents are asked to write down the type of location, the transaction amount and the payment instrument used. Each wave provides information on around 20,000 transactions.

I use transaction data from 2014 and restrict the sample to purchases that were not "planned", as indicated by the participants in their diaries (4,634 transactions). In these cases, the purchasing decision was mainly taken on the spot or at least at short notice and the use of cash could have the disciplinary effect described above. Furthermore, I focus on transactions at local retailers for day-to-day needs and long-term purchases (1,567 transactions). I do this to avoid confounding effects that might result from the location in which a purchase is made. The perceived usefulness of a transaction probably varies substantially depending on the type of location (e.g. café vs. pharmacy), and at the same time, the type of location has been shown to be a major determinant of payment behaviour (e.g. Eschelbach and Schmidt 2013). After deleting 18 transactions with missing information, I use information on 1,545 transactions from 833 individuals for my analysis.

At the end of the reporting week, participants were given the opportunity to name up to three transactions which they "could have most likely gone without during

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this week” and which were thus “unnecessary”. Table 1 shows descriptive statistics of my sample. Around 16% of unplanned transactions were seen as unnecessary.

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Descriptive statistics of estimation sample

Table 1

Variables	Estimation sample		
	Mean	SD	
Transaction the respondent could most likely have gone without during the week	0.16		
Cash payment	0.77		
Transaction amount	20.65	34.66	
Type of location			
Retail trade for daily needs	0.76		
Retail trade for longer-term purchases	0.24		
Day of the week			
Monday	0.15		
Tuesday	0.17		
Wednesday	0.18		
Thursday	0.13		
Friday	0.16		
Saturday	0.17		
Sunday	0.04		
Age	45.11	14.86	
Education			
No qualification / Not specified	0.01		
Secondary education	0.65		
Higher secondary education	0.34		
Number of transactions:	1,545		
Number of individuals:	833		

Note: Unweighted data.

	Variables	Estimation sample	
		Mean	SD
	Income		
	income < 500€	0.08	
	500€ ≤ income < 1,000€	0.19	
	1,000€ ≤ income < 1,500€	0.20	
	1,500€ ≤ income < 2,000€	0.19	
	2,000€ ≤ income < 2,500€	0.09	
	2,500€ ≤ income < 3,000€	0.08	
	3,000€ ≤ income < 3,500€	0.03	
	3,500€ ≤ income < 4,000€	0.02	
	4,000€ ≤ income < 4,500€	0.01	
	4,500€ ≤ income < 5,000€	0.01	
	5,000€ ≤ income < 7,000€	0.01	
	7,000€ ≤ income	0.00	
	Not specified	0.11	
	Female	0.59	
	Non-German citizen	0.10	
	Number of household members	2.39	1.25

2.2 Regression model

I estimate a linear regression model of the form:

$$unnecessary_{ij} = \alpha_0 + \alpha_1 cash_{ij} + x'_{ij}\beta + r_i + \varepsilon_{ij} \quad (1)$$

The dependent variable *unnecessary* has a value of one if individual *i* considers transaction *j* to be unnecessary; otherwise it is zero. The main explanatory variable, *cash*, is an indicator variable which has a value of one if the respondent *i* pays transaction *j* in cash; otherwise it is zero. α_0 is a constant, α_1 is the parameter that gives the effect of *cash*. *X* is a vector of control variables and β the vector of the corresponding parameters. On the individual level, my set of controls includes age, gender, educational level, household size, income and nationality. On the transaction level, I include information on the amount paid, the location and the day of the week.

If using cash has a disciplinary effect on spending, the probability of a transaction subsequently being judged as unnecessary should be lower for cash payments. In this case, I would expect α_1 to be negative.

Because I use real-life data and not experimental data, *cash* is not an exogenous variable in equation 1. The consumption and payment decisions are usually the result of a simultaneous optimization process. Therefore, I must be careful when interpreting α_1 as a causal effect. First, participants might differ in terms of unobserved characteristics r_i that might affect both the probability of paying in cash and the probability of declaring a transaction as unnecessary. If, for example, participants with low spending discipline generally use cashless payment instruments in order to always be liquid, the strength of the disciplinary effect of cash would be overestimated. Therefore, I additionally calculate a model with individual fixed effects. Second, there might also be a correlation between ε_{ij} and *cash*. Consumers might use cash only for their regular expenditure and use cashless payment

methods whenever they buy something on top. As on-top purchases might have a higher probability of being deemed unnecessary, the strength of the disciplinary effect of cash would be overestimated. Also, there is evidence that consumers feel a greater affection for goods when they have paid for them in cash (Shat et al. 2016). In this case, the causality between *cash* and *unnecessary* would be reversed.

The proper method to overcome these endogeneity problems would be to use an instrumental variable approach and generate exogenous variation in *cash*. The instrument must be highly correlated with the individual's decision to use cash but must not be correlated with the subsequent evaluation of the transaction afterwards. Unfortunately, there is no such information available in the payment behaviour study. Instead, I analyse the extent of a possible bias by running a simple robustness check. I compare my estimate of α , in the sample of unplanned transactions with an estimate of α , for a sample of planned transactions. In the sample of planned transactions there should be (almost) no disciplinary effect of cash, as the purchasing decision was probably not taken under the influence of transaction-specific variables such as payment mode. However, if the endogeneity problem described above leads to a spurious correlation between *cash* and *unnecessary*, we should also see this in the sample of planned transactions.

The analysis is based on a linear model, even though the outcome variable in equation one is clearly binary. The reason for this is that a linear framework offers an easy and established way to control for individual specific fixed effects by estimating a Within or a Least Squares Dummy Variable Model. In a non-linear framework, the inclusion of individual fixed effects in the form of indicator variables gives rise to the incidental parameter problem and leads to inconsistent estimates (e.g. Wooldridge 2010). Non-linear models that partial out family fixed effects, such as Chamberlain's Logit Model, have the disadvantage that they yield no estimates for the actual size of these effects (Chamberlain 1980). The estimation of predictions

and marginal effects must then rely on further assumptions (Hosmer et al. 2000). To address the heteroscedasticity problem of linear probability models, I use robust standard errors in all estimations.

3 Results

Table 2 displays the results of a linear regression as described in section 2. The table presents estimated coefficients and robust standard errors. Columns one and two show the results of a model where unobserved heterogeneity among individuals is interpreted as a random effect, uncorrelated with the regressors. The coefficient of *cash*, α_1 , is negative and statistically significant, which is the first evidence of a disciplinary effect of cash. According to the results, paying a transaction with cash is correlated with a five percentage point lower probability of considering the transaction as unnecessary afterwards.

The correlation patterns of the control variables are largely as expected. Longer-term purchases have a significantly higher probability of being seen as unnecessary than those for daily needs. Older people regret their transactions less often than younger people. One explanation for this might be that their greater life experience helps them to restrain their desire to buy. Women are more likely to subsequently declare their transactions as having been unnecessary. Either they actually do buy unnecessary things more often or they are simply more sceptical about their consumption behaviour.

The estimate of α_1 in the random effects model is inconsistent when the unobserved heterogeneity among consumers is correlated with payment behaviour. Columns three and four of Table 2 show the results of a model where unobserved heterogeneity is captured by individual fixed effects. In this model, the disciplinary effect of cash payments is even stronger. Paying with cash is correlated with a ten percentage point lower probability of considering the transaction as unnecessary

afterwards. The effect is statistically significant at the five percent level. I test the hypothesis that the coefficient of cash in the fixed effects model is the same as in the random effects model by using a heteroskedasticity robust version of the Hausman test (Wooldridge 2010). The null hypothesis is rejected at the ten percent level ($p = 0.058$). For the further analysis, I thus concentrate on the fixed effects model.

Table 3 shows the results of the fixed effects model when we allow the marginal effect of *cash* to vary across socio-economic groups. The models additionally contain interaction terms between *cash* and variables indicating gender, age, education, and income, respectively. As can be seen from the coefficients and standard errors, the interaction effects are not statistically significant. The disciplinary effect of cash payments is thus not a marginal phenomenon but present among the wider population.³

Finally, Table 4 presents the results of a robustness check. I apply the random and the fixed effects model of Table 2 to a sample of transactions that were planned. In these cases, I expect there will be no short-term disciplinary effect of cash payments and that α_i should be near zero. Otherwise, my prior results are liable to be affected by a spurious correlation. As can be seen from the coefficients and standard errors in Table 4, the mode of payment reveals no correlation with the advantageousness of purchases that were planned. I am thus confident that my prior results are not subject to an endogeneity bias.

³ In the same way, I tested whether the effect of *cash* depends on the size and the location of the transaction. But again, the coefficients of the interaction terms were not significant (results not presented).

Results of different linear regression models with unnecessary (0/1) as dependent variable (unplanned transactions only)

Table 2

Variables	Random Effects		Fixed Effects	
	Coeff	SE	Coeff	SE
Cash payment	-0.0519*	0.0293	-0.1000**	0.0472
Transaction amount	0.0042	0.0098	-0.0016	0.0162
Type of location				
Retail trade for daily needs	Ref.		Ref.	
Retail trade for longer-term purchases	0.1654***	0.0285	0.1460**	0.0405
Day of the week				
Monday	0.0154	0.0454	0.0162	0.0646
Tuesday	0.0144	0.0440	0.0347	0.0646
Wednesday	-0.0126	0.0427	-0.0282	0.0624
Thursday	0.0393	0.0478	0.0468	0.0686
Friday	0.0552	0.0477	0.0454	0.0685
Saturday	0.0280	0.0446	0.0342	0.0656
Sunday	Ref.		Ref.	
Age	-0.0279***	0.0447	–	–
Education				
No qualification / Not specified	0.0358	0.0857	–	–
Secondary education	Ref.			
Higher secondary education	-0.0081	0.0226	–	–
Number of transactions:	1,545			
Number of individuals:	833			

Note 1: The table presents coefficients and robust standard errors of a random effects and a fixed effects linear probability model with an indicator for unnecessary transaction as the dependent variable.

Note 2: The estimation sample contains unplanned transactions only.

Note 3: *, **, and *** indicate statistical significance at the ten, five, and one percent level, respectively

	Variables	Random Effects		Fixed Effects	
		Coeff	SE	Coeff	SE
	Income				
	income < 500€	Ref.			
	500€ ≤ income < 1,000€	0.0486	0.0408	–	–
	1,000€ ≤ income < 1,500€	0.0643	0.0401	–	–
	1,500€ ≤ income < 2,000€	0.0528	0.0417	–	–
	2,000€ ≤ income < 2,500€	0.0787	0.0481	–	–
	2,500€ ≤ income < 3,000€	0.0994	0.0527	–	–
	3,000€ ≤ income < 3,500€	0.0618	0.0649	–	–
	3,500€ ≤ income < 4,000€	0.1717	0.0966	–	–
	4,000€ ≤ income < 4,500€	0.0704	0.0740	–	–
	4,500€ ≤ income < 5,000€	0.1424	0.1082	–	–
	5,000€ ≤ income < 7,000€	0.2045	0.1925	–	–
	7,000€ ≤ income	-0.1325***	0.0494	–	–
	Not specified	0.0794	0.0462	–	–
	Female	0.0418**	0.0209	–	–
	Non-German citizen	0.0447	0.0359	–	–
	Number of household members	-0.0005	0.0086	–	–
	Constant	0.1341*	0.0954	0.1888	0.1414

Results of different linear fixed effects regression models with unnecessary (0/1) as dependent variable: allowing for heterogeneities in the effect of cash

Table 3

Heterogeneities related to:		Gender	
Variables		Coeff	SE
Cash payment		-0.1553**	0.0714
Transaction amount		-0.0022	0.0162
Type of location			
Retail trade for daily needs		Ref.	Ref.
Retail trade for longer-term purchases		0.1483***	0.0406
Day of the week			
Monday		0.0183	0.0649
Tuesday		0.0370	0.0650
Wednesday		-0.0285	0.0624
Thursday		0.0484	0.0686
Friday		0.0486	0.0688
Saturday		0.0327	0.0655
Sunday		Ref.	
Female x Cash payment		-0.0856	0.0885
Age x Cash payment		–	–
Higher secondary education x Cash payment		–	–
Income ≤ 1.500 € x Cash payment		–	–
Constant		0.2457*	0.1478
Number of transactions:		1,545	
Number of individuals:		833	

Note 1: See Table 2.

Note 2: See Table 2.

Note 3: See Table 2.

	Age		Education		Income	
	Coeff	SE	Coeff	SE	Coeff	SE
	-0.0706	0.1096	-0.1359**	0.0581	-0.1460**	0.0573
	-0.0018	0.0163	-0.0027	0.0163	-0.0025	0.0160
	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	0.1464***	0.04055	0.1477***	0.0405	0.1520***	0.0402
	0.0159	0.0647	0.0147	0.0648	0.0177	0.0644
	0.0348	0.0646	0.0284	0.0648	0.0316	0.0642
	-0.0287	0.0626	-0.0311	0.0626	-0.0291	0.0625
	0.0462	0.0688	0.0424	0.0689	0.0457	0.0684
	0.0446	0.0686	0.0402	0.0686	0.0478	0.0687
	0.0340	0.0656	0.0320	0.0657	0.0298	0.0652
	Ref.		Ref.		Ref.	
	–	–	–	–	–	–
	0.0088	0.0286	–	–	–	–
	–	–	-0.0951	0.0865	–	–
	–	–	–	–	-0.1112	0.0844
	0.1607	0.1692	0.2357	0.1481	0.2409*	0.1398

**Results of different linear regression models with unnecessary
(0/1) dependent variable, planned transactions only**

Table 4

Variables	Random Effects		Fixed Effects	
	Coeff	SE	Coeff	SE
Cash payment	-0.0112	0.0068	-0.0105	0.0101
Transaction amount	-0.0049	0.0023	-0.0026	0.0031
Type of location				
Retail trade for daily needs	Ref.			
Retail trade for longer-term purchases	0.1364***	0.0165	0.1340	0.0178
Day of the week				
Monday	0.0015	0.0134	-0.0136	0.0146
Tuesday	0.0060	0.0139	-0.0131	0.0151
Wednesday	0.0011	0.0134	-0.0203	0.0145
Thursday	-0.0029	0.0136	-0.0165	0.0150
Friday	-0.0017	0.0135	-0.0184	0.0147
Saturday	-0.0019	0.0133	-0.0208	0.0148
Sunday	Ref.		Ref.	
Age	-0.0000	0.0001	–	–
Education				
No qualification / Not specified	0.0088	0.0187	–	–
Secondary education				
Higher secondary education	0.0084	0.0053	–	–
Number of transactions:	7,283			
Number of individuals:	1,887			

Note 1: See Table 2.

Note 2: The estimation sample contains planned transactions only.

Note 3: See Table 2.

	Variables	Random Effects		Fixed Effects	
		Coeff	SE	Coeff	SE
	Income				
	income < 500€				
	500€ ≤ income < 1,000€	-0.0165	0.0105	–	–
	1,000€ ≤ income < 1,500€	-0.0166	0.0104	–	–
	1,500€ ≤ income < 2,000€	-0.0234	0.0106	–	–
	2,000€ ≤ income < 2,500€	-0.0109	0.0126	–	–
	2,500€ ≤ income < 3,000€	-0.0352	0.0119	–	–
	3,000€ ≤ income < 3,500€	0.0011	0.0203	–	–
	3,500€ ≤ income < 4,000€	-0.0157	0.0199	–	–
	4,000€ ≤ income < 4,500€	0.0176	0.0330	–	–
	4,500€ ≤ income < 5,000€	-0.0237	0.0201	–	–
	5,000€ ≤ income < 7,000€	-0.0226	0.0378	–	–
	7,000€ ≤ income	-0.0463	0.0126	–	–
	Not specified	-0.0195	0.0110	–	–
	Female	0.0017	0.0046	–	–
	Non-German citizen	-0.0131	0.0075	–	–
	Number of household members	0.0003	0.0020	–	–
	Constant	0.0861	0.0269	0.0700**	0.0307

4 Conclusions

This short research note investigates whether cash has a disciplinary effect in unplanned shopping occasions and whether it protects consumers from unnecessary spending. Using survey data from the Bundesbank payment behaviour study of 2014, I find that the probability of an unplanned purchase subsequently being considered unnecessary is around ten percentage points lower when the transaction was paid in cash. The disciplinary effect does not depend on age, gender, education or income and is thus equally relevant to all consumers.

The main insight of the analysis is that cash and electronic payment methods are by no means perfect substitutes. According to recent polls, consumers favour cash because it is convenient, anonymous and helps budgeting (Deutsche Bundesbank 2014). In this note, I find evidence for a further advantage of cash which most consumers are probably not even aware of: it can save consumers money by making unnecessary unplanned purchases less likely.

Clearly, this paper cannot advise consumers on which payment instrument they should use in order to maximize their welfare from consumption. Such an ambitious endeavour would require much more sophisticated econometric methods to disentangle consumption and payment decisions as well as a broader data base. For example, one would need information on the optimality of transactions that were prevented by the use of cash, as some of them would certainly have been beneficial.

However, the results indicate the need for greater care in the discussion on the future of cash as a payment instrument. Some economists recommend a stronger regulation of cash payments, which might in the long run result in the total abolition of cash. First steps have already been taken with the abolition of the 500 euro banknote and the introduction of upper limits for cash payment in many European

countries. Restricting the use of cash might lower social costs and make life harder for criminals and terrorists. However, there is a chance that it will also reduce consumers' welfare by depriving them of a means of encouraging budget discipline.

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Helmut Stix¹, Clemens Jobst (Oesterreichische Nationalbank) Assessing recent increases in cash demand



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Abstract

Contrary to predictions that demand for cash will decline with the increased availability and use of non-cash payment means, currency demand has increased in the Euro area and the US over the past 15 years. Against this background, this short article summarizes recent findings from Jobst and Stix (2017), who provide a discussion of trends in currency demand, and presents additional descriptive evidence. In a first step, currency demand over a longer period is analyzed for the USA, Germany and the Euro area. This is helpful for understanding and assessing recent trends. In a second step, evidence from 70 economies is analyzed for the period from 2001 to 2014. This broader perspective informs us about the development for currencies that do not circulate internationally. Our descriptive account provides

¹ The views expressed in this paper are solely those of the author. No responsibility for them should be attributed to the Oesterreichische Nationalbank, or the Eurosystem. I thank Prof. Schneider for sharing the shadow economic indicators and Tobias Himmelbauer for excellent research assistance.

several insights: (i) Recent increases for the euro and the US dollar are strong even if seen over a 100 year horizon. (ii) Over the period from 2001 to 2014 currency demand has increased in many economies. (iii) In economies where currency demand increased, the increase typically happened after the start of the economic and financial crisis of 2007/08. What are the drivers of recent increases in currency demand? Jobst and Stix (2017) estimate panel money demand models, accounting for changes in GDP, interest rates and shadow economic activities. In economies with high GDP, a substantial share of the increase cannot be explained by changes in interest rates or in the size of the shadow economy. We conjecture that the unexplained component is related to increased hoarding.

1 Introduction

Over the past decade, currency in circulation has increased sizably in a number of large economies, including the Euro area, the USA and Japan. This is difficult to reconcile with the extant and growing use of cashless payment technologies in industrialized economies (Amromin and Chakravorti 2009; Bagnall et al. 2014). Also, the mere size of physical cash that is circulating in the hands of the public is difficult to explain by transaction needs: In 2014 per capita holdings were around 4000 US dollar in the Euro area (EUR) and the USA. Accounting for foreign demand would sizably reduce these figures but would nevertheless not change the fact that per capita circulation is substantial. Both the magnitude of cash circulation and its increase over the past decade(s) raise questions that are of relevance for central banks and economic policy makers: What explains the puzzling size of cash circulation? Can the extent and the increase over time be explained by conventional economic forces, e.g. lower interest rates?

In this short paper we summarize results of Jobst and Stix (2017). To assess and to understand recent trends, the analysis looks at currency demand from a broader perspective, i.e. it goes beyond the literature's typically rather narrow focus on

either relatively short time periods (e.g. the post-World War II period) or on relatively few economies (e.g. the USA, the Euro area, etc.). First, the demand for currency is analyzed from 1867 to 2015 for the United States, Germany and, at the end of the sample period, the Euro area. This perspective is informative with regard to the long-run trend in cash as well as how large financial crises affect cash demand. Second, we describe results from an analysis of the contemporaneous development of currency from 2001 until 2014 for a sample of 70 economies. This perspective allows us to econometrically study the drivers of cash demand. The focus is on changes in cash demand, not on absolute levels.

2 Demand for Deutsche mark and US dollar from a longer-term perspective

Figure 1 displays the ratio of currency in circulation (CiC) over nominal GDP from the last quarter of the 19th century to 2015 for the United States (USA), the Euro area (EUR) and Germany (DEU).² Generating long time series involves several compromises and judgments. While details are discussed in Jobst and Stix (2017), it should be mentioned that one important decision concerns the inclusion or exclusion of specie money. Until about the 1920s, countries differed sizably with respect to the circulation of gold coins which in some countries substituted for lower to medium denomination banknotes in payments and/or served as a store of wealth. As can be seen from Figure 1, the inclusion or exclusion of specie money makes a substantial difference in the case of Germany.³

In the following descriptive account, we focus on large trends. The following main observations can be taken from Figure 1.

² The euro series for the period from 1980 to 2001 reflects a synthetic aggregate of Euro area members.

³ The USA series contains specie money. As the deposit to currency ratio is roughly the same in Germany and in the USA until 1914, this could imply that more wealth was held in assets other than cash or deposits (stocks, bonds, etc.) in the USA than in Germany. However, this conjecture would require further scrutiny, which is outside the scope of this paper.

1. Comparing the values of 1990 with those from around 1890 informs us that cash use has declined: from 13% to 6% in DEU (including coins) and from 6% to 4% in the USA.
2. The decline in currency demand is not uniform. World War II marks the most dramatic change; other events which affected velocity are World War I and the Great Depression.
3. Over the post-World War II period there is a secular decline in currency demand. This is the time frame that is usually analyzed in studies on the use of currency. It is evident that the focus on only the post-World War II period “biases” the picture as CiC levels were outstandingly high after the war.
4. Since the mid-1980s the long-run trend decline has come to a halt or even reverted: CiC has increased in the USA and in DEU.
5. Since 2007, CiC over nom. GDP has increased further in the USA and EUR. The recent increases are large even if seen over a 150 year horizon.

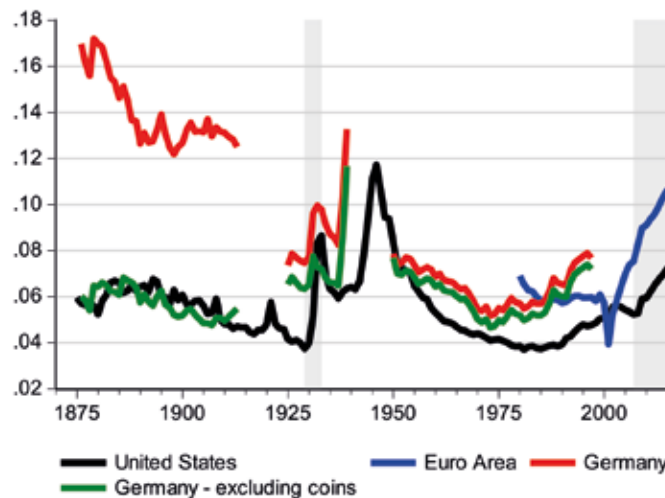
Figure 1 informs us regarding some long-run trends that prevailed in both economies and that cannot be attributed to country-specific developments. There is large agreement as to the causes of the decline after World War II: increase in the dissemination of transaction accounts, the non-cash payment of wages, the increased use of payment cards and cheques and the dissemination of ATMs which allowed consumers to economize on cash balances (e.g. Krüger 2016). The increase in CiC after the mid-1980s fits well to political/economic events (e.g. the breakdown of Communism, developments in Latin American economies) which fueled international demand for US-dollar and Deutsche mark (Porter and Judson 1996, Seitz 1997).

One development which received considerable attention was the rapid increases in euro circulation after the introduction of euro cash in 2002 and before 2007. Figure 1 suggests that this is not so surprising given that the circulation of euro relative to nominal GDP in 2006 was around the level of the Deutsche mark before the

introduction of the euro. In this sense, one could view the trend in euro circulation before 2007 as a catching up effect after the decline in circulation in the wake of the cash changeover in 2001/2002. However, what is astonishing is the very strong increase after the outbreak of the 2007 crisis, with an accelerating trend in EUR and an increase in the USA (cf. Judson 2017). With the exception of World War II, there is only one episode with a comparable increase, the Great Depression. However, closer scrutiny shows that the increase was much steeper and more sudden in the 1930 than it has been after 2007/08.⁴ A similarity between the Great Depression and the concurrent development is that the increase was (and has been) rather persistent.

**Currency in Circulation over Nominal GDP (in %)
in Germany and the USA**

Figure 1



Note: The shaded area marks the period from 1929 to 1933 and from 2007 to 2015. The series for the Euro area has been constructed prior to 2002. Source: See Jobst and Stix (2017).

⁴ See also the analysis of deposit-to currency ratios in Goodhart and Ashworth (2017).

3 Some Facts about the Demand for Currency from 2001 to 2015 for many economies

Another way of assessing recent developments in currency demand in EUR and the USA is to compare them with those in other economies. One advantage of this approach is that it provides evidence on currencies which are not demanded internationally. The disadvantage is that comparable data are only available for a relatively short time period. Specifically, Jobst and Stix (2017) have collected data from around 70 economies for the period from 2001 to 2014.⁵

3.1 Data description and aggregation

Jobst and Stix (2017) provide a description of how economies were selected. In essence, the sample covers the richest economies in terms of their absolute economic size plus some regionally important economies that were added for breadth of geographical coverage. Overall, all included economies account for about 96% of World GDP in each year from 2001 to 2014. Henceforth, this sample will be denoted as the “World”.

Aggregating economies raises the issue of which exchange rate to apply. In this paper, all results which refer to aggregations are based on USD exchange rates that are fixed as of 2006. This eliminates the impact of exchange rate movements that have occurred in the course of the economic and financial crisis. Jobst and Stix (2017) provide results on aggregations based on other exchange rates and find that results are largely unaffected, qualitatively.

⁵ Goodhart and Ashworth (2017) conduct an analysis of currency demand for six economies. Additionally, they analyze the temporal evolution of currency to deposit ratios.

3.2 Descriptives

Table 1 lists the 20 economies with the highest per capita values of currency in circulation both using market exchange rates (USD) and purchasing power adjusted exchange rates (PPP-USD). Per capita circulation fluctuates enormously ranging from about 30-70 USD in African economies (Kenya, Tanzania, Uganda, Nigeria, Cameroon) to 9000 USD in Switzerland (CHE). The Euro area and the USA had a per capita circulation of around 4000 USD. This compares with values of 1250 USD in Sweden and 1520 USD in Norway which are considered as frontrunners in electronic payments. Although the purchasing power adjustment changes the ranking of economies, the table substantiates that cash is not only used for legal transactions but must also be hoarded in many economies and/or serves other purposes.

One interesting aspect concerns the relative importance of economies for total “World” currency demand. Table 2 shows that the four large economies EUR, USA, JPN and CHN account for 72% of total “World” currency in circulation.⁶ All other economies are substantially less important in this respect. Switzerland, Singapore and Hong Kong, for example, account for rather small shares in total “World” currency in circulation despite their large per capita circulation.

⁶ The exact ranking depends on the exchange rate (the table refers to the year 2012). In other years, USA is ranked second and JPN third.

Size of currency holdings in US dollar

Table 1

Country	Currency in circulation per capita (USD)	Currency in circulation per capita (PPP-USD)
Switzerland	9,009	6,024
Japan	7,257	7,303
Hong Kong	5,874	8,055
Singapore	4,546	6,685
Euro area	4,085	3,997
United States	4,059	4,059
Australia	2,565	1,853
Czech Republic	2,144	3,338
Denmark	2,127	1,574
Israel	1,927	1,721
Canada	1,781	1,562
Qatar	1,705	2,556
Hungary	1,634	2,880
Norway	1,525	1,016
Kuwait	1,507	na
Azerbaijan	1,450	3,221
South Korea	1,409	1,731
United Kingdom	1,399	1,201
Saudi Arabia	1,396	3,001
Iceland	1,306	1,087

Note: The table shows per capita values of currency in circulation expressed in US dollar (USD) and in purchasing power adjusted US dollar (PPP-USD) for the year 2014. The table shows the 20 countries with the highest values for currency in circulation (USD). Source: See Jobst and Stix (2017).

Relative shares of currency in circulation

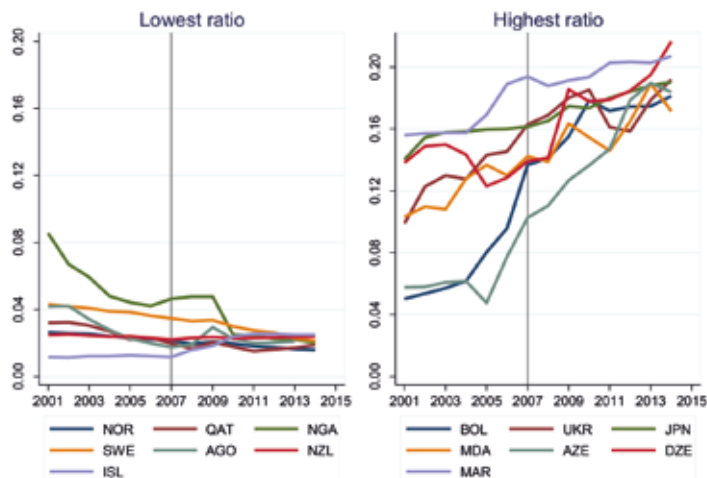
Table 2

Country	Percentage share of "World" currency in circulation	Accumulated share	OECD member	Dollarized
Euro area	19.9	19.9	1	0
Japan	18.9	38.9	1	0
United States	18.6	57.5	1	0
China	14.3	71.8	1	0
Russia	3.5	75.2	1	1
India	3.4	78.6	0	0
Brazil	1.6	80.2	0	0
United Kingdom	1.3	81.5	1	0
Switzerland	1.1	82.6	1	0
Mexico	1.1	83.7	1	0
Canada	1.1	84.7	1	0
Australia	1.0	85.7	1	0
South Korea	0.8	86.5	1	0
Indonesia	0.8	87.3	1	1
Argentina	0.8	88.1	0	1
Saudi Arabia	0.7	88.8	0	0
Thailand	0.7	89.5	0	0
Algeria	0.6	90.1	0	0
Hong Kong	0.6	90.7	0	0
Egypt	0.6	91.3	0	1

Note: The table shows the 20 economies with the highest relative shares of "World" currency in circulation (column 2). Column 3 shows the accumulated share and column 4 and 5 express whether the respective economy is member of the OECD or whether it is classified as dollarized. All values refer to the year 2012. Market rate US dollar (USD) are used for calculating respective values. Source: See Jobst and Stix (2017).

Economies with the lowest and highest currency in circulation over nominal GDP (in %) ratios

Figure 2



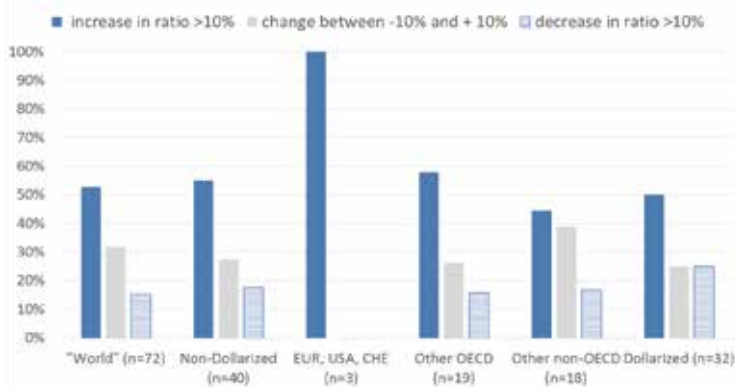
Note: The left panel shows the 7 economies with the lowest ratio of currency in circulation over nominal GDP as of 2013 (in %). The right panel shows the 7 economies with the highest ratio as of 2013.

Source: See Jobst and Stix (2017).

An alternative way of comparison is to rank economies by their CiC over nominal GDP ratios. Figure 2 depicts the seven economies with the lowest and highest ratios as of 2013. Again, a very sizeable dispersion is evident. The group of economies with the lowest ratios contains three Nordic economies (NOR, SWE, ISL). The group of economies with the highest ratios typically consists of economies with lower GDP—with the notable exception of Japan. If one focuses on changes over time, then the ratio is trending downward (upward) in economies with the lowest (highest) ratio. However, there are some exceptions. For example, Island which had the lowest ratio prior to 2007, experienced an increase in the ratio after 2007. Also, in Angola, there is an increase from 2008 to 2009.

Changes in currency in circulation over nominal GDP ratios from 2004/05 to 2013/14

Figure 3



Note: The figure shows descriptive statistics about changes in the currency in circulation over nominal GDP ratios over the period from 2004/05 to 2013/14 for the "World" and several sub-aggregates. The solid bars depict the relative share of economies with an increase of the ratio by more than 10% (within each group). The contoured bars show the relative share of economies with a decrease of the ratio by more than -10%. The grey bars (in-between) show the remaining share of economies with a change in the ratio that lies between -10% and plus 10%. The group size is indicated in parenthesis. Averages are taken for 2004/05 and 2013/14 to reduce the effect of outliers. Source: See Jobst and Stix (2017).

Figure 3 provides a summary of the temporal development of currency in circulation to nominal GDP ratios in 72 economies. Specifically, we focus on the change in the ratios from 2004/05 to 2013/14 and show the relative proportion of economies in which the ratio increased by more than +10 percent as well as the proportion of economies in which the ratio decreased by more than -10 percent. In the sample of all economies ("World"), the unweighted mean (median) change is 17 (13) percent. One quarter of economies faced an increase by more than 37%.

Figure 3 shows that the share of economies with an increase (solid bars) is higher than the share of economies with a decrease (contoured bars). This holds for the "World", for dollarized and for non-dollarized economies (the latter group is

further separated in OECD and non-OECD members).

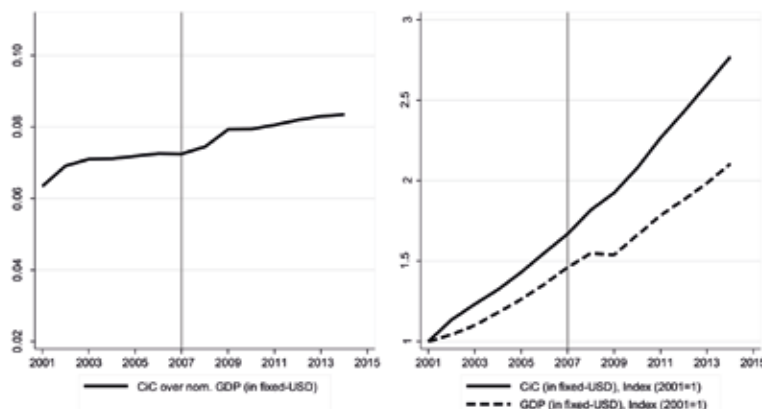
3.3 Aggregate currency demand in the “World” and in sub-aggregates

Another way of analyzing the data is to aggregate economies, which implicitly accounts for their relative size. The left panel of Figure 4 depicts the CiC over nominal GDP ratio for the aggregate of all economies in our sample (“World”). The resulting ratio displays an upward slope throughout and a discernible level shift between 2007 and 2009.

The observed increase of the CiC over nom. GDP ratio could be the result of a declining GDP in the course of the global financial crisis. The right panel of Figure 4 depicts the indexed temporal evolution of nominal CiC and nominal GDP. Nominal

Currency in circulation over nominal GDP (in %) – “World”

Figure 4

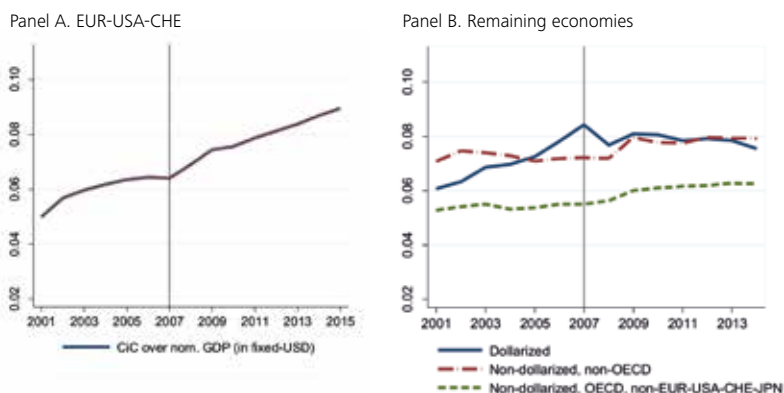


Note: The figures show the currency in circulation to nominal GDP ratios (left panel) as well as the evolution of currency in circulation and nominal GDP (right panel). All figures refer to the “World” as specified in Jobst and Stix (2017). The aggregation is based on market USD exchange rates that are fixed at 2006. Sources and methods are described in Jobst and Stix (2017).

GDP remained roughly constant from 2008 to 2009 but increased afterwards. At the same time, nominal CiC increased from 2008 to 2009. Therefore, the ratio of these two variables increased from 2008 to 2009. The interesting development is that the gap between CiC and nom. GDP was growing throughout the entire observation period.

Figure 5 contrasts the development in the main economies that face overseas demand, USA, EUR and CHE, with the development in the remaining economies. Among the remaining economies, three sub-aggregates are shown: (i) dollarized economies, (ii) non-dollarized economies that are not members of the OECD and (iii) non-dollarized economies that are OECD members. In the latter aggregate Japan has been excluded because of its large weight within this group.

Currency in circulation over nominal GDP (in %) – Sub-aggregates Figure 5



Note: The figures show currency in circulation to nominal GDP for various aggregates of economies. Panel A refers to the aggregate of the Euro area, the USA and Switzerland. Panel B refers to (i) dollarized economies, (ii) non-dollarized non-OECD economies and to (iii) non-dollarized OECD economies excluding EUR, the USD, CHF and JPN. The yen was excluded because of its high weight in this aggregate. All aggregations are based on market USD exchange rates that are fixed at 2006. Sources and methods are described in Jobst and Stix (2017).

The comparison shows that the increase in the CiC to GDP ratio is not confined to the international currencies – although the increase is less strong than for the EUR, the USD or the CHF. In non-dollarized non-OECD member economies, there is an increase from 2008 to 2009 and a constant ratio afterwards. Among non-dollarized OECD member, the increase around 2008 is smaller but the positive trend has continued until 2014. The development in dollarized economies contrasts strongly with the development in non-dollarized economies as a strong upward increase can be found until 2007. We conjecture that this increase is due to the period of “great moderation”, i.e., low interest rates and increasing levels of trust in national currencies resulting in a reduction of currency substitution. From 2007 onwards, this changed as the ratio was first declining and then relatively constant. If one presumed that overall cash demand in dollarized economies, that is domestic currency plus cash of foreign denominations, increased also in dollarized economies around 2008/09, as it did in many other non-dollarized economies, then Figure 3 visually suggests that some EUR, USD and CHF cash flowed to dollarized economies after 2007.

Overall, the descriptive account shows (i) that cash demand has increased in the World as a whole, (ii) that cash demand has increased not only in EUR and the USA but in the majority of economies from 2003 to 2014 and (iii) that the increases cannot be assigned to only poorer or richer economies.

4 Reasons for recent increases in currency demand

There are four plausible arguments that could rationalize the increase in cash demand.

- First, after 2007/08 interest rates decreased in the majority of economies and reached near-zero levels in some economies.
- Second, it has been stipulated that increases in shadow economic activities, tax evasion and/or higher shares of self-employed could be drivers of higher cash demand (Goodhart and Ashworth 2014).
- Third, the increases could be a consequence of portfolio shifts either due to lower confidence in banks or due to increased uncertainty. This interpretation focuses on the asset (safe haven) role of cash. Note that this interpretation does not necessarily rely on the occurrence of banking panics as in the 1930s. Goodhart and Ashworth 2015, for example, exclude banking panic as a main driver of cash increases in some major economies.
- Forth, Friedman and Schwartz (1963) argue that velocity tends to decrease in contractions because agents' demand for cash is based on permanent income rather than period income. In this line of argument, cash holdings could be higher relative to GDP if agents have not adjusted their pre-crisis estimate of permanent income to the lower income growth that occurred after 2008.

To analyze the relative importance of these factors Jobst and Stix (2017) estimate a panel money demand model where (log) real per capita cash holdings is related to (log) real per capita GDP, deposit interest rates and a measure of shadow economic activities. This measure is based on Schneider (2017) and does not employ cash as an input in its computation. In addition time dummy variables for the years after 2008 are employed to measure whether any shift can be observed after 2008 that cannot be assigned to the other independent variables. The panel estimation is based on a fixed effects model such that the focus of the analysis is on changes

over time (with different levels in cash demand across economies being controlled for). Also, it is important to note that point estimates reflect an average effect across economies, not accounting for their relative size.

Given the difficulties in isolating the foreign demand component we omit the USA, EUR and CHE from our sample such that all estimations primarily reflect domestic demand. Similarly, the estimations focus on non-dollarized economies only. The main results can be summarized as follows:

1. In general, the results yield plausible parameter estimates. This is reassuring as the economies that are included in the estimation differ substantially by their economic and financial development.⁷ For example, the income elasticity, which is allowed to vary across economies is on average below one in higher GDP economies which suggest that there are economies of scale in the use of cash.
2. Interest rates are found to exert a significant negative impact on cash demand. Given the changes in interest rates after 2008, Jobst and Stix (2017) conduct various specifications to check for the robustness and to analyze whether the elasticity of cash demand changes as interest rates become very low (log-log, semi-log, different slopes after 2008, different parameters for interest rates below and above one percent). The findings suggest a saturation level of cash that agents are willing to hold even if interest rates are (very) close to zero. In general, this result implies that part of the increase in cash demand can be attributed to lower interest rates.

⁷ A few economies with very implausible point estimates for the income (scale) elasticity were omitted from the sample.

3. No significant effect is found for the shadow economy indicator, suggesting that changes in shadow economic activities exerted no impact on changes in cash demand during the period under study. The reason for this finding is that the shadow economic indicator is declining in many economies over the sample period, while demand for cash is increasing.⁸
4. Does the temporal evolution of GDP and interest rates explain all of the changes? Given the heterogeneity of economies, the sample is split into several groups. For economies with below median GDP per capita, it is found that the time dummy variables are insignificant, implying that all of the changes (increases) can be explained by these conventional economic forces. However, for economies with above median GDP the time dummy variables indicate an unexplained upward shift after 2009 that cannot be explained by GDP and interest rates. To delve deeper into the reason for this unexplained increase, further analyses are conducted for higher GDP economies.
5. The use of (an incomplete proxy for) permanent income instead of period income as a scale variable renders the unexplained shift smaller but does not eliminate it.

A natural next extension would be to include measures of trust in banks or perceived uncertainty and to study whether these variables account for the unexplained level shift. As such data are unavailable, an indirect test is conducted by splitting the sample into groups of economies. Specifically, economies (i) that did not experience any systemic financial crisis in the post World War II period were compared with economies that (ii) either experienced a financial crisis in 2007/08

⁸ For example, it declined in 30 out of 32 OECD economies from 2003 to 2014. Although cash demand estimations omit the Euro area it should be noted that an increase of shadow economic activities is only found in Cyprus, Spain and Portugal. In the USA, GBR and JPN there is a slight decrease.

or had (iii) experienced a financial crisis before 2007/08.⁹ The idea for the inclusion of the latter group is that memories of crisis can have a strong impact on financial behavior of individuals (Malmendier and Nagel 2011, Osili and Paulson 2011, Stix 2013) even if no crisis occurred in the specific economy in 2007/08.

The currency demand model can be estimated for each of the three groups and it is tested whether the time dummy variables remain significant. The problem with this approach is that the group without any financial crisis is very small (the model is estimated only for above median GDP economies). Moreover, there might be unobserved variables which affect cash demand that are correlated with the groups. Therefore, results are indicative only and cannot be interpreted as causal.

The estimation results are in line with expectations. In the group of economies without a financial crisis no unexplained level shift is found. In the group of economies with a financial crisis a significant level shift is found¹⁰ such that results are indicative that financial crises have had an impact on post-crisis cash demand. The finding indicates that cash demand increased also in economies that had a financial crisis before 2007/08 but not in 2007/08.

⁹ The separation of economies into these groups is based on Laeven and Valencia (2012).

¹⁰ With regard to the effect of the financial crisis of 2007/08, results depend on the functional form of money demand (log-log or semi-log) and are not unambiguous.

5 Conclusions

The paper summarizes results from Jobst and Stix (2017) and provides some additional descriptive evidence. Findings show that cash demand has increased not only in EUR and the USA but also in many other economies over the past decade.

The results from panel estimations for non-dollarized economies and for currencies that are not circulating internationally indicate that lower interest rates and the evolution of income explain parts of the increase. However, in economies with a higher GDP, the increases after 2009 cannot fully be accounted for by these conventional economic forces. Changes in shadow economic activities are not found to have had an effect on changes in cash demand. As results represent an average effect across economies this does not mean that changes in shadow economic activities might not have been of importance for cash demand in some economies as, for example, stated in Goodhart and Ashworth (2015, 2017). Moreover, it should be made clear that we focus on changes in cash demand and not on level differences across economies and that we just use one indicator of shadow economic activities.¹¹

On a general note, the finding that cash demand has increased in relatively rich economies – whereas one would expect a decline in these economies due to the proliferation of cashless payments (Bagnall et al, 2016)--implies that overall currency in circulation is dominated by hoarding and other motives rather than by transaction motives.

What are the drivers for the unexplained increase in cash demand? Many factors other than income and interest rates could be important for the increase in cash

¹¹ A measure of self-employment or alternative measures of tax evasion are available for a subset of economies (cf. Goodhart and Ashworth, 2017).

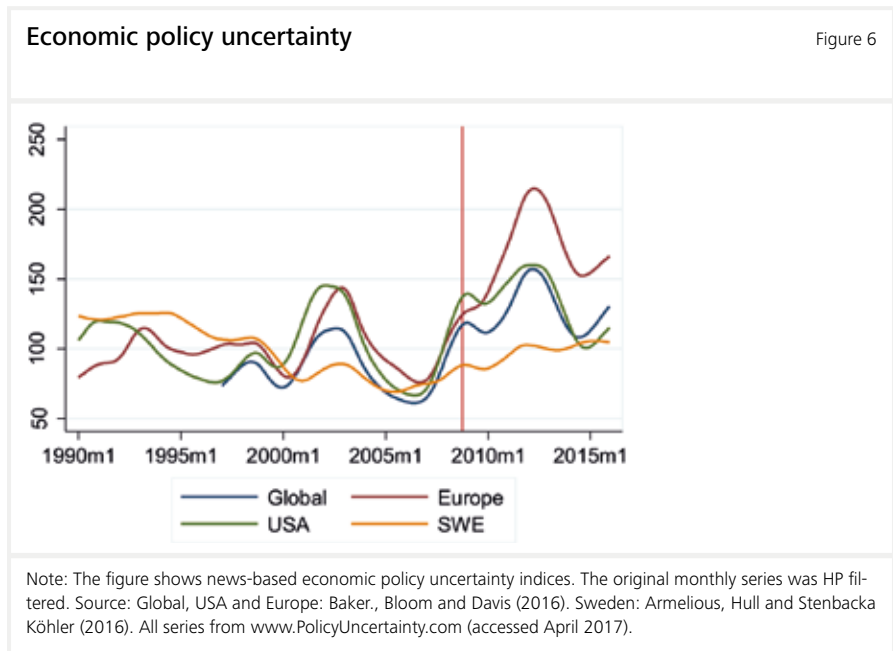
demand. The problem is that good empirical measures are unavailable across time and across economies to solidly assess their importance. Therefore, any explanation of the unexplained increase in cash demand in higher GDP economies necessarily has to remain speculative.

In this sense, we conjecture that the financial crisis of 2007/08 and the subsequent turbulences in some economies might have lowered confidence in banks and/or increased uncertainty, notably also in economies without a financial crisis. Friedman and Schwartz (1963), discussing cash demand after the Great Depression, stress the general role of uncertainty: *"The more uncertain the future, the greater the value of [the] flexibility [of cash] and hence the greater the demand for money is likely to be"* (p. 673). This channel, in combination with very low interest rates, might constitute one additional important reason for the increase in cash demand in many richer economies after 2009. However, without detailed data on confidence in banks or the public's perception of uncertainty, this explanation is difficult to test empirically. Not least in order to explain the observed pattern in cash demand the argument requires a rather persistent increase in uncertainty/decrease in confidence and not just a short-term temporary change in 2008/09.

Evidence about the temporal evolution of uncertainty is provided by the news-based Economic Policy Uncertainty Index which is available for some economies (Baker, Blum and Davis 2016). Figure 6 shows a substantial increase in policy uncertainty after 2008 in many economies, i.e. the Global index, Europe and the USA.¹² In Sweden, which is shown for comparison, there was no increase. In Europe, the increase in economic policy uncertainty has been persistent, in the USA it normalized around 2015. Alternative evidence is provided in Figure 7 which

¹² The index for Europe reflects policy uncertainty in France, Germany, Italy, Spain und the United Kingdom.

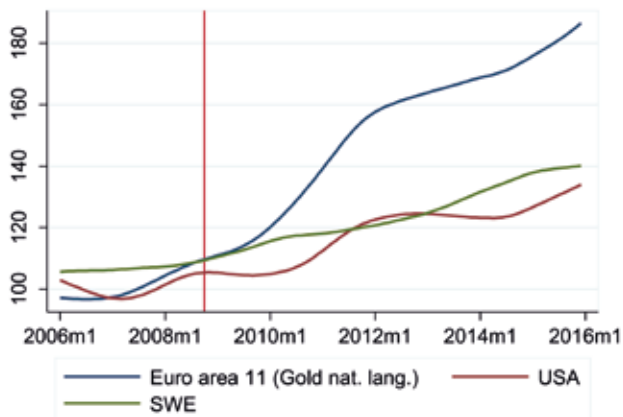
shows trends in Google searches for the word “gold” (Google Trends 2017¹³). The idea is to measure the tendency of the broad public to search for information about a safe asset. The respective index for the Euro area has deviated from the index for the USA or Sweden around 2010 (the time of the Greek debt crisis) and has been much higher since then.



13 Jobst and Stix (2017) construct a weighted index for the Euro area 11. In principle, Google records all searches for the term “gold” which could be “gold medal” or any other term and relates it to the overall number of Google searches. Further contextual information provided by Google Trends shows that “buying gold” is always in the top 10 list of searches which included the word “gold”. For the construction of the Euro area 11 index, the national language searches for “gold” were used.

Index of Google Searches for „Gold“

Figure 7



Note: The figure shows HP filtered indices of Google search trends for the word "Gold". The series for the Euro area 11 aggregate was constructed using search terms in national language and weights according to the Euro-system capital keys of individual economies. Source: Google Trends (trends.google.at/trends), accessed April 2017. Own calculation.

The fact that the reasons underlying the increases in currency demand cannot be identified with reasonable certainty highlights that there is a dire need for more data and more research to better understand the public's use of cash in calm times and in times of crisis/uncertainty. Without this understanding, it is not a good idea to phase out physical currency and to replace it by electronic means of payments as has been advocated by some scholars (e.g. Rogoff, 2016).

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Stefan Augustin

Technical innovations in cash processing – the future cash cycle



Stefan Augustin
Oesterreichische Nationalbank

In the last couple of years many researchers, among them most notably Kenneth Rogoff (2016)¹, have declared a “war on cash”. Despite the fact that Sweden has been at the forefront when it comes to promoting a cash-less society, even the former vice governor of Sveriges Riksbank, Lars Nyberg, had to admit that cash is here to stay: „However, cash will survive, like the crocodile, even though it may be forced to see its habitat gradually cut back “.²

¹ Rogoff (2016): The Curse of Cash

² Nyberg (2011): Will cash replace cards?

Demand for cash is still growing.

Cash continues to play an important role in the economy and remains in demand. The total value of euro cash in circulation came to EUR 1,137.8 billion (Feb 2017). Since the introduction of the Euro in 2002, the value of circulating cash has already quadrupled. Demand for cash is rising and there has never been before as much cash as today.

The behavior of the general public does not give any indication that cash's days are numbered.

Every day, billions of banknotes and coins change hands, enabling all kinds of transactions to be carried out. The role of cash as a payment instrument is well known and volumes of economic literature deal with the resilience of cash. Cash continues to play an important, often dominant role in retail payments.

The ever-growing demand for cash in Austria since its introduction in 2002 is in part due to cash being used for transaction purposes. The Austrian Central Bank's (OeNB) most recent payment diary survey conducted in 2016 provides proof of that.

Table 1 confirms the dominant role cash plays in direct payment transactions: 82% of all payments made in 2016 were cash payments. Debit cards were used to pay for 10.9% of all purchases, credit cards for 2.7%. Some observers may regard the share of cash in payments at Austrian retail stores as very high, but a closer look shows that the respective amounts are usually quite low. The value of 50% of all payments covered by the survey is below EUR 12.4, and 90% of payments are for amounts of less than EUR 51.4. The high share of cash in the transactions recorded signals that cash remains the payment instrument of choice for low-value payments. Moreover, while the transaction share of cash is high, the share of cash in overall payment values is much smaller: Whereas 82% of all payments were in

Cash versus noncash payment shares in 2011 and 2016

Table 1

in %

	Value shares		Volume shares	
	2016	2011	2016	2011
Cash	65.0	73.2	81.8	85.9
Debit card	17.3	15.6	10.9	9.5
Credit card	6.1	5.6	2.7	1.9
NFC contactless	0.8		1.2	
Direct debit payments/transfers	8.2	4.2	1.7	1.5
Internet/mobile	1.9	0.2	0.8	0.2
Other	0.7	1.2	0.9	1.0

Source: OeNB (2011 and 2016 payment surveys).

Note: The table shows the share of the relevant payment instruments as a percentage of the overall payment volume and value that the survey respondents recorded in the seven-day (2011) and in the three-day payment diary (2016). Person-to-person payments were excluded. A breakdown of how those shares were compiled is given in the annex.

cash, these payments accounted for only 65% of the total transaction value.

On the other hand, in Austria cash still accounts for a surprisingly high share of payments over EUR 100. Chart 1 shows the shares of payment instruments by value categories. Cash accounts for 92% of all payments up to EUR 10 and still holds a 47% share of payments higher than EUR 100. As for the share of card payments, it rises in tandem with the payment amount and becomes significant at a volume of about EUR 50. This pattern is in line with expectations.

Consumer preferences provide an important explanation for the high degree of cash use: Consumers simply choose their favorite payment method. To confirm this assumption, the OeNB's 2016 payment diary survey included a question on the preferred payment method in stores, hypothetically assuming that respondents

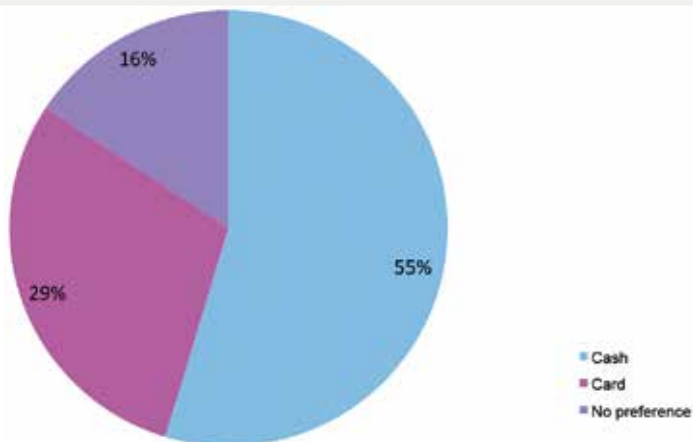
had sufficient cash in their wallets and that cards were definitely accepted.

Slightly over half (55%) of the respondents stated that cash was their preferred payment instrument; an additional 30 % favored payment by card. The remaining 16% did not express a preference. A comparison of actual payment behavior (as recorded in payment diaries) with the stated preferences confirms that the survey responses are consistent with the declared preferences. This result signals that the high share of cash payments in Austria can indeed be largely attributed to consumers' preferences, which in turn can be at (least partly) explained by how positively they perceive cash compared to other means of payment.

Chart 2 illustrates in how far cash, debit cards and credit cards fulfill the most important properties of a payment instrument by showing the percentage of

Preferred payment instrument if given a free choice

Chart 1



Note: This chart indicates the percentage of respondents who reported that they had a preference for either cash or cards or for neither payment instrument when paying in a store.

Source: OeNB 2016 (payment survey).

respondents who agree that the respective feature is “very much” or “much” fulfilled. No matter what feature you look at, be it that the payment is easy, fast and efficient, that you don’t have much hassle in case of fraud or theft, or that the given means of payment keeps you from spending more than intended, cash always receives better ratings from respondents than debit cards or credit cards.

Nevertheless, cash faces ever-increasing competition from alternative payment instruments, ranging from debit and credit cards to credit transfers, as well as payment instruments such as electronic and mobile payments and even virtual currencies. All these instruments challenge the payment function of cash. Despite this evolution, the demand for banknotes and coins has continued to grow at a significant pace around the world. Cash has numerous other attributes beyond payments.

In how far do cash, debit cards and credit cards fulfill the desired properties of a means of payment?

Chart 2



Note: The chart shows in how far cash, debit cards and credit cards fulfill the most important properties of a payment instrument. The chart shows the percentage of respondents who considered the respective property as „very much” or „much” fulfilled. For „acceptance”, it was assumed that cash „very much” fulfills this property. Source: OeNB Barometer Q3/2016.

Cash benefits

As already mentioned a longer-term view on cash demand reveals that cash is surprisingly resilient and plays an essential role in emergencies. One reason is that large financial crises lead to a surge in demand for cash and cash serves as a safe asset in times of uncertainty. The cash cycle has demonstrated its robustness and resilience in times of natural and man-made disasters.

Cash has a legal tender status, is a store of value, is faster, simpler, and more cost effective.

Furthermore, it is a contingency and fallback solution.

Cash provides an area of freedom, where people can transact and protect their privacy. In a society where big data is leading to the increasing transparency of personal information, anonymity is becoming scarcer and more valuable.

Cash gives consumers better control of their budgets as they can actually see how much money they have at their disposal. It is a real-time payment instrument and does not involve payment risk or credit risk.

Furthermore, cash is an increasingly secure payment instrument, as illustrated by the declining levels of counterfeit currency in most markets. Indeed, it is statistically much more likely to become a victim of card fraud than to come into possession of a counterfeit banknote. According to Deutsche Bank research, in 2013 in the Euro area, there was one counterfeit banknote in about 24,600 but one fraudulent transaction in 5,300 card payments.

Strengthening the faith not only in the economy but also in the currency is important.

Cashless instruments and innovation

At present, cash payments still constitute the majority of retail payment transactions although many innovations have appeared during the last couple of years. In some EU countries, a marked decrease in the number of cash payments has been observed, but the notion of full replacement of cash by electronic means of payments is still remote even in these economies. The Eurosystem is neutral with regard to the use of cash and non-cash payment instruments in the capacity of its official and sole issuer.

An almost cash-less (in terms of the share of cash payments in all retail payment transactions) society is not beyond imagination over the very long term but this would have to be induced by market participants (consumers, businesses and merchants) and should not be the result of central banks' or Member States' policies.

In Austria, the most used cashless payment instruments (in numbers) are payment cards (38%, mostly debit cards), followed by credit transfers (34%) and direct debits (28%). The number of credit transfers and direct debits remain stable over the last years; the use of payment cards has increased continuously. Checks are hardly used in Austria and the numbers are decreasing constantly.

The euro retail payments market is characterized by active innovation in recent years and this activity is expected to further accelerate in the coming years due to the technological, societal and economic changes related to digitalization and due to a legislative environment, which will allow market entry by non-traditional (non-bank) providers. Digitalization and in particular the fast technological development and social diffusion of real-time information and transaction services makes user expectations also more demanding towards payment services, in particular with regard to user convenience and speed of execution. This user demand and the nature of the available technologies seem to foster the entry by non-traditional

service providers into the retail payments market. The two most salient groups of such new entrants are the financial technology ('FinTech') companies - often 'start-ups' and large internet platform companies (e.g. Google, Facebook, Microsoft, Amazon, Apple). These and other new entrants tend to focus on the customer relationship and on payment initiation while relying on payment accounts held with traditional payment service providers and relying on traditional interbank payment schemes in the back-end. Hence, traditional payment service providers (mostly banks and other credit institutions) are likely to be challenged in retaining the relation and the frequent interactions with their customers in payment services, which (via the ability of cross-selling products) is an important source of revenue in banking.

Innovation in retail payments brings significant improvements in efficiency and contributes to economic growth. As a catalyst, the Eurosystem has contributed to a great extent to a robust, technology-neutral EU legal framework embodied in the Payment Services Directive (PSD) which has been reviewed and amended as of January 2016 and will enter into force as of January 2018. PSD fosters innovation and competition by – inter alia – supporting the market entry of non-traditional service providers and a set of requirements, which is proportionate to the risks of services, provided. However, as innovation moves fast, the Eurosystem and EU lawmakers have to be vigilant and constantly reassess the appropriateness of the regulatory framework to ensure that end-users can benefit from technological development to the greatest possible extent in retail payments.

Some market participants as well as NCBs have raised the idea of using new technologies (e.g. DLT) to issue central bank currency in electronic form directly to payment service users. The Eurosystem has currently no plans to issue digital euros directly to payment service users (i.e. in e-money or cryptocurrency form), but closely monitors the use of DLT by market participants and analyses the impact and the potential of the application of this new technology in financial services.

Current trends in retail payment innovation do not seem to significantly affect monetary policy implementation. 24/7/365 instant payments becoming the norm for retail payments might induce changes to the way money markets operate over the longer term but major changes are not expected even in this case. The use of virtual currencies do not seem to grow at a pace that would pose any measurable effect on monetary conditions. Furthermore, as long as DLT is deployed by existing financial service providers instead of replacing them the scope for its knock-on effect on monetary policy implementation is very limited.

Central banks

The objectives of the central bank in terms of cash supply are based on security quality, efficiency and confidence.

It is typically part of the central bank's mandate to supply banknotes. This service is carried out in the best interests of the public.

The precise objectives of the central bank in terms of cash supply vary from country to country, but they are generally based on four principles:

- Security: banknotes should be difficult to counterfeit.
- Quality: notes, which are no longer fit for circulation, are withdrawn and destroyed;
- Efficiency: the overall cost of the issue and circulation of notes should be kept to a minimum;
- Confidence: the public should have a high level of trust in its banknotes.

Automation and standardization - Austria

The Eurosystem is making a clear commitment to the future of cash and monitors the cash cycle in the Euro Area. It aims for further increase of its security and efficiency. An important consideration is the permanent enhancement of automation and standardization in the cash cycle.

In Austria, the Geldservice Austria GmbH (GSA) is a joint venture of the Austrian banking community and the Austrian Central Bank (OeNB), responsible for cash management and transport coordination. The OeNB as majority owner holds more than 90% of the shares, the remaining shares are owned by more than 40 Austrian commercial banks.

GSA performs and supports the cash circuit in Austria and has a substantial part in the cash logistics supporting the business of Austrian banks and ECB cross border activities. GSA focusses on quality and security – preservation of price stability via permanent process optimization.

This Public Private Partnership between the central bank and commercial banks has made it possible to achieve economies of scale in cash handling, thus enabling both the commercial banks and the OeNB to reduce costs.

GSA is the leading company in cash management holding the biggest market share within Austria but also offering its services to neighboring countries.

In order to be able to satisfy customer needs in the best possible way, GSA offers the processing and the logistic distribution of banknotes, coins and other values in the highest possible quality, cost-effective, within the shortest possible time and within the servicing borders.

In order to make sure that our currency system is stable, security is the number one issue. Our customers will only trust means of payment when they know that they are secure.

In order to be „fit for the future“, the GSA initiated its „Cash 2020“-project. Optimizing processes through automatization is one of the key aims of this project.

In particular, technology and innovation are important drivers to reach higher productivity.

The NotaTracc solution – a standard for cash cycle logistics

The strategic partner Giesecke & Devrient has complemented its high-speed processing systems BPS M7 with NotaTracc, a standardized industrial solution for the increase of automation and standardization in the cash cycle. NotaTracc specifically targets central banks, large commercial banks, cash in transit operations and casinos.

A multifunctional system can be used in cash rooms, cash centres and during all process steps of the cash cycle.

The BPS M7 machine is the new generation and the benchmark for cash processing in state-of-the-art cash centres. The processing rate is up to 120.000 banknotes per hour (=2.000 banknotes per minute).

Before NotaTracc the operating staff at the processing system had to manually stack, align and insert loose banknotes into the system. This slowed down the process, and the staff had to continuously feed the system to achieve a high throughput, and, eventually, limited the system's productivity. The manual loading also left room for error and security hazards.

NotaTracc loading module is positioned in front of the BPS M7. NotaTracc is not a feeding module, it's a part of a complete system for maximum productivity. The tray is only opened before it is inserted into the loading module – with a seamless material and data flow for the highest efficiency. NotaTracc trays have a unique identification number on the label and barcodes for tracking. They can be locked with a transparent cover and a seal for secure transactions.

The impact on productivity is impressive. Because of the continuous automated loading, the processing systems achieved consistent maximum throughput, which had not been possible before.

The best business cases are those with NotaTracc: high throughput per hour and low operating effort – less FTEs. Rejects always depend on the quality of bank-notes.

The BPS M7 NotaTracc multi denomination was installed at the end of January 2017. We can see a continuous and stable improvement due to learning effects.

Currently GSA owns one M7 multi-denomination with NotaTracc and one M7 mono-denomination with NotaTracc.

Conclusion

There is an increase in demand for cash. This leads to an increase in cash processing. It requires an increase in technical efficiency and productivity and leads to an increase in the efficiency of the cash cycle.





Bram Scholten¹

Decline management: the case of cash Policy response in the Netherlands and the Nordic countries



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Abstract

The Netherlands and the Nordic countries are faced with a rapid decline in the use of cash. Sooner or later, they will be confronted with the question whether cash remains necessary as well-functioning means of payment for POS transactions. This paper focuses on how this issue is addressed in the Netherlands and the Nordics, based on answers to a detailed questionnaire submitted to the central banks of these countries, covering the three main elements of the well-functioning of cash: paying in cash, drawing cash from, and lodging cash in one's bank account.

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All central banks seem to believe that at least for the foreseeable future, cash remains needed as well-functioning means of payment. Leaving legal issues aside, main arguments are that for part of the population, use of electronic payment instruments is not, or not always, possible or desirable. In addition, cash functions as fall back in case of temporary breakdowns in the functioning of, or trust in, the electronic payment system. In Norway and the Netherlands, this view seems shared by the government and society at large. As far as Denmark, Finland and Sweden are concerned, a broad consensus and a general policy to ‘manage’ the decline of cash have not or not yet materialized.

Once authorities and society at large are convinced that cash remains needed as well-functioning means of payment, it has to be determined whether, and if so which, specific action is required to keep cash well-functioning as means of payment. In this respect, unlike the market approach (at least so far) favored in Sweden, Norway and the Netherlands adopted a pro-active approach, with the idea that it is easier to prevent unwelcome developments than to correct them once they have occurred. In the Netherlands, agreement has been reached on a cooperative approach.

Introduction and acknowledgement

In parallel with the increasing use of electronic payment instruments in point of sale (POS) payments, cash usage in the Netherlands is declining. The number of ATM locations is also declining. Against this background, the Netherlands National Forum on the Payment System set up a taskforce to consider and advise on the future role of cash as means of payment in POS payments (see attachment for a summary of the taskforce report).

This taskforce was aware of the fact that the shift from cash to electronic payments in the Nordic countries has advanced further than in the Netherlands. The task-

force was therefore interested in knowing how these countries (in particular Denmark, Finland, Norway and Sweden) have addressed this development so far. Accordingly, the taskforce drew up a detailed questionnaire, with questions grouped around three themes: the use of cash as means of payment in POS transactions, the withdrawal of cash from payment accounts and the depositing of cash in payment accounts.

This paper draws on the answers to the questionnaire that have been received from the central banks of Denmark, Finland, Norway, Sweden and the Netherlands (hereafter: 'the central banks'). The author would like to thank his colleagues in the cash departments of these central banks, without whose generous support this paper could not have been written. However, the author does of course bear full responsibility for any omissions or errors.

The focus of this paper is on the functioning of cash as means of payment for POS transactions in Denmark, Finland, the Netherlands, Norway and Sweden. The scope of this paper does not cover the use of cash for hoarding purposes, nor the use of cash as means of payment for the settlement of transactions that are not POS transactions. The functioning of cash as means of payment for POS payments can be considered to comprise the following three elements:

- a. The payment itself, from consumer to business/retailer.
- b. For consumers: the withdrawal of cash from their own payment account.
- c. For businesses: the deposit of cash in their own payment account.

Accordingly, this paper is organized around these three constituent elements of the functioning of cash as means of payment.

1 Cash use and cash acceptance in point of sale payments

Data on cash use

Table 1 shows some comparative figures on the use of cash. In terms of value, the use of cash seems to have declined the most in Norway, where the value of cash withdrawals (at ATMs and via cash back transactions at POS terminals) declined between 2010 and 2015 from 22 % to only 14 % of the combined value of cash withdrawals and card payments at POS terminals (taken together as proxy for the total value of POS payments). This is (less than) half the share of cash withdrawals in Denmark, Finland and the Netherlands, at 32 % 28 % and 31 % respectively.

Contrary to data on values (based on banks' accounting records), data on the number of cash transactions are estimates. Such estimates are only available for the Netherlands and Sweden, but the data for these countries cannot be compared, due to differences in estimation procedures. Unfortunately, data on the number of cash transactions are very sensitive to the estimation procedures used.² Nevertheless, for both the Netherlands and Sweden, the 2016 data are based on broadly the same methodology as the 2010 data, and therefore, on a country-by-country basis, the 2016 data can be compared to the 2010 data. From these data, it is clear that in both countries, the use of cash in terms of the number of transactions has also been declining quite rapidly, particularly in Sweden.

2 Jonker, N. and Kosse, A. (2013) 'Estimating cash usage: the impact of survey design on research outcomes', *De Economist* 161, page 19-44.

Payment indicators (2015)					Table 1
	Denmark	Finland	Netherlands	Norway	Sweden
Number of POS card payments per inhabitant	275	209	192	335	242
Share of cash (in %) in combined value of ATM cash withdrawals and card payments at POS terminals 2010/2015	32/20*	31/28	37/31	22/14**	29/18
Share of cash (in %) in total number of POS payments	–	–	65/45	–	40/16

Data: ECB, Statistical Data Warehouse and Norges Bank, 'Developments in retail payment services – 2015' Norges Bank Papers No. 1, 2016
 * Danish Payments Council, Report on the role of cash in society, 2016
 ** Including cash withdrawals via cash back.
 *** Estimation procedures not comparable between countries. Source: De Nederlandsche Bank /Betaalvereniging Nederland, 'Factsheet point of sale payments 2016', April 2016 and Riksbank, 'The payment behavior of the Swedish population', 2016

Legal situation regarding refusal of cash payments

In Denmark and Norway, national legislation prescribes the mandatory acceptance of cash in POS transactions with consumers in most cases.³ In Denmark, the government has proposed relaxing this obligation by providing that it does not apply from 10 p.m. to 6 a.m.

In Finland, the Netherlands and Sweden, contractual freedom is generally considered to prevail. Accordingly, the exclusion of cash can be part of contracts involving the sale of goods and services. In general, when a 'cards only' clause is used, it is

³ Denmark: Section 56 of the Payment Services Act. The Danish cash rule does not apply to sales in unstaffed self-service environments. Norway: Section 38 of the Act on Financial Contracts and Financial Assignments.

not individually negotiated with the customer, but included in the general conditions used by the seller of the goods or the provider of the service (often indicated at the entrance to the premises of the seller or service provider). However, in the case of contracts between businesses and consumers, as in other EU member states, such a clause is unfair and not binding if, contrary to the requirement of good faith, it causes a significant imbalance in the parties' rights and obligations arising under the contract, to the detriment of the consumer (articles 3 and 6 of Council Directive 93/13/EEC of 5 April 1993 on unfair terms in consumer contracts). Therefore, if a 'cards only' clause were to cause such significant imbalance, it would not be binding. This could for instance be the case when a consumer who needs to pay in cash cannot find a nearby alternative supplier for the same service or goods that does accept cash.⁴

In addition, in the case of Finland and the Netherlands, EU legislation prescribing that euro banknotes and coins have legal tender status in these countries, may have as yet uncertain consequences. Among euro area member states, views differ on the implications of legal tender status for the acceptance of cash (obligatory or not), and the European Court of Justice has not yet been called upon to provide a preliminary ruling on the interpretation of the notion of legal tender. It may be inclined to follow the view of the European Commission that the acceptance of cash in retail transactions should be the rule and a refusal only possible for reasons related to the 'good faith principle' (for example that the retailer has no change available).⁵

Furthermore, some questions remain regarding the extent to which national legislation may restrict the use of cash to settle POS transactions. According to

⁴ See Scholten, A.A. (Bram) (2015) 'Paying in cash, favor or right?', *Nederlands Juristenblad*, 27 November 2015, nr. 41, page 2870 – 2876. In Dutch, English translation available upon request to the author.

⁵ Article 3 of Commission Recommendation of 22 March 2010 on the scope and effects of legal tender of euro banknotes and coins (2010/191/EU), *PbEU L 83*, 30 March 2010.

preamble 19 of EU Regulation 974/98, limitations on payments in notes and coins, established by euro area member states for public reasons, are not incompatible with the legal tender status of euro banknotes and coins as long as other lawful means for the settlement of monetary debts are available. This provision is quite generous, but, as noted by the ECB in a number of legal opinions, such limitations should be proportionate to the objective pursued and should not go beyond what is necessary to achieve this objective.⁶ Also in this respect, ultimately the European Court of Justice is the competent authority to determine how this provision should be interpreted.

In this respect, it is worth noting that in Sweden, some courts have restricted the possibility for excluding cash as means of payment for certain public services.⁷

Refusal of cash as means of payment for POS transactions still rare

The answers received from the national central banks indicate that the acceptance of cash in POS transactions is still the rule in all countries. However, in most countries, cash payments are often not possible at parking meters and some petrol stations, as well as in parts of the public transport system. Refusal of cash in face-to-face situations seems to remain quite rare. In a survey commissioned by the Riksbank, 70% of respondents indicated having never encountered a situation where they could not pay with cash in a shop.⁸ And in a survey commissioned by DNB for the Netherlands National Payment Forum, 82% of the respondents indicated never having encountered a face-to-face situation where it was not possible

⁶ See e.g. ECB Opinion of 10 May 2012 on limitations on cash payments (CON/2012/37) and ECB Opinion of 18 March 2013 on the limitation of cash payments (CON/2013/18).

⁷ Svea Court of Appeal's decision on 11 March 2011 in case OA 1269-11, the Administrative Court of Appeal in Sundsvall's judgment on 5 June 2013 in case no. 852-12 and the Administrative Court of Appeal in Jönköping's judgment on 23 April 2014 in case no. 3636-13.

⁸ See Riksbank, 'The payment behaviour of the Swedish population', 2014 version.

to pay in cash.⁹

Legal provisions that limit the use of cash for certain amounts

Both Denmark and the Netherlands have legislation banning the use of cash in certain cases. But so far, only Denmark has a legal ceiling for the amount that can be paid in cash (as do countries such as Belgium, France, Italy and Spain).¹⁰ However, this would change if the EU decides to introduce such a ceiling, as currently contemplated by the European Commission.¹¹

Motives for refusing cash payments

As far as motives for the refusal of cash are concerned, security concerns are mentioned, in particular the limitation of vandalism in unmanned situations. But also efficiency (cost savings) is mentioned as a motive for banning the use of cash.

Reaction of the public

Because the refusal of cash in POS payments is still so rare, it is difficult to generalize about public attitudes to the refusal of cash. Mostly, people seem to take it in their stride when they cannot use cash in a situation where they would like to do so. However, occasionally, complaints have been heard. In Sweden, in a recent survey commissioned by the Riksbank, 31 % of the respondents reported a negative attitude about the declining use of cash.¹² In the Netherlands, in a recent survey, 71% of the respondents indicated that they felt that cash should always be accepted for POS payments, while only 14% of those who had encountered a

⁹ Maatschappelijk Overleg Betalingsverkeer, Bereikbaarheidsmonitor 2016, page 46 (see <http://www.dnb.nl/betalingsverkeer/maatschappelijk-overleg-betalingsverkeer/publicaties-mob/index.jsp>)

¹⁰ In Denmark, Section 2 of the Money Laundering Act provides that business operators may not receive cash payments of DKK 50,000 (EUR 6,700) or more.

¹¹ European Commission, 'Proposal for an EU initiative on restrictions on payments in cash. Inception impact assessment', January 2017. http://ec.europa.eu/smart-regulation/roadmaps/docs/plan_2016_028_cash_restrictions_en.pdf See also Consultation EU initiative on restrictions on payments in cash: https://ec.europa.eu/info/content/eu-initiative-restrictions-payments-cash_en

¹² See Riksbank, 'The payment behaviour of the Swedish population', 2016 version.

situation where cash was refused, had no problem with that.¹³

Attitude of the authorities

Official views on the future role of cash and the refusal of cash in POS payments differ. In Norway, the proper functioning of cash as means of payment for POS transactions is underpinned by legislation. On the one hand, as noted above, the acceptance of cash in POS transactions is mandatory in Norway (with a special regime for exceptions), while on the other hand, as from 2016, to the extent expected and needed by their customers, credit institutions are legally obliged to offer facilities to withdraw cash from payment accounts and to deposit cash in payments accounts.

In the Netherlands, the same objectives are pursued in a cooperative approach by the main stakeholders (i.e. consumers, retailers and credit institutions), as agreed in the National Payment Forum. It believes that it is essential that cash continues to function well as a means of payment, in the sense that cash is almost universally accepted as means of payment for POS transactions, that it is generally easy to withdraw cash from one's own payment account and that for retailers, it is relatively easy and affordable to deposit cash in their own payment account. This is considered particularly important for people who do not have a debit card or who are temporarily or permanently unable to use one, people with a visual impairment, as well as for people who live on a cash budget in order to have a better overview of and control on their expenditures. Furthermore, the Forum recalls the needs of young people (aged under 14) and of those who have a justified wish to pay anonymously.

Last but not least, the National Payment Forum considers it imperative for the

13 Maatschappelijk Overleg Betalingsverkeer, Bereikbaarheidsmonitor 2016, page 46 (see <http://www.dnb.nl/betalingsverkeer/maatschappelijk-overleg-betalingsverkeer/publicaties-mob/index.jsp>)

stability and shock-resistance of the point-of-sale payment system that cash continues to be a fully functioning means of payment, because cash is the alternative of last resort if the electronic payment system should be temporarily out of action for any reason.¹⁴

In the other three countries, the desirability of the continued proper functioning of cash is generally recognized by the central banks concerned. In Finland, the central bank has confirmed this position in a press release, but so far, further measures have not been deemed necessary. In Sweden, the role of cash is currently a matter of public and parliamentary debate, but the Riksbank has advised the government to provide for legislation that obliges banks to offer cash withdrawal and cash depositing facilities in accordance with their needs.¹⁵ In Denmark, however, the central bank has made it known that it would prefer lifting the cash rule rather than relaxing it as presently proposed by the government (lifting the cash rule between 10 p.m. and 6 a.m. the following day).¹⁶

Mobile alternative for use of cash in P2P payments

Commercial banks are gradually introducing apps that allow direct mobile and often real time person-to-person (P2P) payments that can function as substitute for cash also in P2P payments. In Denmark, two mobile payment solutions are available. They both offer P2P payments. One is MobilePay, which is a mobile app from the largest bank in Denmark, Danske Bank, but also available to customers outside the bank. MobilePay was launched in 2013 and is used regularly by about half of the population (2015 data). Technically, the solution consists of a card payment from the payer to Danske Bank and a subsequent credit transfer from Danske Bank to the payee. The credit transfer is cleared within seconds in the Danish system,

¹⁴ See the attached summary of the National Payments Forum's report.

¹⁵ See Riksbank, 'Introduce a legal requirement for the banks' cash service', press release, 16 March 2016.

¹⁶ Danmarks Nationalbank, letter to the Ministry of Finance, 3 February 2017 (only in Danish).

Instant Payments. The other solution is called Swipp and is a joint solution offered by almost all other Danish commercial banks. It is based on a credit transfer cleared via Instant Payments.

In Norway, in 2015 the person-to-person payment solution VIPPS was introduced by Den Norske Bank, Norway's largest bank. In 2017 VIPPS will be spun off as an autonomous company, in which more than 100 other Norwegian banks will hold 48% of the shares.¹⁷ So far, VIPPS has been downloaded by approximately 40% of the population.

In Sweden the ten largest banks jointly launched 'Swish', which provides for real time payments. Swish, launched in 2012, has gained general acceptance very quickly, making it a real substitute for cash in P2P transactions. In a recent Riksbank survey, 52 % of the respondents answered having made payments using Swish in the past month.¹⁸

The major banks in the Netherlands cooperate in the construction of a new infrastructure that will allow mobile instant payments across all banks by May 2019.

2 Withdrawal of cash from own payment account

Availability of ATMs

The number of ATMs per 10,000 inhabitants varies between 2.8 and 4.7 (table 2, 2015 figures). Finland and Sweden are at the low end of this range, with 2.8 and 3.3 ATMs per 10,000 inhabitants. In the case of Finland, this relatively low number is the result of the gradual integration of the ATM networks of the three major banks into one common single network, after the establishment of their joint

¹⁷ Press release Den Norske Bank 13 February 2017.

¹⁸ See Riksbank, 'The payment behaviour of the Swedish population', 2016.

venture Automatia.

More recently, the five largest banks in Sweden also integrated their ATM networks into a single network, owned by their joint venture Bankomat.

In all countries surveyed, some of the ATMs are operated by non-banks. In all countries, ATMs are located in or near the branch offices of banks, but also at so called 'off premises' locations. In Finland and the Netherlands, most ATMs are at such off premises locations.

Most countries also report that the number of ATMs is declining. In terms of the number and the value of cash withdrawals, Sweden stands out as having the lowest number and value of ATM withdrawals on a per capita basis.

Data on ATM (2015)

Table 2

	Denmark	Finland	Netherlands	Norway	Sweden
Number of bank/non-bank ATMs	2,540/14	1,474/72	7,004/900	2,033/300	2.285/550
of which "off premise" ATMs (in %, 2014 data)	–	70/100	64/100	–	45/100
Change in the number of bank ATMs 2010 – 2015	- 12%	- 11%	- 12%	- 11%	–
Number of ATMs per 10.000 inhabitants	4.5	2.8	4.7	4.5	3.3
Number of ATM/ cash back withdrawals per inhabitant	–	25.0	20.7	10.5/8.0	15.3
Value of ATM/cash back withdrawals per inhabitant (EUR)	.–	2,482	2,761	1,896/408	1,627

Data: ECB Statistical Data Warehouse and Norges Bank, 'Developments in retail payment services – 2014, rev.'

Norges Bank Papers No. 1, 2015

Finland: number of ATMs provided in the response to questionnaire.

The role of cash back transactions

Cash back transactions (using a card payment at a POS terminal to pay a higher amount than required in order to receive the difference in cash) are a widely used and important method to withdraw cash from one's own bank account in Denmark and Norway, and to a somewhat lesser extent in Sweden.

In Finland and the Netherlands, although increasing, cash back transactions are still at a low level. Nevertheless, in the Netherlands, in a recent survey among retailers, over 58% of the respondents indicated to be prepared to allow cash back transactions on request.¹⁹

In Finland, the central bank would welcome cash back transactions becoming more popular, as an alternative distribution channel and as a way to lower the societal costs of the use of cash.

Minimum number of ATMs needed for smooth cash cycle

None of the interviewed central banks was able to indicate the minimum number of ATMs that would be required to allow cash to remain a generally used means of payment. In principle, as long as the distance between most people's homes, or where they do their shopping, to the nearest ATM is not by itself a deterrent to their use of cash, this seems assured. However, it proved difficult to say when the distance to the nearest ATM by itself becomes a deterrent to using cash in payments. The popularity of cash back as an alternative method to withdrawing cash from one's bank account is also a relevant factor in this context: the more popular cash back, the longer the acceptable distance to the nearest ATM.

¹⁹ DNB, Factsheet 'Cash - retailers' behaviour and perception', April 2015.

ATM withdrawals: free of charge or not?

In all countries, for private clients withdrawals from ATMs of their own bank are free of charge. However, in Denmark and Norway, in general a fee is required for withdrawals from other ATMs. In Finland, the Netherlands and Sweden, ATM withdrawals are always free of charge for clients of the major banks.²⁰ In the Netherlands, this is the result of market forces. In Sweden, the competition authority requires that the banks that participate in Bankomat also do not charge their clients for withdrawals from other ATMs. Interestingly, in more or less similar circumstances, until 2015 the banks that participate in Automatia were allowed to charge their clients for withdrawals from non-bank ATMs, although their withdrawals from Automatia's ATMs were (and still are) free of charge. However, in December 2014, the Finnish Financial Services Authority determined that this was no longer accepted.

Merchant filled ATMs

ATMs operated by banks are practically always stocked by CIT companies.

In the Netherlands, non-bank ATMs account for about 10% of all ATMs in the country. They are almost always located in shops and usually, these ATMs are stocked by the retailer with cash from its tills. In Sweden, around 20% of the ATMs are merchant-filled.

Has the closure of ATMs (e.g. in rural areas) ever been an issue in parliament or in the media?

Apart from Denmark, all central banks report that the closure of ATMs has sometimes been an issue in the media and in parliament. In the Netherlands, already a number of years ago, parliament discussed a draft law that would make it mandatory for the banking system as a whole to pay for keeping service points in remote

²⁰ Recently, Finnish banks have started to limit the number of free of charge withdrawals.

areas. The banks reacted to this pressure (see below) and the draft has remained pending. In Norway, partly as a result of discussions around the closure of bank branches and ATMs, banks' responsibilities have been clarified in a law that came into effect at the start of 2016 (as described above).

Do banks use an explicit or implicit norm for the location of their ATMs?

Little is known about whether, and if so how, individual banks use norms for the location of their ATMs. However, Automatia does not close an ATM if the nearest ATM is more than 20 km away. In the Netherlands, as approved by the competition authorities, the major banks have agreed to prevent closure of the last ATM in a village if the next ATM is over 5 km away. In addition, in a case where the next ATM was over 5 km away, banks installed an ATM on a cooperative basis. In both countries, these location policies are the result of public and/or political pressure.

Are banks or other ATM deployers usually or sometimes paid for operating an ATM at a location that would otherwise not have an ATM?

In Finland, if an ATM doesn't meet Automatia's profitability requirements, it provides a local sponsor (a bank, retailer or in some rare cases even the community) with the opportunity to support the ATM in order to retain it. However, this concerns under 10% of all Automatia's ATMs. In Sweden, Bankomat receives payment for the operation of 1-2% of its ATMs. In the Netherlands, just a few ATMs are 'subsidized' in this way.

3 Depositing cash in own payment account

Banks' facilities to deposit cash in own payment account

In Denmark, Finland and Sweden, banks' branch offices still offer their account holders the possibility to deposit cash over the counter. However, this is generally no longer the case in the Netherlands and Norway, where it is only possible at a small number of branch offices.

The regular channel for depositing cash in one's own payment account, especially for retailers, is via night vaults and cash in machines (CIMs), sometimes also operating as ATM and then referred to as cash recycling machines (CRMs). Most of these CIMs and CRMs are inside or outside branch offices (not off premises). In most instances, clients can only deposit cash with their own bank. Contrary to what is customary for ATMs, banks in all countries have been very reluctant to open up their cash depositing facilities to clients from other banks. However, in the two countries where the banks have gained experience with the integration of their ATM networks into one common network of jointly owned ATMs, banks, as a second step, have become more willing to share depositing facilities. In Finland, where most night vaults and CIMs are still operated by the banks themselves, the over 100 night vaults and over 150 CRMs operated by Automatia can be used by clients from all Automatia's customer banks. As Automatia is steadily increasing the number of CRMs, a gradual shift is taking place towards depositing facilities that can be used by clients from all major Finnish banks. In Sweden, a similar development has started. Bankomat now operates more than 250 CIMs/CRMs, which can be used by clients from three of the five major banks. In addition, it should be noted that in Sweden, some of the night vaults operated by CITs are in practice open to customers of different banks.

Do banks use an explicit or implicit norm for the location of their depositing facilities?

In all countries, banks have their own policies regarding the location of their deposit facilities. The closure of such facilities is hardly ever a matter for media or political attention.

Fees charged to retailers for depositing cash

Data on deposit fees are hard to come by. In the Netherlands, fees are dependent on the value or the number of the notes. Typically, the lowest fee for a deposit of EUR 1,000 (34 notes) is around EUR 4, and EUR 8 for a deposit of EUR 5,000 (170 notes). In Sweden, banks or CIT companies may charge EUR 9 to EUR 12 for a deposit in a night vault.

Retailers' use of CIT companies for transportation of cash

In all countries, many retailers use the services of a CIT company to transport their cash. In general, this cash is transported by the CIT company to a cash sorting center.

The following configurations exist:

- a. The cash sorting center is owned by the commercial bank where the retailer has its payment account: the CIT company only acts as transport company. In this case, retailers mostly separately pay the CIT company for transport, and their bank for depositing the cash. This may be called the traditional model. It continues to have a role in the Netherlands.
- b. The cash sorting center is owned by a CIT company, but their handling and sorting takes place on behalf of the commercial bank where the retailer has its payment account: in its relation with the retailer, the CIT company only acts as transport and counting company. In this case as well, retailers mostly pay separately for the transport services of the CIT company, and for the services of

the bank for depositing the cash. This model is dominant in Denmark and also in Finland and Norway. In Finland and Norway, cash is first counted and sorted in the cash center on behalf of the commercial bank where the retailer has its account, and thereafter, ownership of all cash is transferred to the depot owned by (in Finland) Automatia viz. (in Norway) the commercial bank that 'sponsors' the cash center.

- c. The cash sorting center is owned by the CIT company that transports the cash, and the handling and sorting takes place on behalf of a commercial 'sponsor' bank that has a special relation with the CIT company (but not with the retailers that deposit the cash): in its relation with the retailer, the CIT company acts as transport company and also as agent of the sponsor bank. In this case, retailers tend to pay one all-in fee to their CIT company, for transportation, sorting and crediting. Nowadays, this model is dominant in Sweden and it also has an important role in the Netherlands.
- d. The cash sorting center is owned by the CIT company, and during and after handling, cash is temporarily owned by the CIT company; the retailer's payment account is credited from a payment account of the CIT company. In this model, the CIT company would need a license as payment institution (in accordance with the EU Payment Services Directive). Probably because of the costs of having such a license and the risk of this model to retailers, this model is no longer in use in the countries surveyed.

Which share of the retailers uses the services of a CIT-company?

Generally, the central banks do not have data on the share of retailers that use CIT transport nor on the share of retail turnover for which use of CIT transportation is made. In the Netherlands, in terms of numbers, most of the retailers do not make use of a CIT company. However, in terms of turnover, more than 50% of retailers' cash proceeds is transported by CIT companies.

Typical fees (transportation + sorting/crediting) for lodging cash using the services of a CIT company.

As mentioned before, data on fees or fee structures are hard to come by. In the Netherlands, a typical minimum all-in fee for the transportation and lodging of an amount of up to EUR 5,000 is EUR 16. In Sweden, one company has an all-in tariff of EUR 145 per month.

4 Other issues

Cooperative structures in the cash area

In all countries, cooperative structures play an important role in the functioning of the cash cycle.

In Denmark, Bankernes Kontant Service (BKS) was established in 2010 as joint venture between the central bank and a number of important commercial banks. BKS operates two cash centers. These cash centers provide cash processing and storage functions to both the central bank and the commercial banks. The main reason for the establishment of BKS was to implement the new and higher security standard (DS3999) agreed between the central bank, CIT companies and other participants (banks), and to distribute cash in areas where it was needed. As a result, the central bank closed most of its cash deposit locations and centralized its cash handling at two cash-centers in the biggest cities of the country, owned by Danske Bank viz. Nordea and both operated by BKS. BKS handles the commercial banks activities in the cash market (in addition to cash processing also the management of the replenishment and maintenance of the ATMs). Transportation was outsourced by BKS to the traditional CIT providers in Denmark, Nokas and Loomis, who at the same time were competing with BKS in cash processing. In 2016, BKS has been sold to Loomis.

In the Netherlands, the three major banks have combined their cash processing

and the organization of the servicing (filling and maintenance) of their ATMs/CIMs/CRMs and night vaults to a joint venture called Geld Service Netherlands (GSN), also established in 2010. The reason for the establishment of GSN has been that the realization of efficiency gains, as a means of allowing the major banks to continue providing the cash services demanded by the public and the retail sector at a reasonable cost.

In Finland, for the same reasons and as noted above, banks' cooperation has gone further, in the sense that the major Finnish banks have not only pooled their cash processing and the management of their ATM networks, but they also transferred the ownership of their ATMs to Automatia (established in 1994), allowing Automatia to create one efficient single ATM network with nationwide coverage. However, in contrast to the Netherlands, cash processing itself has been outsourced by Automatia to the international CIT companies that are active in Finland (Loomis and G4S).

In Sweden, as noted above, the five major commercial banks have transferred their ATMs to their joint venture Bankomat. Like Automatia, Bankomat outsources operational activities like transportation, sorting and ATM servicing to the traditional CIT companies, like Loomis. In addition, it should be noted that the same five commercial banks also cooperated in their joint venture Bankernas Depo AB (BDB), which in 2016 has been merged with Bankomat. BDB sells and buys cash to and from the central bank. In order to minimize the cash transactions with the central bank's cash center near Stockholm, BDB also keeps cash depots, at 16 locations all over Sweden. Operation of the cash depots is outsourced to the traditional CIT companies. BDB receives interest compensation from the central bank for its bank-note stocks.

In Norway, Nokas was founded in 2001 as a cooperative structure of the central bank and a number of commercial and savings banks. However, after a few years,

the central bank sold its share and later, all the other banks also sold their shares. Gradually, Nokas has developed into a full-fledged cash management and CIT company, active in several countries in Northern Europe.

Cooperative arrangements

Table 3

	Denmark BKS (until 216)	Finland Automatia	Netherlands GSN	Norway Nokas	Sweden Bankomat + BDB
Cash processing management	X	X	X	X	X
Cash transport and ATM servicing management	X	X	X	–	X
Cash processing operations	X	–	X	X	–
Cash transport and ATM servicing Operations	–	–	–	X	–
ATM ownership	–	X	–	X (in competition with banks)	X
Central bank participation	X	–	–	–	–
Central bank stocks	X	X	X	X	X
Central bank destruction	X	–	–	X	–

In Norway, Nokas fulfills several functions: transportation and processing of cash on behalf of commercial banks and retailers and management of private depots on behalf of commercial banks (like Loomis). In addition, Nokas has the management and custody of 4 (out of 5) cash depots of the central bank, and this function includes destruction of unfit banknotes. Finally, Nokas owns and operates 300

non-bank ATMs in Norway as well as over 500 in Sweden (in both countries through its subsidiary Kontanten).

These cooperative structures show a number of similarities, but also remarkable differences, as summarized in the table above. One similarity is that in all countries, banks have at some point integrated the management of their cash processing and ATM servicing in a joint venture (although usually, every bank kept its own service level agreement with the joint venture). However, to a large extent, these joint ventures outsource the actual operational activities to traditional, independent, internationally active CIT companies like G4S and Loomis. Apparently, the banks feel that by cooperating in the outsourcing of these operational activities (rather than outsourcing them on their own), they can increase their cost savings. It is only in the Netherlands that actual cash processing activities are not outsourced by the joint venture and kept under direct control of the banks. In Norway, Nokas is a special case, as it has developed from a joint venture of the banks into an independent CIT and cash management company that carries out all these operational activities itself and even competes with the banks in the area of ATMs, through its subsidiary Kontanten.

It is also noteworthy that in all countries, notes held to order systems have been introduced or systems with a similar financial effect, allowing the central bank to reduce its number of cash centers and its own operational activities. In this context it should also be noted that in all countries, the central bank encouraged the cooperative approach, in Denmark and Norway in the most formal sense as co-founder and initial shareholder of a joint venture that also takes care of the destruction of unfit banknotes, which is typically a central bank responsibility.

So far, only in Finland and Sweden have banks transferred their ATMs to a joint venture.

It is likely that many of the differences in the cooperative approaches can be explained by special national circumstances. For instance, the creation of common integrated networks of ATMs in Finland and Sweden was probably facilitated by the fact that for consumers, withdrawals from ATMs owned by other banks were already free or charge, while the market was dominated by a few major banks, with more or less comparable market shares. Seen from this angle, the Netherlands may be the next candidate for the establishment of one integrated ATM network.

Attitude of the competition authorities

In the case of Nokas, BKS, GSN and Bankomat, the competition authorities were already consulted at the time of their establishment, and care was taken for the banks not to infringe on competition law. This was also the case for the recent initiative of the major banks in the Netherlands to cooperate in respect of a pilot project that aims to place an ATM in rural areas that do not have an ATM nearby.

In the case of GSN, the position of the competition authorities was challenged in court by Brink's Company, but without success.

In the case of Automatia, the competition authorities were not involved at the time of its establishment (many years before the establishment of Nokas, BKS, GSN and Bankomat). However, nowadays, Automatia is scrutinized by the competition and the financial markets authorities, and on three occasions, in 2004, 2008 and 2014, Automatia had to adjust its policies as directed by them.

In general, it can be concluded that (EU) competition law offers enough room to allow cooperative arrangements that contribute to the continued provision of cash services that society demands, at reasonable costs and with sufficient security.

Exchange of views among the major stakeholders

Denmark, Finland, the Netherlands and Sweden all have a formal forum for the

exchange of views among the major stakeholders in the cash cycle, i.e. consumers, retailers and banks (Norway has a cash forum with more limited participation). However, it is only in the Netherlands that this forum has agreed on a clear policy vis-à-vis the future role of cash (see Annex). In Denmark, the Danish Payments Council did issue a report on the role of cash in society, but it was unable to come to a consensus view on the future of the Danish cash rule.²¹

View of the major stakeholders

All central banks report that to date, consumers and retailers are mostly satisfied with the functioning of the cash cycle, with some concern about cash service levels in rural areas. However, in several if not most countries, the banks would like to further reduce the use of cash as due to competitive reasons, they are not able to recover their costs in the cash area.

5 Concluding observations

In all countries that are the subject of this survey, the use of cash as means of payment for POS transactions is in decline. Nevertheless cash has by and large remained a well-functioning means of payment, in the sense that it is almost universally accepted in POS transactions, is relatively easy to withdraw from one's payment account, and for retailers is relatively easy and at a reasonable cost to deposit on their payment accounts. However, gradually the first signs have emerged that the proper functioning of cash cannot be taken for granted. In some instances, problems emerged when cash was refused as means of payment for POS transactions, and in particular in rural areas, the availability of facilities to withdraw or deposit cash from or to one's own payment account is no longer assured. The main question facing the authorities is: does this development require any intervention from their side, or can it be left to market forces?

²¹ Danish Payments Council, Report on the role of cash in society, August 2016.

Finding an answer to this question requires, as a first step, an answer to the question whether from the perspective of society as a whole, it is important that cash continues to be a well-functioning means of payment for POS transactions. If the answer is no, then there is no need for any public intervention. However, all central banks seem to believe that at least for the foreseeable future, the answer must be yes, in the sense that it is important that cash remains a well-functioning means of payment while there is demand for it. The main arguments supporting this view seem to be that for part of the population, the use of electronic payment instruments is not, or not always, possible or desirable. In addition, cash functions as a fallback solution in case of temporary breakdowns in the technical functioning of, or trust in, the electronic payment system. In Norway and the Netherlands, this view seems to be shared by the government and society at large. As far as Denmark, Finland and Sweden are concerned, a broad consensus and a general policy to 'manage' the decline of cash has not or not yet materialized. This may be partly explained by the fact that until now, cash continues to function well in these countries. But, in particular in Sweden, there may also be reluctance on the side of the authorities to interfere with market forces, although it should be noted that in 2016, the Governor of the Riksbank came out strongly in favor of the continued availability of cash services.

Once a broad consensus has emerged that the answer to the first question is yes, the next step is to determine whether, and if so what, specific action is required to ensure that cash continues to remain a well-functioning means of payment.

In this respect, unlike the market approach favored in Sweden, Norway and the Netherlands have adopted a pro-active approach, with the idea that it is easier to prevent unwelcome developments than to correct them once they have occurred. In Norway, a legislative approach has been followed, as laws have been adopted that ensure both the acceptance of cash in POS transactions, as well as the continued availability of facilities for the withdrawal and depositing of cash from/on

payment accounts according to customer demand. In the Netherlands, agreement has been reached on a cooperative approach. The major stakeholders in the cash cycle (retailers, consumers and banks) have agreed on the same objectives as pursued in Norway, and they have agreed to continue monitoring whether any specific measures are required in this respect. So far, the National Payments Forum has adopted general guidelines on the continued acceptance of cash and the major banks have developed a cooperative solution ensuring the continued presence of ATMs in rural areas.

Attachment

Report of the Netherlands Payments Forum task force on the future role of cash

November 2015

Summary and recommendations

The migration from cash to electronic payments is continuing steadily. In 2014, 53% of point-of-sale (POS) payments were settled in cash, compared with 65% in 2010. This trend is set to continue solidly as card payments become ever easier and faster and consumers become increasingly accustomed to using cards, encouraged by retailers and banks. In the years ahead, some cash payments may also be replaced by new payment methods.

This is gradually raising questions about the long-term role of cash. In response to these questions, the Dutch National Forum on the Payment System (Payments Forum) considers it desirable to formulate a clear vision for the future which is supported by and provides guidance to all parties represented in the Payments Forum. At its meeting of 26 November 2014, the Payments Forum appointed a task force with the remit of developing such a vision, taking into account both the needs of consumers and the needs of SMEs.²² This 'Vision on the role of cash in point-of-sale payments' is the task force's final report.

The first question that has to be addressed in developing a vision on the role of cash is how important it is that cash continues to function well as a means of payment for POS payments. In the task force's view, even in an environment where more and more electronic payments are being made, it is important in our society

²² Payments Forum press release dated 28 November 2014.

that cash continues to function well as a means of payment at points of sale, in the sense that retailers continue to accept cash payments, consumers can continue to withdraw cash easily from their bank accounts and retailers are able to deposit the cash they receive into their accounts with ease and at reasonable charges.

The task force believes it is essential that cash continues to function well as a means of payment in the first place because – and for as long as – some consumers still experience difficulty if they are unable to pay in cash. This is particularly important for people who do not have a debit card or who are temporarily or permanently unable to use it, people with a visual impairment, people who budget or whose budgets are set in cash and young people aged under 14, as well as in situations where people wish to pay anonymously. The task force also considers it imperative for the stability and shock-resistance of the point-of-sale payment system that cash continues to be a fully functioning means of payment, because cash is the alternative of last resort if the electronic payment system should be temporarily out of action for any reason. Although a great deal has been done in recent years to avoid disruptions in the electronic payment infrastructure and deal with them adequately when they do occur, calamities can never be totally avoided. It also has to be borne in mind that a breakdown in the physical point-of-sale payment system on a larger scale can have disruptive societal effects.

The task force also points out that for many people in our society, cash is still the only form of 'real' money.

The importance of the above aspects is difficult to quantify, but taken together they do in any event appear to give sufficient cause for caution in abandoning cash as a universal means of payment. This is all the more relevant since other countries have not yet gained any experience with this. Reference can be made to developments in Scandinavia in this regard. Although the transition from cash to electronic payment is considerably further advanced there than in the Netherlands,

Scandinavian society still attaches value to being able to use cash. The authorities in Norway took legal measures in response to this at a relatively early stage, while the need for adjustment in Sweden only became apparent when a number of problems began to appear in practice. Both countries have shown that, with a limited adjustment, cash can continue to function well as a means of payment even where it accounts for a substantially smaller proportion of point-of-sale payments.

The task force believes that the Payments Forum's vision on the future of cash in point-of-sale payments should therefore make clear how cash can continue to function well as a means of payment in the light of the continuing shift from cash to electronic payments. The task force advises the Payments Forum to leave it essentially to market forces to ensure that cash functions properly but to enforce adjustments whenever and wherever such proper functioning is at risk.

Viewed from the perspective of the three pillars on which the functioning of cash is based, the task force offers the following points for consideration.

Paying in cash

In general, point-of-sale payments can be made using cash. However, the investigation carried out by the task force suggests that a trend could emerge in which more and more retailers stop accepting cash payments. The task force believes that such a trend carries risks. If it should gather momentum, this could severely undermine the functioning of cash as a means of payment and engender social resistance.

The task force therefore advises the Payments Forum to give guidance at an early stage on how retailers should deal with the acceptance of cash in point-of-sale payments and the expectations that consumers may have in this regard. In princi-

ple, this could be achieved through supplementary Dutch legislation. However, legislation is relatively inflexible and does not sit easily with the tradition of the Payments Forum, which is based on working together to guide developments in the payment system.

Without intending to impose immediate policy changes on individual retailers with regard to accepting cash, the task force advises the Payments Forum to establish recommendations concerning the approach of retailers to the acceptance of cash in point-of-sale payments, whereby the Forum's stakeholders commit to promoting these recommendations among their own members. The task force advises the Payments Forum to adopt the following position:

- The Payments Forum considers it desirable that people have a choice between using cash and debit cards, unless retailers have specific reasons for not accepting cash, such as security reasons.
- Nevertheless, it supports joint initiatives by banks and retailers taken within the context of the Covenant on the Payment System aimed at promoting debit card payments without exerting coercion, in order to enhance the efficiency and safety of retail payments.
- The Payments Forum considers it unreasonably onerous for consumers if cash payments were refused in situations in which no other cash-accepting provider of a similar product or service is unavailable in practice.
- Furthermore, the Payments Forum understands that, in a legal sense, retailers are at liberty to choose which means of payment they accept, provided they clearly announce this in advance. Case law on this point is scarce, and ultimately it falls to the European Court of Justice to interpret the provision that cash is “legal tender”.

Consumers and interested organisations can go to court if they believe that a retailer's refusal to accept cash payments is unlawful. In other words, it is not just

retailers but also consumers and interested organisations that can influence the impact of these guidelines in practice. The legislature also reserves the right to consider further, more mandatory legislative measures.

In addition to the foregoing, it is advisable to periodically monitor trends in the acceptance of cash as a means of payment and public reactions to these trends. This will help prevent passing a point of no return unnoticed.

Facilities for withdrawing cash from one's own bank account

Given the undertakings made by the large banks concerning the installing of ATMs in areas where the public is unable or likely to become unable to withdraw cash from their own accounts within a radius of 5 km, the task force does not anticipate any problems in the foreseeable future concerning the accessibility and availability of cash for members of the public.

The task force does, however, advise the Payments Forum to continue monitoring the trend in the accessibility of ATMs on an annual basis, based on the percentage of the population living within 5 km of an ATM, possibly – depending on developments – supplemented with information on accessibility in urban settings, where people are more likely to have to walk to an ATM.

Based on experiences in Finland and Sweden with the amalgamation of individual bank ATM networks to create a single integrated network, the task force considered the potential implications of a similar form of partnership for the Netherlands. A key advantage of this form of partnership is that it could save costs without affecting accessibility, because it would still be possible for individual banks to have good national coverage with fewer ATMs. As experiences in Finland have shown, however, for the proper functioning of such a partnership it is still necessary to have one or more clear standards for the ATM placement policy, which are accept-

able both to the partner banks and to the public.

Naturally, the banks concerned will decide whether they wish to cooperate in this area, and if they do wish to do so, this must also be acceptable for the competition authority, the Netherlands Authority for Consumers and Markets (ACM). In Finland, and more recently in Sweden, both EU Member States whose competition laws are based – as they are in the Netherlands – on EU competition law, the competition authority has accepted this restriction of competition under certain conditions, in view of the efficiency gains to be achieved through the collaboration, which are considered to be essential in enabling cash to continue functioning adequately as a means of payment. It remains an open question whether and under what conditions this might also apply for the ACM.

The task force also considered whether the Payments Forum ought to develop initiatives to promote the use of cash-back services, because with these services it is not necessary to use expensive ATMs to deposit and withdraw cash. Since individual retailers take very different views on the desirability of cash-back, however, it was decided not to do this. Nonetheless, cash-back services are already available at many retailers and could in practice play a larger role if the number of ATMs should decline further.

Facilities for paying cash into one's own account and withdrawing small change

The task force currently sees no generic issues regarding the facilities available to retailers to pay cash into their own accounts and withdraw cash for use as small change.

Nonetheless, some retailers (usually smaller ones) who use bank cash deposit machines are concerned about the costs of doing so as well as about the security and

accessibility of the locations. This also applies to a lesser extent to the facilities for purchasing coins.

The task force advises the Payments Forum to continue monitoring developments annually in this area, too, on the basis of the following parameters:

- the percentage of retailers located within a radius of 5 or 10 km from a cash deposit facility (for users of these facilities, distance is just one of the relevant accessibility aspects; they are also concerned particularly about security and parking facilities);
- the commercial rates charged for depositing standard packs of banknotes (in values of EUR 1,000, EUR 5,000 and EUR 10,000), as published by the banks that offer this service;
- the number of bank branches where coins can be deposited and the fees charged by the banks for depositing and purchasing coins (the cash payment system cannot function properly without a good supply of coinage).

An important difference between ATMs and cash deposit machines concerns non-customer use. Non-customer use is not possible with cash deposit machines, whereas it is with ATMs and dispensers. In practice, therefore, maintaining national coverage of cash deposit machines means that the three largest banks in the Netherlands each maintain a national network of these machines. That is relatively expensive. Especially as the use of cash continues to decline, therefore, the number of locations where these machines are installed is likely to reduce further, and/or the fees for using them may be expected to rise sharply. If the development of the aforementioned parameters suggests that this is occurring, the task force believes this would call for measures.

In the first place, these measures might include facilitating non-customer use of these machines, a long-held wish of retailers. If non-customer use were to be facil-

itated, good national coverage could be achieved with substantially fewer machines. However, this would require far-reaching coordination of the banks' policy at an early stage, and the proposals would have to be submitted to the ACM. It may be that under these circumstances and on certain conditions the ACM would approve the merging of the banks' networks to create a single, joint network, which would then be configured as efficiently as possible. Machines would then be available for use by account holders of any bank. The individual banks would continue to set the fees to be charged for deposits by their account holders. Clear standards would also need to be applied in the placement policy if this form of collaboration was to be accepted.

The task force currently sees no problems for retailers having their cash collected by a cash-in-transit company, now that the danger of monopolisation in this market appears to have passed. The two nationally active CIT companies in the Netherlands have assured the task force that they intend to continue operating nationwide and offering cash services to their customers. The task force has the impression that the fees currently payable for this service are relatively low on an international scale. The task force does not expect any increases in fees of such an order that they could cause problems that call for measures.

Conclusion

The task force believes that, with the combination of market forces and partnership described above, the Netherlands is on the right track towards enabling cash to continue functioning well as a means of payment in the decade ahead, even in the light of a continuing shift away from cash payments to PIN-based and other forms of electronic payment.



Manjira Dasgupta

Moving towards “cashlessness” in an emerging economy: a case study of latest policy steps in India¹



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Abstract

On November 08, 2016, India took a decisive step towards going “cashless” by suddenly announcing withdrawal of its existing currency notes of two highest denominations, namely, the Rs. 500/= and the Rs. 1000/=. The move, announced with a suddenness that took the entire nation by surprise, had at its root the purpose of countering the threefold menaces of rampant corruption, counterfeit money and cross-border and internal terror funding. It has generated widespread controversy, the main criticism being that while the policy intent was sound, the

¹ Revised version of the Paper presented at the 3rd International Cash Conference, 2017, Deutsche Bundesbank, Germany. Invaluable research assistance received from Sambuddha Dasgupta is acknowledged with a deep debt of gratitude. The author also thanks Conference Participants for helpful comments and questions and valuable insights. The responsibility for all errors rests solely with the author.

execution plan was rather unsound. With one of the highest cash-GDP ratio in the world (close to 11%), India was revealed by RBI (Reserve Bank of India) data as having a staggering share of nearly 86% held in Rs.500/= and 1,000/= notes in the currency stock in circulation (end of FY 2014-15). The cost of “retiring” this volume of currency was therefore, going to be enormous which, as economists like former World Bank Chief Kaushik Basu (Basu 2016) emphasize, could far exceed the gains.

In view of the intriguing developments overtaking the Indian economy since the date of submission of the initial abstract, problems that subsequently emerged as considerably more pressing and pertinent have been treated in greater detail in this study. Consequently, the approach and methodology has been substantially modified, although of course retaining the original motivation.

With its laudable objectives of striking at the cash-corruption link, India saw, within the first four days of the announcement of demonetization, a staggering surge in bank deposits exceeding USD 52 billion, leading to high hopes of trapping unaccounted or illegal money through this route, a hope that was unfortunately to be belied. Given the enormous problem of Non-Performing Assets plaguing Indian Banks, we have also paid special attention to this potential vast source of unaccounted money in some detail. Next, an overview of India’s vast informal sector has been given, and the guidelines by Schneider and Williams (2013) and Schneider and Buehn (2008) have been used in an attempt to estimate the shadow economy in India using cointegration in a MIMIC framework. Finally, not only did India’s decision to demonetize have enormous economic or financial implications, but it also has had huge social and political ramifications that must be recognized.

Introduction

While the world was sitting up in stunned wonder at Donald Trump’s emphatic and complete victory in the US Presidential elections, a “revolution” of an entirely different sort was taking place on the other side of the hemisphere in India, arguably the world’s largest democracy. For those who had argued that India’s recent demonetization was not only a highly risky economic measure but a step loaded with enormous political fallouts waiting to become manifest—the wait is almost over.

Having stunned the entire nation and close “India-Watchers” by his out-of-the blue announcement of demonetization at midnight November 8th 2016, the Indian Prime Minister could have hardly timed his announcement better. On one side was the mindboggling scale of betting and hawala operators waiting to jump into the fray and strike gold on the eve of the US Presidential Elections with its entirely unpredictable fierce contest, a boon to the jackpot-hitters. Overnight, existing Indian currency notes of Rs. 500/= and the Rs. 1000/= became illegal tender, leaving speculators and dealers in massive cash amounts with little more than incriminating pieces of useless paper in hand!

Closer home, on a much modest scale, but something on which the Prime Minister’s very political survival would depend, vastly huge sums had been making the rounds in the impending State Assembly Elections in selected Indian states. We are talking here of five among the 29 individual states in the Indian Federal Union framework, with each holding its own State-level Parliamentary Elections in the multi-Party democratic system of the Indian democracy. This is in addition to the quinquennial General Lok Sabha Elections at the Centre that India holds every five years. During the last General Election in 2014, the Bharatiya Janata Party (BJP) led alliance, under Narendra Modi, had come to power with a more than two-thirds majority.

In the just concluded Assembly Elections in the five Indian states whose results were announced on 11th March, 2017 – the mandate could not have been clearer. The ruling party at the Centre (Prime Minister Modi’s BJP) was handed a resounding win in Uttar Pradesh, one of India’s largest states which acts typically as the trend-setter for the whole country, followed by a similar near wipe-out for the Congress Government in Uttarakhand – another major state. In two other states, viz. Goa and Manipur – BJP came to power forming alliances with regional parties, while in Punjab they lost the election to Congress, mainly due to the incumbency factor. Given the profile of the average masses that make up the vast body of the electorate in the Indian democracy-- one feature has been made clear by these results – the BJP has emphatically emerged as the Party that identifies itself with the poor and the downtrodden, at the expense of the “corrupt Rich” – and it has been dramatically successful in convincing the average electorate that it “means business” when talking of rooting out corruption, ill-gotten wealth and unjust inequalities. A second-term win and an emphatic comeback in the 2019 General Elections seems, at this point of time, almost a certainty for the BJP in the face of weak, rudderless and divided Oppositions.

The above, obviously, is the **pragmatics** of the political dividend that India’s demonetization exercise has yielded its architects. It remains for us to look at some of the economics of the measure-- weighing out some empirical evidence to understand precisely what demonetization has entailed for India’s economy.

India’s demonetization came at a time when the government had been faced with a number of imperatives. There was, first, the urgency of countering the threefold menace of rampant corruption, counterfeit money and cross-border and internal terror funding that had been assuming alarming proportions day by day. Flagrant tax evasion by the Indian rich as well as big businesses and the size of the black and illegal economy was becoming an enduring scourge.

There was, in addition, the need to introduce India’s large informal and non-monetized sector to the purview of banking and enhance the revenue-constrained government’s access to resources. The move, announced with unprecedented suddenness, has generated widespread controversy ranging from vociferous support to strident criticisms. With one of the highest cash-GDP ratio in the world (close to 11%), India was revealed by RBI (Reserve Bank of India) data as having a staggering share of 39% held in Rs.1,000 notes in the currency stock in circulation (end of FY 2014-15), while Rs.500 notes accounted for a further 45% of currency stock. The cost of “retiring” this volume of currency was, therefore, going to be enormous. Would the gains ultimately justify such huge costs?

Since the time the original abstract for our study had been submitted, I have been compelled to rethink much of the study at hand. With a considerable number of intriguing and urgent developments having overtaken the Indian economy ever since, the focus of this study had to be substantially modified and updated to reflect the urgencies of reality and preserve the immediate relevance of this paper. Accordingly, while the original conception has been retained, we felt it necessary to bring a shift in the main themes addressed.

The present paper is structured around six basic sub-themes. Section I notes in brief the pro-s and con-s of going “Cashless” or “Going with Cash” in a global economy that has passed through the travails of the financial crisis. In Section II we explore India’s recent experiences with “demonetization” till date. We also note the serious obstacles such measures face against corruption given the well-known Indian penchant for holding the bulk of unaccounted wealth in jewelry, real estate and above all, stashed away in tax havens. Next, given the severe problem of NPAs and huge unaccounted money plaguing the Indian Banking Sector, we take a detour in Section III to examine this problem in some depth. Section IV introduces the vast extent of informal sector in India, presenting some detailed data and problems, while Section V presents a very much concise analysis of India’s shadow economy.

Section VI concludes.

India: An Overview

India has emerged in its globalized avatar among one of the powerful economies in the emerging world. After sluggish growth under a strongly socially-oriented development philosophy and a plethora of regulations cynically termed “license-permit Raj”, India’s reforms programs were spearheaded in 1990-91 after an unprecedented crisis in both domestic and external balances and an abysmally sliding credibility in the global creditors’ eyes, crises which were reversed after some concerted efforts at short-term macroeconomic stabilization and structural reforms over the medium and longer-term.

It is India’s relative conservatism rather than going the “whole hog”, an aura zealously guarded by Indian monetary authorities in particular, that to a great extent saved the economy from the upheaval of the financial crisis that peaked in 2008 and is still playing out in some cases in a long drawn-out aftermath. India has stood relatively resilient by dint of this very conservatism that has often, in the past, drawn flak from ardent neoliberals.

Nevertheless, from records of governance that leave much to be desired, to the State’s failure to guarantee, even today, the basic minimum standard of living with dignity to the poorest with the contrasting lifestyles of the super-rich, one could indeed say that the Indian State has failed its masses in many ways. In spite of being a serious contender for emerging with the largest GDP in the coming 15 years (WEO 2016), India is truly a surprising study in contrasts. Ironically enough, the fact of India’s being a democracy has often been interpreted as having put the country into shackles with little possibility of pursuing ruthless growth, and the country’s being contrasted, to its own disadvantage, to economies like China.

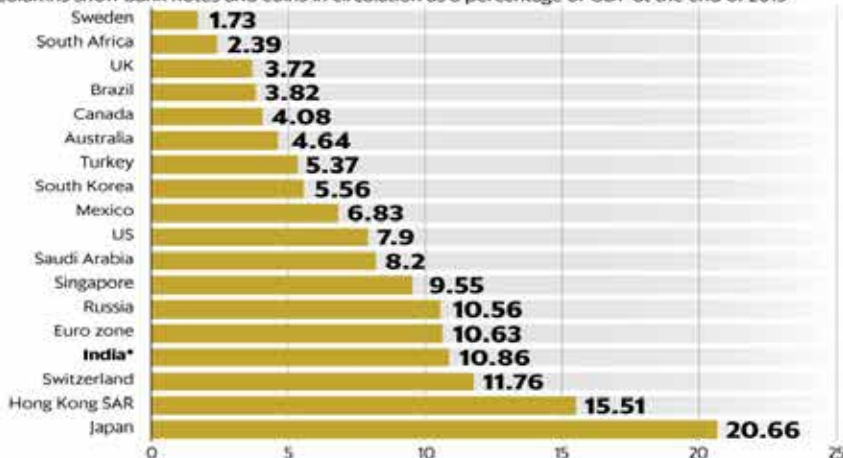
Figure 1 below presents a brief overview of certain features of India’s cash use pattern and banking scenario. In the first place, India’s cash-GDP ratio, nearing 11% in 2015-16, is one among the highest in the world. Surprisingly, though, Switzerland is revealed as having an even higher ratio, with Japan leading the list with close to 21%.

Cash Use in India: A Brief Impression

Figure 1

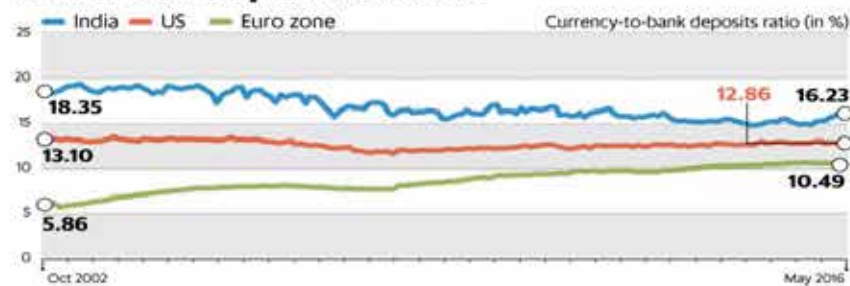
India has a high cash-to-GDP ratio

Columns show bank notes and coins in circulation as a percentage of GDP at the end of 2015.

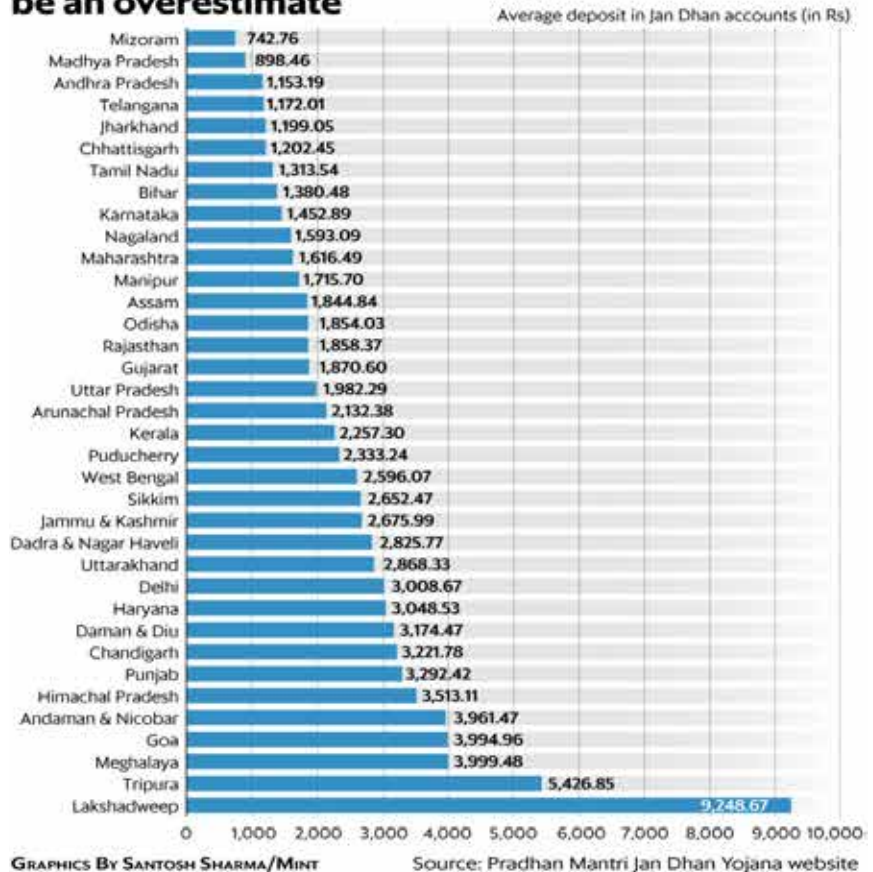


* India data is for 2015-16.

India's cash-deposit ratio is much higher than that of developed countries



Access to banking services might be an overestimate



Against such a backdrop, the demonetization drive announced by Indian Prime Minister Modi on Nov 8th 2016 meant that overnight, currency notes of Indian Rupees 500/= and 1000/= became illegal tender scrapped and to be deposited by the public with banks within 31st December 2016. Stringent upper limits were put on cash transactions, withdrawal facilities from ATMs, and PAN was made mandatory in transactions exceeding a specified limit. The interconnected issues of the country’s “black economy”, and India’s large non-monetized shadow and informal economy are all entities that were the avowed targets of India’s policy of demonetization and reform of the monetary system.

I Going “Cashless” or “Going with Cash”? Concerns in a post-Crisis World

In a post-financial crisis world, increased financial complexity is closely tied up with compounded uncertainty and increased need for cash. All over the globe, for a considerable time now, the debate has become intense as to whether to “go cashless” in all economic transactions. Increasingly sophisticated financial instruments, coupled with the perception that cash transactions are invariably associated with rampant and difficult-to-detect corruption, has for a long time strengthened the move towards cashlessness-- cash payments, in any post-industrial economy, being deemed “merely a barbarous relic of the past” (Beretta 2014), with many advanced European countries taking the lead.

The events of 2008, however, went a long way to underscore the total collapse of confidence on entire banking and financial systems that such crises could generate. If common people lost the very foundations of trust on banking and complex financial arrangements – then cash would indeed emerge as the last resort of confidence in monetary transactions. What would then happen to “going cashless”?

This total breakdown of confidence in what was today’s most “sophisticated” financial system that had dispensed with lowly cash to oil the wheels of its smooth

machinery, has been elegantly put, among others, by Negueruela (2014). ... “The crisis of values was also, and in some cases especially, a crisis of confidence. The crisis of 2008 was a classic example of “anything’s possible”, “anything goes”, and “the sky’s the limit”. The disbelief, amazement and paralysis witnessed at the various peaks of the crisis reflected complete powerlessness, impotence in the face of the unexpected, the unforeseeable, and the impossible. At the source of this process was the crisis of moral values, the breakdown of the basic principles of honesty and professional ethics, (...) the focus on the quick buck, (...) the creative accounting where the new products invented by a financial market in turmoil (options, futures, puts, calls, derivatives, intangibles) came to be worth more than productive assets, business organization, know-how and experience, market share and brand recognition. And in the face of it all, analysts, economists and experts with no answers, ridden with hang-ups and doubts, who surrendered to the market, to bonuses and rates of return, letting market forces wash over them to reach all corners of the globe,” Negueruela (2014, pp. 5).

In the face of such issues, the world has no simple, direct answers. While “Going cashless” would appear the norm in the current global scenario, there are undisputed advantages of holding cash even in today’s globalized and complex world. “Going cashless”, it is true, can only succeed when there is sufficient confidence and security safeguards in the financial system to ensure customer financial security.

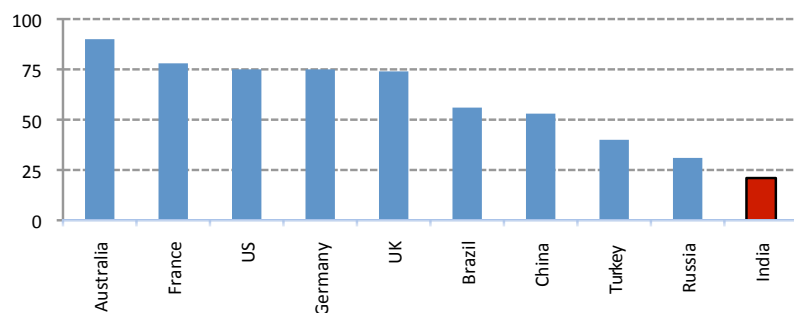
Nevertheless, disadvantages of excessive dependence on cash have become apparent in a world beset with terrifying and unprecedented levels of global and internal terror-funding and counterfeiting of currency involving vast amounts. The disadvantages of cash have been variously discussed in numerous contexts. Transactions in cash leave no trace, encouraging flagrant corruption and entire parallel universes where “Cash is King”, usually pertaining to large-scale illegal and underground activities. Arguments or problems that are specific to the developed West

do not, however, always apply lock stock and barrel to the conditions of developing and transition economies – an issue that we subsequently encounter in the context of the informal economy in such countries.

As Figure 2 reveals, India’s share of non-cash transactions as a percentage of total value of transactions was among the lowest, at a level of 22%, in 2015. This is, in fact, lowest even among the BRIC countries. Obviously it is some of the disadvantages of cash discussed above that had prompted India’s steps towards demonetization last November. In what follows, we discuss India’s actual experiments with demonetization stressing on the economics and the arithmetic of the step.

Non-Cash Transactions (% of Total Transactions)

Figure 2



Source Courtesy: Economic Times and Boston Consulting Group (2016)

II India’s “Demonetization”: Experiences Till Date

Not India’s First Demonetization

As the research note by Lahiri (NIPFP 2016) puts: “Interestingly, even during the two previous episodes of demonetization of high value notes over INR 100 in India, on January 12, 1946 and on January 16, 1978, the express objective of the exercise was containing black marketing or black money. (...) In 1978, the High Denomination Bank Notes (Demonetization) Act, 1978, which followed the Ordinance by the same name on January 16, 1978 demonetizing INR 1,000, INR 5,000 and INR 10,000 notes, also stated that the action was needed because such high denomination bank notes facilitate “...the illicit transfer of money for financing transactions which are harmful to the national economy or which are for illegal purposes.” (Lahiri 2016 p 2).

Demonetization: Currency Scrap and the Fallout

A necessary reminder first of all. The humble monetary numbers with which we are going to deal now, are to be seen in the context of an economy with a per capita GDP of 5730/= (PPP constant 2011 international \$), a tax-paying population of 12.5 million individuals, just about 1% of the 1.23 billion population of India in 2013, and with a World Bank (2011) estimate of 23.6%, or about 276 million Indian people living below \$1.25 per day on purchasing power parity basis. These essential truths would help us retain some perspective of the overall scenario.

One should not forget here the large-scale painful experience that the initial days and weeks of demonetization proved for the common man, taking the nation by utter surprise as the measure did. Data has already shown that India is a remarkably cash-use intensive economy—so that overnight, the common citizen was left, minus any forewarning, without the money necessary for hospitalization, paying for medicines, grocery, essential daily items and nearly every other conceivable necessities of life. In the rural sector which houses 70% of India’s people and whose

livelihood depends on growing the produce that the rest of India consumes, selling to the Marketers and the middlemen became near impossible without cash to be paid, the daily wage earning laborers suddenly found themselves without any work at hand, for the same reason that suddenly there was no money to pay their wages.

The problem, of course, lies with the huge informal economy structure running entirely on cash which is part and parcel of India’s daily life. Extremely small digitization of payment transactions in selected pockets only of the economy, coupled with the fact of Indians’ long-ingrained habits of cash transactions unfortunately combined to create unmitigated sufferings for the huge Indian masses, whose only hope and sustenance, indeed, was the thought that this move was all for the ultimate greater good, “to teach the corrupt rich a lesson”.

So where has demonetization with its attendant steps left us? The ultimate long-run effects of the step are yet to become clear in the absence of the reliable and complete data. We present below a brief data-based overview of the demonetization and its aftermath as it played out in India starting from November 2016 to the beginning of March 2017.

Steps Taken By the RBI and the Government during Demonetisation: A Chronological Overview:

On November 8, 2016, the Reserve Bank of India with concurrence of the government had initiated measures for demonetisation, aimed at cracking down on black money and the shadow economy. However, the unpreparedness for such a massive exercise became too apparent with the unfolding series of ad-hoc measures and notifications continually being announced in quick succession over the subsequent months, tantamount to a ship constantly trying to correct course on a rough sea, primarily to plug loopholes in the process and also with intentions to ease the pain on the “Common Man” from the measures undertaken.

The flurry of directives from RBI, set in chronological order and appended below, indicates the dilemma and ad-hocism that continued for the 3-4 months period, subsequent to the announcement by the PM.

November 8:

The PM goes on air at 20:00 hours announcing that currency notes of Rs. 500/= and 1,000/= cease to be instruments of legal tender, effective from mid-night the same day, i.e., just 4 hours away.

The detailed notification further clarified that

- i) the banned currency notes must be tendered into banks, RBI by December 30, 2016
- ii) Old bills could be exchanged over-the-counter at banks up to Rs. 4,000 (US \$60/=).
- iii) Cash withdrawals allowed from bank accounts at Rs. 10,000 (US \$ 149/=) per day till November 24, 2016
- iv) Cash withdrawals from bank accounts up to Rs. 20,000 (US \$ 299/=) per week till November 24; 2016
- v) Cash withdrawals from ATMs up to Rs. 2,000 (US \$ 30/=) per day per card till November 18, 2016
- vi) Cash withdrawals from ATMs up to Rs. 4,000 (US \$ 60/=) per day per card from November 19, 2016
- vii) Payments in old notes allowed for petrol, train tickets, hospital and other emergency services for limited period.

To be only fair, the timing perhaps could not have been better – the world, including the illegal betting market was in preparation for the Trump-Clinton battle to ensue in the next 8 hours. In India, all the political parties were in preparation for the ensuing state elections, where availability of liquid cash plays a big role.

The mixed reaction in the streets was palpable. While for a small section of the population the panic was pretty apparent indeed for the most obvious reasons, a large section of the middle class and the poor seemed to have welcomed the move, although the hardships and extreme inconveniences these common public would have to endure through the subsequent steps became apparent only much later. Meanwhile, the opposition political parties took the event as a great opportunity and went tong and hammer against the government.

November 9:

All banks and ATMs announced closed. In reality, a number of ATMs continued to be closed for days.

November 11:

Deadline for payments in old currency notes for petrol and other emergency services extended for limited period.

November 13:

New notifications:

- i) Cap on weekly cash withdrawals from banks raised to Rs. 24,000 (US \$ 358) from the earlier level of Rs. 20,000 (USD 299/=).
- ii) Daily withdrawal limit cap of Rs. 10,000 removed
- iii) Limit for over-the-counter exchange of old bills at banks raised to Rs. 4,500 (US \$ 67/=) from Rs. 4,000:
- iv) Waiver of ATM fees for all transactions by savings bank customers till December 30, 2016
- v) Withdrawal limits raised at recalibrated ATMs to Rs. 2,500 (US \$ 37) /day from Rs. 2,000.

November 14:

Deadline for payments in old notes including for petrol extended yet again for limited time

November 15:

Banks instructed to use indelible ink on finger to ensure people change cash only once. However, this could not be implemented due to objections from the Election Commission

November 17:

New notifications:

- i) Farmers allowed to withdraw up to Rs. 25,000 (US \$ 373) a week against the crop loans .
- ii) Time limit for farmer to pay crop insurance premiums extended by 14 days
- iii) Over-the-counter exchange of old bills at banks limited to 2,000 rupees from 4,500

November 18:

Cash withdrawal limit at card swiping machines set at Rs. 2,000 per day

November 21:

New notifications:

- i) Farmers allowed to withdraw up to Rs. 25,000 a week from their loan, deposit accounts
- ii) Farmers would also be able to purchase seeds from state-run outlets with old Rs. 500 notes
- iii) Small borrowers allowed 60 more days before loans of up to Rs. 10 million (USD 0.15 mn) were marked substandard

- iv) Cash withdrawal to meet wedding-related expenses allowed up to Rs. 250,000 (US \$3730/=).

November 22:

New notifications:

- i) Monthly limits on transactions via PPIs raised to Rs. 20,000 for 10,000 till December 30, 2016
- ii) Transfer up to Rs. 50,000 (USD 746/=) from PPIs to banks allowed till December 30
- iii) RBI asks state-run NABARD to disburse up to Rs. 230 billion (USD 3.4 mn) for crop loans

November 23:

Government announced offer of Rs. 210 billion (USD 3.13 mn) in farm credit to farmers

November 24:

New notifications:

- i) Exchange of old currency notes at bank counters stopped, only deposits allowed.
- ii) Payments in old 500 rupees notes allowed at tolls, hospitals for limited time
- iii) Government to ensure adequate cash supply for pensioners, armed forces personnel:

November 25:

New notifications:

- i) Old currency notes could be exchanged at RBI branches
- ii) Basket of securities expanded so that it could be accepted for collateral under money market ops.
- iii) Tourists allowed to exchange foreign currency worth up to Rs. 5,000 (USD 75/=) per week till December 15, 2016

November 26:

RBI orders banks to place 100 per cent of deposits between September-November under cash reserve ratio

November 28:

New notifications:

- i) Tax amnesty scheme for unreported cash announced. Penalty charges would be 50% in taxes, surcharges. Also quarter of total sum should be parked in non-interest bearing deposit for 4 years period.
- ii) Withdrawals above Rs. 24,000 weekly limit of deposits made in legal tender allowed.

November 30:

New notifications:

- i) Banks allowed to use all cash to meet hiked cash reserve requirement ratio
- ii) Monthly withdrawal rules from “Jan Dhan” accounts for poor made more stringent

December 1:

Petrol stations, airline ticket counters stopped accepting old 500 notes, although initially it had been decided to continue till December 31, 2016.

December 2:

Government raises limit for market stabilisation bonds to 6 trillion rupees to absorb extra liquidity

December 7:

India withdraws temporary order for banks to place deposits under cash reserve ratio

Dec. - Jan. 2017:

All restrictions on cash withdrawal from banks / ATMs withdrawn

While the government is still in the process of evaluating the amounts that were deposited with Banks after the note ban, initial estimates put the unaccounted (that is, tax evaded) money deposited over the remarkably short span between November 10 and December 30, 2016 at Rs. 3.5 to 4.0 lakh crores (between USD 52.24 bn. to 59.7 bn.), the I-T department being instructed to meticulously inspect the deposits and send notices to the depositors.

The problem is, of course, that nearly all available estimates reveal close to 90% of the scrapped notes as having already found their way back to the banking system, although the RBI has insisted it would make its announcements public only after scrupulous investigations.

Under suspicion and vigilance of the I-T Department are multiple accounts, recorded under the same PAN, mobile number and addresses, which have seen individual deposits ranging from Rs. 2 lakhs to 2.5 laks, with the total of such deposits

reaching Rs. 42,000 crores (USD 6.3 bn).

Post demonetization, Times of India Group estimates put the volume of loan repayments in the form of bank deposits up to January second week as close to Rs. 80,000 crores (USD 11.9 bn). The co-operative banks recorded a deposit of 16,000 crores (USD 2.4 bn), sources of which are being closely investigated by the I-T Department and the Enforcement Directorate (ED).

Banks also revealed Rs. 2.0 lakh crores (around USD 30 bn) as having been deposited in the 60 lakhs bank accounts all over India. The fact that accounts that had remained dormant up to November 9, 2016 suddenly registered deposits to the tune of 25 thousand crores (USD 3.7 bn), has not escaped the notice of the I-T Department and the ED.

Another dramatic revelation came from the “Jan Dhan Yojna” accounts, or ostensibly, the Government-initiated “Common People’s Fund”. Deposits in these accounts grew to Rs. 87,000 crores (USD 13.9 bn) within 45 days post demonetization, prompting the Income Tax department to “dissect” information relating to such deposits (Economic Times January 2, 2017). Overall, detailed reports have been sought from the banking System on the deposits made by the population belonging to various economic strata, to be thoroughly analyzed and sifted through to detect irregularities.

Demonetization: Effect on “Black Money”

The fact of close to 90% of the notes banned finding their way back into the banking system as deposits only serves to underscore the fact that the notion that “rich and corrupt” Indians keep their ill-gotten wealth stashed in cash is an extremely dated and perhaps a somewhat dramatic one.

Indeed, as noted by the likes of NIPFP (1985), Patnaik (2016) and others, one needs

to distinguish between “black wealth”, a stock concept and the stream of “black activities”, a flow which adds to the stock of wealth.

Immediately after assuming Office in 2014, Prime Minister Narendra Modi’s government had acted on Supreme Court directives to form a Special Investigation Team (SIT) to probe black money that was believed to be mostly stashed abroad.

An estimate of the US-based think-tank Global Financial Integrity put the illicit money outflow from India as running close to \$462 billion in 2014, referring to the “money that is earned and transferred illegally abroad in tax havens ... generally to avoid tax”. Nearly a third of black money transactions were believed to be in real estate, followed by manufacturing, gold and consumer goods purchases.

In spite its best intentions, the SIT had not proved quite effective in unearthing and “bringing back black income” (a ringing promise on which Modi had rode his massive electoral victory in 2014), due to understandable reasons. Tackling black money in the domestic front is difficult enough. Also, the unpalatable truth is that amidst the fierce bickerings of India’s multi-party political set-up, delinking money and muscle power from Party politics is a near-Utopian dream, which no Party that is serious about its own political survival can actually contemplate. Finally, where overseas transactions are concerned, diplomatic and international political protocol among Governments makes certain disclosures and measures a formidable task.

On the domestic front, post demonetization, imminent steps are being envisaged by the Indian government to sift through the voluminous data to identify those who have deposited cash or purchased high-value assets (real estate, jewelry and the like) not satisfactorily accounted for by PAN. Till January 2017 first week, undisclosed income worth Rs. 4,314 crores (USD 644 mn) had been unearthed, Rs. 1, 05.5 crores (USD 16 mn) in new currency and seizure of Rs. 554.6 crores

(USD 83 mn) had been reported (Sikarwar, January 2, 2017). In all this, the I-T Department was duly assisted by Banks and Investigation Agencies.

Following a detailed evaluation of banned note deposits, the Government and I-T authorities collected over Rs. 6000 crores (USD 896 mn) as tax on unexplained cash deposits (unaccounted deposits) post demonetization as the Economic Times reported (March 18, 2017), an amount that could further go up according to Justice Arijit Pasayat, Vice-chairman of the SIT on black money.

Individuals who deposited substantial amount of cash after demonetization, either in their own account or in the name of others, have been asked for explanation by the tax authorities.

“The onus is on those who have deposited huge cash to explain the source,” ... “The authorities, while examining the huge bank deposits, will finally have to come down to the macro level at some point of time to examine sudden huge deposits of cash in even Jan Dhan accounts. The exercise will be tedious and time consuming. But the tax authorities are determined to undertake this workload,” Economic Times sources cited Justice Pasayat as saying.

Many later agreed to avail the amnesty scheme which earlier allowed compounding by payment of 60 per cent of the deposits as tax, now hiked to 75 per cent, the report said.

Demonetization: Effect on Investment Pattern

In November 2016, the “demonetization month” itself, the total deposits in Equity MFs increased by Rs. 9,079 crores (USD 1.4 bn). The pattern of average investor behavior has also shifted away from one-time large investments and in favor of Small Investment Plans (SIP) in Mutual Funds.

Demonetization: Impact on Terror and Hawala

As of January 2017, intelligence sources reported demonetization as having hit hard at terror activities in Kashmir and Maoist terror activities. The hawala business had also been hit hard by the withdrawal of old currency notes.

While announcing the note ban the Government had, among other goals, the twin objectives of reigning in hawala transactions and terrorist activities. According to Intelligence sources, hawala business had been reduced by 50% while terror activities at Kashmir had gone down by 60% by the first week of January 2017.

Typically, inciters of terrorism in Kashmir, who deal in huge amounts of cash, were put into serious trouble following the note ban. Counterfeit currency, printed outside India's borders find their way into Indian soil and are used for the purpose of terror funding activities by various organizations. As a result of ban on the old 500/= and 1000/= notes, the counterfeit currency has lost their use, making terrorists and their support groups unable to finance their terror campaign. This is very much apparent in Kashmir where organized revolts and demonstrations by large mobs, pelting, arson and destruction of public property had become almost daily features, with a lot of money being spent to incite the youth population into destructive activities. In the interiors of the country, Maoists who typically engaged in intimidation and extortion of people and used money to buy explosives are also facing trouble. Similar instances can be found in other Indian states.

Hawala routes, the major instrument of illegal monetary transactions in the parallel economy, are one main channel through which black money is smuggled abroad. Since majority of the hawala transactions take place in 500/- and 1000/- notes, scrapping of those denominations has landed hawala circles into trouble as the enormous stock of cash in their hands has become useless. One estimate puts the volume of smuggled money as having come down to half by the first week of January 2017.

Finally, as put by Professor Maitreesh Ghatak (2017) of the LSE “People suffered but voting may have been driven less by anger over the damage to immediate economic interests than by their belief that a ‘decisive’ Modi would make them better off in the long run” (Ghatak 13th March 2017).

To sum up, extensive data from the Press and Banks bring out that:

- India’s “experiments” with its process of demonetization in the face of stiff opposition from political rivals is a phenomenon which only time can tell if it succeeded in fulfilling its objectives.
- Laudable intentions notwithstanding, the actual process left a lot to be desired, causing undeniable hardship to the common people and specially India’s large informal economy, at least initially. This underscores once again the need for basic financial literacy to be put in place first, instead of forcing people into banking habits through coercive measures and acute inconveniences.
- In fact, the process had huge social costs. Hospitals in some places refused to treat life-threatened patients, mostly from the lower socio-economic strata, in exchange of old notes even when they had been clearly instructed to do so. In addition, more than 100 people, again mostly poor and disadvantaged, fell acutely ill while standing in queues after having travelled miles after miles in search of a bank that would serve them.
- Instead of a sudden out-of-the-blue announcement with repeated and bewildering changes that almost daily marked the process, a more carefully thought-out planned transition could have helped common people escape huge sufferings.
- Demonetization, with the large amount of bank deposits, has probably failed in “unearthing” black money, as more than 90% of the deposits have come back into the system.
- This means that in India, as repeatedly iterated, it is black “activities” rather than “black money” as such, that generate most of the black or illegal wealth.

- The RBI has been surprisingly vague about the details of money flowing in and out of the system.
- The decision to introduce 2000/= (equivalent to USD 30/=) currency notes at the same time as withdrawing 1000/= notes, is difficult to comprehend given the objective to eliminate big bills. With counterfeit 2000/= notes having already surfaced in the system, the wisdom of these steps is seen as rather suspect.
- Calibration of the ATMs to dispense the slightly modified new currency bills is still incomplete. On top of that, instances abound where already rampant counterfeiting of the new 500/= and high denomination notes of Rs. 2000/= has started, so much so that a number of Bank ATMs have been frequently reported as having dispensed bunches of counterfeit currency.
- “Going cashless” can only succeed when sufficient confidence and security safeguards have been put in the financial system to ensure customer financial security. Instances of fraudulent card transactions have been on the rise all over the world, India not excepted.
- On the positive sides, there is the unquestionable new awareness about banking and digitization among common public, and a sense of renewed responsibility on the part of the government to usher in financial literacy to a large section of neglected masses.
- Overall, Indian public’s investment profile has improved towards longer-term investments. December 2016 saw the maximum impact of the demonetization step and the note scrapping exercise. Even then, the consequent inevitable decline in the share market could not prevent gains in the equity mutual funds, which registered an increase of Rs. 10,103 crores (USD 1.5 bn), the highest in last 18 months. This implies that the same scrapped money which was par force deposited with the banks were then re-invested in mutual funds with a view towards long-term returns.
- Speculative and rampant terror activities across the border do seem to have become subdued.

It is, of course, common wisdom that the unscrupulous and the ruthlessly corrupt are more than certain to find ways to subvert the system and devise multiple methods to bypass legal provisions and accountability.

That the problem of vast unaccounted money and wealth is not necessarily synonymous with having cash in the system becomes even more apparent in Section III, where we explore the malady of Non-Performing-Assets (NPAs) that has been plaguing the Indian banking sector. The advances given by banks (termed assets), clearly meant to generate income via interests and instalments, become “bad loans” when the instalment is not paid after the due date, and NPAs beyond 90 days. The ratio of NPAs to total advances given by a bank is a commonly used indicator reflecting the health of the banking system. Non-performing Asset (NPA) is an alarming threat to the sustainability of the banking industry in India and a burning concern for Indian Policymakers. Despite a series of correctional steps advocated by RBI over the last couple of years, concrete results are eluding the economy.

III A Problem of Trust? Indian Banks and their NPAs in a Liberalized Regime: A Brief Digression and Overview

As per latest estimates, bad loans of Public Sector Banks (PSBs) grew by more than 1 lakh crores (USD 14.9 bn) in the first nine months of the current of this financial year (2016-17) to a whopping total of Rupees 6 lakh Crores (USD 89.6 bn). (Source: ET; 22/03/2016). As per CRISIL’s estimation, weak assets in the Indian banking system were about to touch a high of around Rs. 8 lakh crores (USD 119.4 bn) by end of the current fiscal (2016-17), having reached the astounding level over the last three decades where one major contributor was the infrastructure sector.

For an in-depth understanding of how some of the ills inherent in the Indian Banking System has led to lakhs of crores of Rupees being siphoned off, we showcase the problem with reference to the energy and power sector, one of India’s most

important sectors given the country’s acute dependence on power for continued expansion of industrial and social infrastructure and requiring huge orders of investment involving Banking and Non-bank Financial Institutions, Public Private Partnerships (PPPs) and huge foreign investment.

In point of fact, the problems of power financing through the Indian Banking and Financial Systems have gone so endemic and near unsolvable that concerned circles have coined the term “Money Laundering in the Power Sector”.

Since the late 1970s till about 2012, the demand for electrical energy in India had been increasing in leaps and bounds. In 1991, the Indian Power Sector was opened up for Private Sector participation by liberalizing the regulations. Initially the focus was on adding generating capacities to meet growing power demand. Consequently many Independent Power Projects (IPP) were planned but only very few projects could materialize, mainly due to monopoly/single buyer options (State Electricity Boards) then available. To correct matters, the Government of India introduced the new Electricity Act, 2003, to boost the ongoing reform process for effecting comprehensive turnaround and promoting private participation in Power Sector.

What followed was absolute mayhem – anyone and everyone, with some money in hand, started investing in the power sector, smelling out lucrative business. While power producers with genuine credentials made investments, there were huge investments from Developers from unscrupulous background. The banks on their part invested heavily without a proper due diligence being carried out at their end.

By 2012 initial signs of the recession in industry were visible. Moreover, the initial demand estimates proved grossly over-estimated. The distribution companies projected a lower demand as they were short on the receivables. Gas was no longer

available option for fuel and linkage coal was difficult to obtain, in absence of Power Purchase Agreements (PPA). Coupled with all these problems, the government decided to turn its attention and incentivize the renewable sector. The thermal power sector didn't find it easy to identify off-takers for their power, resulting in the IPPs unable to tie up the necessary power purchase agreements. Stringent environmental laws from the Environment Ministry ensured that thermal power was no longer a viable option for investment.

It was time for unscrupulous business to flourish. Those promoters who had invested heavily realized soon that the returns were not as high as expected. Various ways and means to siphon off the money were devised. Little wonder that a large part of investments from the banks and financial institutes gradually moved towards being NPAs—opening a floodgate of sorts for the perennial generation of unaccounted money.

Since the early 1990s, the Indian banking system, which for long had been operating in a closed economy, was suddenly faced with the challenge of an open economy. On one hand a protected environment ensured that banks never needed to develop sophisticated treasury operations and Asset Liability Management skills. On the other hand a combination of directed lending and social banking relegated profitability and competitiveness to the background. The net result was unsustainable NPAs and consequently a higher effective cost of banking services.

A look at some of the data reveals that Gross non-performing assets of the Power Finance Corporation (PFC) were 3.15% of its loan assets as on 31 March 2016 against 1.16% a year back. Net NPAs rose to 2.55% of the loan assets as on March 31 from 0.93% in same period a year back. PFC's gross NPAs stood at Rs. 7519 Crores (USD 1.1 bn) of the total loan assets of Rs. 238,920 Crores (USD 36 bn) as on March 31, 2016.

Gross NPAs of Rural Electrification Commission (REC) stood at 1.71% of its loan assets, while net bad loans were at 1.36%. In 2014-15, gross NPAs were 0.74% while net NPAs were at .54%.

On a similar note, Gross NPAs of state-run banks in December 2015 stood at 7.30%. (The Economic Times, 27th May 2016).

We can now summarize some of the causes for Non-Performing Assets (mainly related to investments in the power sector), that have a direct relation to economic factors.

Some among the major internal factors can be identified as:

- i. Lack of proper tracking mechanism for the utilization process of the funds borrowed. Diversion of funds for other purposes, even to the extent of promoting sister concerns are various ways the loans are squandered. Often excess capacities are created for non-economic reasons. All these are attributable to slackness on the part of the Lenders/ Lenders' Engineer/ Legal Counsel / Financial Advisers for a proper credit appraisal, monitoring and follow-ups.
- ii. Procrastination of problems where postponement may lead higher earnings. Funds disbursed are often made to accrue interest when purposefully left unutilized.
- iii. Debtors often resort to manipulations using political influence, resulting in delayed recovery or even in total loss of receivables.
- iv. Often there are a large number of lenders (often as high as 26 lenders) for a single project. It becomes difficult for all of them to converge on issues during the joint lenders' forum (JLF) meetings, thereby delaying vital decision making process.

To be fair, there are also quite a few “outside” or “External” factors genuinely beyond the control of the Projects in question that also come into play to affect performance and profitability, such as:

- i. A sluggish legal system, which results in legal impediments and time consuming nature of asset disposal process.
- ii. Political interferences.
- iii. Dearth of proper and adequate project management and construction resources as well as raw material, construction power and water and other infrastructural requirements.
- iv. Truly external factors like industrial recession, adverse swings in exchange rates, changes in government policies like excise or import duty changes, to cite a few.

Reserve Bank Guidelines for Restructuring Stressed Assets

The 5:25 scheme

This scheme allows banks to extend long-term loans of 20-25 years to match the cash flow of projects, while refinancing them every 5 or 7 years, thus allowing infrastructure loans to be stretched out over a longer tenure.

Strategic Debt Restructuring (SDR)

Under SDR, RBI allows banks to convert a part of their debt to majority equity in a defaulting firm. This helps in taking control of the defaulting firm and effecting a change in management. After banks have decided to convert their debt, they have 18 months to find a new buyer or strategic investor who can buy the majority equity from them and take over the company.

Scheme for Sustainable Structuring of Stressed Assets (S4A)

With the above tools unable to deliver the desired results, this was Reserve Bank of India’s yet another improvisation to provide banks with sufficient arms to tackle the

growing challenge of stressed assets and could help banks limit fresh slippages to non-performing assets (NPAs) from large corporate exposures.

S4A entails an in-depth study through financial modeling including sensitivity analysis to determine the sustainable debt level for stressed projects. The outstanding debt is then classified as sustainable debt and equity/quasi-equity instruments. It is assumed that this would provide advantage to the lenders when the project turns around. This would be only applicable to projects that have started commercial operations and have outstanding loans of over Rs. 500 crores. More transparency in the process is expected through appointment of an external agency for techno-economic viability study and also authorized through an oversight committee of independent experts.

The 3 restructuring schemes and the effect on power sector

The 5/25 scheme has been successful where the project in financial terms is viable. It provides a definite advantage to the borrower as it helps in stretching the repayment period (thereby reducing the monthly /quarterly repayment amount); the lender has to ensure protection of net present value (NPV) of the loans refinanced. The decision to refinance is taken on the basis of a techno-economic viability of the project, conducted by an independent agency. Many power projects have taken advantage of this scheme.

The SDR scheme mandates the banks to take majority stake (51%) in the stressed plant along with management control over the plant administration. The bank would then require finding a buyer for the plant within 18 months from the reference date, failing which the plant is to be classified as NPA.

Several plants are being considered under the scheme by banks, but not with much success. The borrower, while extending his cooperation for the process, is not prepared to let go his controlling stake over the plant. He puts in whatever hurdles he

can devise to turn away any interested buyer. In fact, several plants are under consideration for the SDR process, but none of them have been able to identify the new buyer.

Though the S4A scheme addresses some of the challenges faced in implementing the 5:25 scheme and SDR, its successful applicability as a loan recovery instrument, is to be proved yet. It is hoped in banking circles that the S4A scheme shall enable the lenders to find a way to deal with stressed assets. However, the government is already looking to set up a new mechanism for faster resolution of stressed assets that shall allow state-run lenders to take a bigger haircut on their bad loans without fear of vigilance action. This process is expected to be initiated with the top 50 non-performing assets.

We now come to the issue of India’s vast informal or unorganized sector which has attracted a huge volume of research and speculations in the literature.

IV India’s Informal Economy: A Brief Overview

In India, we live surrounded by the informal economy. Let alone the substantial agricultural sector of the country, even amidst some of the select confines of India’s “A1” Metro cities, the informal or unorganized economy has managed, not only to make inroads and survive, but to flourish at an unbelievable extent, by dint of its sheer never-say-die spirits, its gritty innovative stamina and entrepreneurial pluck. India’s informal sector is one indispensable, if precarious, attendant of the track along which India’s development has progressed. One of the avowed objectives of demonetization was to reduce the extent of the huge volume of cash transactions that occurs in the informal sector in India, one of the largest in Asia and certainly in the world.



Figure 3: The Ubiquitous Informal Economy of India

Image Courtesy: pixabay, www.mbascool.com

How do we define the term “informal economy”? The problems of arriving at a straightforward and unanimous definition have been discussed at length in the literature. Below, we briefly recapitulate some essential concepts and empirical evidences.

Known variously as the unorganized, “shadow, underground, unobserved, unofficial, subterranean, unrecorded, informal, irregular, second, twilight, parallel – synonyms used for the ‘hidden economy’ seem to highlight the fact that this concept, which essentially captures the activities beyond measurement by fiscal or

economic factors, is itself replete with differences in definitions and pathologies” (Chaudhuri et al 2003).

As noted economist C. P. Chandrasekhar points out, the National Sample Survey (NSS) of India identifies the informal sector as “consisting of proprietary and partnership enterprises (excluding those run by non-corporate entities such as cooperatives, trusts and non-profit institutions), in the non-agricultural sector and in agriculture-related activities excluding crop production (AGEGC). These kinds of non-agricultural enterprises are the ones that do not correspond to the organisationally more modern enterprises that economists like Simon Kuznets saw as coming to dominate the non-agricultural sector in the course of development” (Chandrasekhar 2014). In Kuznets’ view, as modern economic growth occurred, not only would economic activity be diversified away from agriculture but there would be an attendant increase in the size of non-agricultural enterprises and a growing role for impersonal forms of organisation (ibid).

In the Indian context, is the term informal economy synonymous with the “shadow” economy as understood in the West? Not quite, as the illuminating commentary by Schneider and Williams (2013), among others, clarifies. “There is also a very large shadow economy in many less developed countries. Here we use the **less ‘loaded’ term ‘informal economy’** to describe this activity because its characteristics are different from the shadow economy in the West. The informal sector in poorer countries is typically between 25 and 40 per cent of national income and can represent up to 70 per cent of non-agricultural employment. In such countries, informal activity often arises because of the inadequacies of legal systems when it comes to formalizing business registration rather than as a result of deliberate evasion activity. Nevertheless, the problems that informality can bring are enormous: it can be a serious constraint on business growth; and the lack of enforceability of business and employment contracts in a country makes prosperity much harder to achieve” (Schneider and Williams 2013, pp. 22, emphasis added).

In the same vein, the authors add,

“It is worth noting that, in many parts of the world, the shadow economy is more or less endemic and is often described simply as ‘informal’ rather than ‘shadow’. Such informal activity does not take place because individuals are deliberately avoiding paying taxes and avoiding abiding by regulation but because the infrastructure does not exist for the effective and efficient registration of businesses and to ensure the efficient collection of taxes. In many poorer countries, the shadow economy is not so much a problem of evasion by citizens but of an inability of people to pay taxes and register their activity even if they would wish to do so,”(Schneider and Williams 2013, pp. 59, italics added).

As Chandrasekhar (2014) notes, “The fact that sectors like trade and construction are important contributors to the unorganized sector and to informal employment is of significance. (...). The really stringent form of size-based regulation applies to the manufacturing sector, in which units that meet the criteria set by the Factories Act, 1948 need to register themselves and be subject to factory legislation. This legal distinction does not apply to non-agricultural sectors outside manufacturing” (Chandrasekhar 2014).

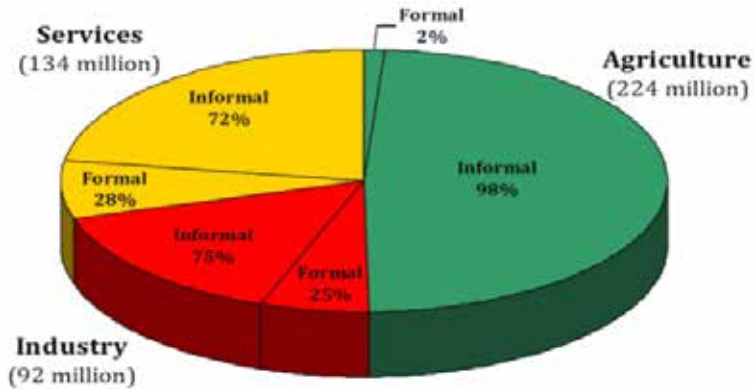
Figure 4 below clearly brings out the stark contrast between organized employment vis-à-vis the vast proportion engaged in unorganized labor in India around 2009, that is, nearly two decades after wide-ranging reforms on industrial and other fronts had been undertaken. As fig. 4 shows, more than 90% of India’s employment arose in the informal sector² around 2008-09.

² Although for most purposes, the terms unorganized and informal sector are used interchangeably, the former concept is “a bit broader than the related concept of the informal sector” (Bosworth et al 2006). In the present context we continue with the practice of equivalent use of the two terms.

Extent of Informal Sector in India (2008-09)

Figure 4

Formal and informal employment, by sector, 2008-09 estimates



Source: Table 2.7 „Modified Current Weekly Status employment estimates” in *The Challenge of Employment in India Report*, National Commission for Enterprises in the Unorganised Sector, April 2009.

Interestingly, even in the organized sector, workers may be informally employed without any social protection. This is the basis on which the NCEUS (2007) made a distinction between the organized vs. unorganized economy in the sense of output production, and the formal vs. informal so far as conditions of employment are concerned.

The NSS Report No. 539 (NSSO 2012) of the Government of India clarifies and distinguishes between the coverage of informal sector and informal employment (NSSO 2012 pp. 20 § 2.25). The distinction may seem trivial or purely an issue of semantics, but it makes a huge difference to the worker whose fate it is to be informally employed. A four-fold classification of the workforce may thus be possible with workers in both organized and unorganized sectors being either formally or informally employed (Table 1).

Proportion of Informal Workers in India (2007)

Table 1

Sector/ Workers	Informal worker	Formal worker
Informal/unorganized sector	99.6	0.4
Formal/organized sector	46.6	53.4
Total	92.4	7.6

Source: NCEUS (2007), p.4

Table 2 below depicts how, post- India’s economic reforms in 1990-91 up to 2004-05, unorganized sector employment continued to grow much more rapidly while employment in organized sector lagged behind in absolute terms and shrunk as ratio of total work force.

The 2009 NCEUS Report (National Commission for Enterprises in the Unorganized Sector) was thus led to comment:

“ ... The entire increase in the employment in the organized sector (over the post-reforms period) has been informal in nature i.e. without any job or social security. (...) this can be termed as *informalization of the formal sector*, i.e., employment increase consists of regular workers without social security benefits and casual or contract workers again without the benefits that should accrue to formal workers” -- (NCEUS 2009), emphasis added.

What about the recent scenario? For the necessary updating of the informal sector employment scenario, as far as data available till date, we turn to Chandrasekhar (2014) again: “Between 2004-05 and 2011-12, (...) employment in the organised, non-agricultural sector (...) rose from 28.8 million to 47.7 million, whereas employment in the unorganised sector rose from 185.4 million to 209.6 million. That is, organised sector employment stood at 6.3 per cent and 10.1 per cent

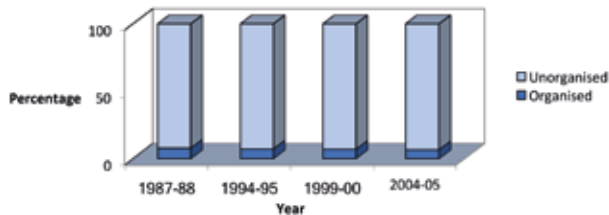
**Workers in Organized and Unorganized Sectors,
1987-8 to 2004-5**

Table 2

Unorganized Sector in India-II
Organised vs. Unorganised Sector 1987-2005

Year	Number (million persons)			Percent of Total Work Force		
	Organised	Unorganised	Total	Organised	Unorganised	Total
1987-88	25.4	301.8	327.2	7.8	92.2	100.0
1994-95	27.0	348.8	375.8	7.2	92.8	100.0
1999-00	27.8	371.2	399.0	7.0	93.0	100.0
2004-05	29.1	410.0	439.1	6.6	93.4	100.0

Growing „Informalization” of the Formal Sector (NCEUS 2009)



Source: Dasgupta and Saha (2012)

respectively of total employment in 2004-05 and 2011-12. In absolute terms there were more who joined the unorganised sector’s workforce than the number who entered the organised sector between the two years. Even in 2011-12, as much as 86 per cent of workers in the private sector and 50 per cent in the public sector were in units that could be designated as unorganised based on employment size”.

Finally, one must note the crucial difference between the weightages of formal /

**Estimated Gross Value Added by Informal Sector,
Industry Group-Wise (Major)**

Table 3

Industry / Sector	Percent of Unorganized to Total	
	1999-2000	2004-05
Agriculture	96.55	94.48
Mining	30.00	18.00
Manufacturing	28.85	26.84
Construction	44.66	46.33
Trade	77.35	75.08
Hotels & restaurants	56.19	50.8
Transport & Storage	57.27	44.45
Banking, Finance & Insurance	7.43	9.29
Real Estate, Renting and Business Services	77.24	63.44
Educations	13.81	12.33
Health & Social Work	21.8	23.19
Other Community, Social & Personal Services	61.04	69.44
Private Household & Extraterritorial Organisation	80.11	95.29
Total	55.42	49.94

Source: NCEUS (2012) and Author's Calculations

informal employment vis-à-vis the values added by the respective sectors. Table 3 dramatically brings out the fact that notwithstanding the large proportion of the population that the informal sector absorbs, their productivity continues to be quite low and value added by the informal sector has actually gone down over the years, as made evident from the data on gross value added by the different sub-sectors of the informal sector in the total economy.

Total factor productivity (TFP) of the informal sector in manufacturing has continued to be quite low as compared to formal manufacturing well into recent years (Planning Commission 2016).

V The shadow economy in India: An Analysis

Confronted with the conceptual dilemma, and the various definitions available in the literature as to what exactly constitutes the shadow economy, it is helpful to recall here our foregoing discussion on the Indian informal economy. We employ the useful version provided by Chaudhuri, Schneider and Chattopadhyay (2006) in their study of India’s shadow economy where the distinction between the “informal” and the “shadow” economy is brought out clearly. Chaudhuri et al (2003) also provide a number of equally able alternative definitions, among them the one by Bagawacha and Naho (1995) “as a combination of informal (small-scale production and distribution units), parallel (illegal production of legal activities) and black market activities (production and distribution of market and non-market goods forbidden by the government)”.

In this study, then, our definition of the “Shadow economy” includes “the portion of the income earned from legal and illegal activities that cannot be accounted for by the standard measurement procedures used in compilation of national income accounts” (Chaudhuri et al 2006).

For an idea about the relative sizes of shadow economies across the world, we present in Table 4 below selected data obtained from previous estimate attempts for a wide range of countries all over the world, for the period of estimation from 1999 to 2007.

The overall extent of the shadow economy has thus ranged, on an average, between 34% of GDP (1999) to 31.2% in 2007, apparently having declined

**Estimated Gross Value Added by Informal Sector,
Industry Group-Wise (Major)**

Table 4

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	Average
Australia	14.4	14.3	14.3	14.1	13.9	13.7	13.7	13.7	13.5	14.0
Austria	10.0	9.8	9.7	9.8	9.8	9.8	9.8	9.6	9.5	9.8
Belgium	22.7	22.2	22.1	22.0	22.0	21.8	21.8	21.4	21.3	21.9
Bolivia	67.0	67.1	67.6	67.7	67.7	66.9	64.3	62.8	63.5	66.1
Brazil	40.8	39.8	39.9	39.9	39.6	38.6	38.4	37.8	36.6	39.0
Cambodia	50.4	50.1	49.6	50.0	49.2	48.8	47.8	46.8	46.0	48.7
Canada	16.3	16.0	15.9	15.8	15.7	15.6	15.5	15.3	15.3	15.7
Central African Republic										
China	42.8	42.6	43.1	44.0	46.9	47.3	46.9	45.9	45.1	45.0
Denmark	13.2	13.1	13.0	12.9	12.8	12.6	12.5	12.2	11.9	12.7
Finland	18.4	18.0	18.0	18.0	18.0	17.8	17.6	17.0	16.9	17.7
France	18.4	18.1	17.9	17.8	17.7	17.6	17.4	17.1	17.0	17.7
Germany	15.7	15.2	15.0	15.1	15.0	14.9	14.8	14.8	14.7	15.0
Georgia	68.3	67.3	67.2	67.2	65.9	65.5	65.1	63.6	62.1	65.8
Haiti	16.4	16.0	15.9	16.1	16.3	16.1	16.0	15.6	15.3	16.0
India	54.8	55.4	56.1	56.5	56.4	57.4	57.1	57.0	57.1	56.4
Japan	23.2	23.1	22.8	22.6	22.3	22.0	21.7	21.2	20.7	22.2
Luxembourg	11.4	11.2	11.2	11.3	11.2	10.9	10.7	10.4	10.3	11.0
Mexico	10.0	9.8	9.8	9.8	9.8	9.8	9.7	9.6	9.4	9.7
Netherlands	30.8	30.1	30.3	30.4	30.5	30.1	29.9	29.2	28.8	30.0
	13.3	13.1	13.1	13.2	13.3	13.2	13.2	13.2	13.0	13.2

Source: Based on Buehn, Monte Negro and Schneider (2010) as cited in Schneider and Williams (2013).

gradually over this period. Two points are to be noted here, viz. 1), at individual country levels, the time trend of the extent of the shadow economy has been more varied and it has gone up with time in a few countries like Haiti. 2) This overall average, on disaggregation, comprises country average figures as low as 8.5% of GDP (Switzerland) to as high as 66.1 % in countries like Bolivia.

For India, the weightage of the shadow economy in GDP is seen to have remained more or less steady around the own country average of 22%-- a figure on the lower side of the overall (world) average of around 32%. A McKinsey estimate put India's shadow/ GDP ratio around 25% in 2013.

The Shadow Economy in terms of Causal and Indicator variables

Among the most difficult to measure (unobservable) entities in the national economy, both “indirect” and “direct” methods have been used to estimate the shadow economy. With direct methods employing survey and cash use data, correct responses are understandably difficult to elicit, thus limiting their usefulness. Indirect methods include currency demand, and later, the Multiple Indicators.

Multiple Causes (MIMIC) method has been developed to complement both direct and indirect methods. MIMIC has been found particularly useful and hence prevalent in estimating the shadow economy in various parts of the world, as it treats the unobservable entity viz., the shadow economy as a “latent” variable. Typically, in the MIMIC framework a number of proximate causal variables are used, ones those are thought to exert a causal influence on the extent of the shadow economy, and a number of “indicator” variables, viz. manifestations of the shadow (latent) variable.

A huge body of research literature exists on recent estimates of the shadow economy, including, among relatively later works, Bajada and Schneider (2003, 2005 and 2009); Del'Anno and Schneider (2004 and 2006), Giles et al (2003) and

**Estimated Gross Value Added by Informal Sector,
Industry Group-Wise (Major) (continued)**

Table 4

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	Average
Pakistan	37.0	36.8	37.0	36.8	36.2	35.3	34.9	33.8	33.6	35.7
Russia	47.0	46.1	45.3	44.5	43.6	43.0	42.4	41.7	40.6	43.8
Singapore	13.3	13.1	13.3	13.3	13.1	12.8	12.7	12.4	12.2	12.9
Sri Lanka	45.2	44.6	44.6	44.1	43.8	43.9	43.4	42.9	42.2	43.9
Switzerland	8.8	8.6	8.6	8.6	8.8	8.6	8.5	8.3	8.1	8.5
Thailand	53.4	52.6	52.4	51.5	50.2	49.6	49.0	48.5	48.2	50.6
UK	12.8	12.7	12.6	12.6	12.5	12.4	12.4	12.3	12.2	12.5
USA	8.8	8.7	8.8	8.8	8.7	8.6	8.5	8.4	8.4	8.6
Time Average	34.0	33.7	33.6	33.6	33.3	32.9	32.5	32.1	31.2	

Source: Based on Buehn, Monte Negro and Schneider (2010) as cited in Schneider and Williams (2013).

Schneider et al (2008 and 2010, 2013 and 2016).

As observed earlier, being a “latent” or alternatively unobservable variable the shadow economy can be estimated only indirectly, through causes and Indicators. What are the causal variables that may be conceptualized as affecting the shadow economy, and secondly the indicator variables which can be conceived as being manifestations of the shadow economy?

Chatterjee, Chaudhury and Schneider (2003, 2006) are examples of analysis in the Indian context among the various studies undertaken on the shadow economy. Research includes estimates for developed as well as developing country groups; the French and German economies, and specifically, India in comparison with

other Asian nations as well as a study at the Indian state-level.

Among the various causal and indicator variables suggested, a careful review of the extensive literature shows that our choice of variables must be pragmatic as at the same time reflecting an analytical framework that is relevant to India’s unique characteristics ...

Causal Variables

Value added by agriculture

India had started its post-independence planned industrialization with a predominantly agricultural economy, with agriculture and allied activities contributing 53% to the gross value-added in overall GDP (1950-51). With progress of planned industrialization, share of agriculture gradually contracted (35% in 1970-71), although, as noted in Section IV, agriculture continued to be the mainstay of the large informally employed population of India. The slow contraction of value added by agriculture saw further shrinkage since 1990s with the structural adjustment package shifting emphasis away from agriculture and social and rural development, and stood at 20% of GDP as of 2012-13. Value added by agricultural (share in GDP) can be taken as a highly relevant causal factor in the Indian shadow economy, with the intuition that greater this value-added, greater the extent of the shadow economy.

Burden of taxation affects the labor-leisure choice through the disincentive effect of high taxes. Secondly, the decision to avoid taxable areas of activity also increases participation in shadow economy. Thirdly of course, there are the instances of pure tax evasion. India’s initial lofty ideal of development with social justice and equality gave rise to attempts at highly progressive direct taxation, which in reality, resulted in a direct taxes share of merely 8% in total tax share in 1950-51 while indirect taxes, consisting of various sales, excise, cess, customs duties stood at 88.9%. Indian income and corporate tax rates had been particularly high in efforts

to address rampant inequality and poverty; but the extremely complicated tax laws and statutes in India, with innumerable number of slabs and bewildering complexities and exemptions gave rise to rampant tax evasions and the innumerable tax loopholes, serving only to encourage tax avoidance and evasion in ingenious ways. Indirect taxes, on the other hand, are essentially regressive in nature. Moreover, in India the pattern of duties and indirect taxes has frequently added directly to the problem of inflation. Eventually India has enabled itself (by simplification of the tax structure) to raise the share of direct taxes against the indirect taxes, thus also achieving some semblance of social equality in the tax structure.

Our second and third variables reflect the burden of taxation on the economy. On the whole, larger the burden of taxes relative to the economy, larger will the share of the shadow economy as larger will be the tendency to work outside the purview of activities under the purview of taxation. We employ two variables, one the share of direct taxes to total taxes, and secondly the share of indirect taxes, expecting both to bear a positive relationship with the size of the shadow economy.

The next causal factor to consider is the **state of regulations**. As Singh et al (2012) note, “... In developing countries, large informal economies limit state capacity to deliver governance and strong institutions, which in turn discourages participation in and expansion of the formal economy. ... We find that when businesses are faced with onerous regulation, inconsistent enforcement and corruption, they have an incentive to hide their activities in the underground economy” (Singh et al 2012). Thus, regulatory institutions are an important determinant of the size of the underground economy, with the shadow economy being positively related to the regulatory intensity of the economy.

Inflation (Schneider 2006) is another significant causal variable, although literature suggests that frequently the shadow economy in turn puts pressure on the former.

Finally, as the shadow economy comprises people failing, or opting out of, formal sector employment, shadow economy size would be lower the more people find employment in the organized public sector. Thus, we have another causal variable in **public sector employment**, inversely influencing the extent of shadow economy.

Indicators

Indicator variables can be thought of as manifestations of the latent variable, viz. shadow economy, acting as markers to the existence as well as extent of the latter. We have focused on GDP in real terms, and the ratio of currency held by the public among the variables suggested in the literature.

Data and Methodology:

Numerous researchers have estimated comprehensive (sometimes dynamic) MIM-IC model to get a time series index of the hidden variable for various countries. Our study presents an attempt to estimate the shadow economy in India over 1970-2014, employing time-series data on the Indian economy, following the methodology of Bühn and Schneider (2008). Their study demonstrates how cointegration and error correction (ECM) can be accommodated in a MIMIC structure, and the unobservable latent variable (in this case the shadow economy) can be derived from the estimated long run cointegrated relationship, to be later calibrated into cardinal indices from ordinal ones.

Data Availability and Choice of Variables: A Note

Our main data sources for this analysis were 1) World Development Indicators (World Bank); 2) various issues of the Economic Surveys of Ministry of Finance of the GOI; 3) Indian Public Finance Statistics of the Ministry of Finance, 4) the Reserve Bank of India Handbook of Statistics for the Indian Economy. However, while collecting the data on regulatory intensity, attempts to use the Fraser Institute and the Heritage Foundation Database failed to locate continuous and consistent time-se-

ries data dating as far back as to 1980. Whatever data was available prior to 1995, contained too many discontinuities. Considering the substantial range of unavailable data, we decided against employing interpolation for this rather large number of missing data points. Accordingly, we were forced to omit the very crucial variable of regulatory intensity from our final choice of causal variables, remaining fully aware of the fact that this is far from a satisfactory solution. We are conscious of the serious limitation our study suffers from exclusion of an adequate measure of regulation, a shortcoming that we attempt to address in our ongoing research.

The variables structure we thus finally adopt is as follows:

Proposed Structure of the MIMIC Model (India)

Table 4

Variables	Variable Name	Measure	Direction of Relationship with Shadow Economy
Causal	agr_gdp	Share of agriculture in GDP	Positive
	dt	Share of direct taxes in Total Taxes	Positive
	idt	Share of indirect taxes in Total Taxes	Positive
	cpi	Inflation: % annual change of CPI	Negative (Chaudhuri et al 2003, among others)
	pubemp	Population Employed in Public Sector	Negative
“Latent”: The Shadow Economy			
Indicator	lngdp	Natural log of real gdp	Positive
	Curr_pub	Cash with public as ratio of M3	Positive

Source: NCEUS (2012) and Author’s Calculations

Analysis in Brief:

The present analysis studies the time period 1970 to 2014, using annual data. Since time series macroeconomic data generally exhibit non-stationarity, therefore methodologically we follow the comprehensive study by Böhn and Schneider (2008) on the French economy to use cointegration and error-correction (ECM) in a MIMIC framework. This method is also capable of permitting us to derive ordinal estimates of the latent variable from the long-run cointegrating equilibrium equation, which must next be calibrated to obtain some cardinal measure from these ordinal indices.

Table 5 reports the results of the Stationarity (Unit Root) Tests for our variables, both causal and indicators.

All causal and indicator variables being I (1), we now proceed to investigate the possibility of cointegration between all five causes and each of our indicators, under the Engle and Granger two-step approach. Following short run error correction mechanism (ECM), the following two regressions are estimated (Engle and Granger 1987) in least square regressions with variables in levels, where the particular indicator is the dependent variable and the causes are the independent variables (Böhn and Schneider 2008).

$$\text{Ingdp} = \alpha_1 (\text{agr\_gdp}) + \alpha_2 (\text{dt}) + \alpha_3 (\text{idt}) + \alpha_4 (\text{cpi}) + \alpha_5 (\text{pubemp}) + u_1 \dots \dots \quad 1)$$

and

$$\text{curr-pub} = \beta_1 (\text{agr\_gdp}) + \beta_2 (\text{dt}) + \beta_3 (\text{idt}) + \beta_4 (\text{cpi}) + \beta_5 (\text{pubemp}) + u_2 \dots \dots \quad 2)$$

Because all variables are deviations from their means, no constant is included in the regression equations.

Analysis of Stationarity: Causal and Indicator Variables

Table 5

Variable	Test Equation	Level			Test Equation	First Difference		
CAUSES		ADF	PP	KPSS		ADF	PP	KPSS
Agr_gdp	C & T	0.3491	0.3907	0.1039***	C	0.0000	0.0000	0.2801***
DT	C & T	0.7797	0.7528	0.2012*	C	0.0000	0.0006	0.3140***
IDT	C & T	0.7797	0.7528	0.2012**	C	0.0000	0.0000	0.3140***
infln	C & T	1.0000	1.0000	0.2151**	C	0.0496	0.9889	0.6542*
pubemp	C & T	0.6139	0.5635	0.2237	C	0.4175	0.0038	0.7269*
INDI-CATORS		ADF	PP	KPSS		ADF	PP	KPSS
Ingdp	C & T	0.3417	0.3270	0.2163**	C	0.0000	0.0000	0.5720*
curr_pub	C & T	0.4726	0.6149	0.1688*	C	0.0001	0.0001	0.3429***

* Stationarity at 1%. ** Stationarity at 5%. *** Stationarity at 10%.

Note: For the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test, the MacKinnon (1996) one-sided p values are given whereas test statistics are reported for the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. Its critical values are taken from Kwiatkowski et al. (1992). For a test equation with constant (C) the critical values are: 0.347 (10% level), 0.463 (5% level), and 0.739 (1% level) whereas for a test equation with constant and trend (C & T) the critical values are: 0.119 (10% level), 0.146 (5% level), and 0.216 (1% level). For the order of the autoregressive correction for the ADF test, we use the Akaike Information Criterion (AIC). For the PP and KPSS tests, we use the Bartlett kernel estimator and the Newey-West (1994) data-based automatic bandwidth parameter method.

Next, as the unit root test (KPSS) results in Appendix Tables A1 and A2 show, presence of unit roots in either of the residuals u_1 or u_2 is rejected, confirming the stationarity of the residuals. Thus both of our two indicators are cointegrated with the causal variables.

Having confirmed the existence and validity of both cointegration relationships, how do we next proceed to estimate our unobservable latent variable, viz. the size of the shadow economy and the growth thereof? This is possible as now we can

estimate the long run cointegration, which in fact is the equilibrium MIMIC model, which would allow us to derive estimates for the latent variable.

Finally, for estimating the latent variable, Bühn and Schneider (2008) suggest “fixing a scale” for this unobservable variable, one convenient method of doing which is “to set the coefficient of one (...) indicator variables to non-zero” (Bühn and Schneider, 2008). The authors themselves have fixed the coefficient of their GDP variable for this purpose. The ordinal index is then transformed into a cardinal series on the basis of existing parallel studies containing already estimated.

In our case, Chaudhuri et al (2003), Schneider et al (2009) and Sharma (2016) are among the existing studies offering alternative estimates with which to compare and calibrate our estimates for the chosen latent variable, viz. the shadow economy as a ratio of GDP in India.

As indicated earlier, the present study is a work in progress where we are still in the process of consolidating our analysis and results on the Indian shadow economy. Complete analysis of this part has been rescheduled in view of our preoccupation with the other major developments simultaneously unfolding in the Indian economy which, to our mind, merited immediate and greater attention.

Having established that there is, indeed, a valid cointegrating relationship between the causal and indicator variables of the latent shadow economy in India, we are still continuing our further research into this entity. We, therefore, present this section as a tentative and preliminary but a very much indispensable part, of our ongoing research.

VI Conclusion

To sum up this study on what it means for an economy like India with her most pressing problems to go the “cashless” way, our primary inference is that it is still rather early to deduce firm conclusions about the full impact of India’s demonetization attempts. Many economists have argued that the steps should indeed be termed as a currency swap rather than “going cashless” in the truest sense, since rather than cash withdrawal lock stock and barrel, the government has actually replaced old currency with new, although this “remonetization” has fallen short of the extent of withdrawal. However, until the “new numbers” come out fully, the effects of demonetization on India’s long-term economic prospects cannot be properly assessed.

Post-demonetization, official estimates put India’s GDP growth at an unimpaired 7% in the first quarter of 2017, although, as some argue, the cash crunch and the consequent inevitable slowdown in primarily consumer demand should have some medium-term effects.

India has gradually adjusted itself to greater reach of banking and online transactions, but instances of online fraud and scams abound, so that increasing degrees of financial literacy as well as awareness about proper security safeguards have become imperative.

Solving the problem of large scale corruption and tax evasion, all along the bane of India, even now seems rather a distant possibility, given the loopholes in the system and the political and muscle power enjoyed by the rich. To that end, India’s demonetization, no doubt a laudable enough gesture, must stand the test of time. Addressing the staggering extent of the unrecovered loans by the banking sector to Indian big business houses is another urgent concern.

Next, given the evidence on the vast unorganized sector that characterizes the Indian economy, it is not difficult to appreciate the challenges that policymakers face to bring this large volume under accounting and the purview of banking regulations. The “growing informalization” of the Indian economy over the past decades, a remarkably pronounced trend, underscores the urgent necessity of having in place policies designed towards the informal sector which could, with some effort, be transformed from its perceived status as a liability to a flourishing asset to the national economy.

Finally, we conclude our brief analytical foray into India’s shadow economy by reporting the favorable and significant establishment of cointegration among our causal and indicator variables. Our study, under the adopted methodology, is still in its exploratory stage which we are in the process of consolidating further. Second, we must re-emphasize the limitation of having had to omit an index of regulation from our list of causal variables, which our future and ongoing research intends to address. Identification of further relevant causal and indicator variables is also under process. To that end, our research in India’s shadow economy should be seen as a first necessary step towards developing and contributing towards a nuanced understanding of this elusive phenomenon in India’s unique scenario.

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Appendix and equations

Appendix A: Stationarity Tests for Residuals of Cointegration Unit Root Tests for Residual u1 (KPSS)

Table A1

Null Hypothesis: U1 is stationary
Exogenous: Constant, Linear Trend
Bandwith: 1 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.103329
Asymptotic critical values*:	1% level	0.216000
	5% level	0.146000
	10% level	0.119000
Residual variance (no correction)		4.545833
HAC corrected variance (Bartlett kernel)		4.640817

KPSS Test Equation
Depent Variable: U1
Method: Least Squares
Date: 03/23/17 Time: 23:55
Sample (adjusted): 1972 2014
Included observations: 43 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob
C	-5.25E-16	0.701237	-7.49E-16	1.0000
@TREND("1970")	2.06E-17	0.026832	7.67E-16	1.0000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Appendix A: Stationarity Tests for Residuals of Cointegration Unit Root Tests for Residual u1 (KPSS) (continued)			Table A1
Variable	Coefficient	Variable	Prob
R-squared	0.000000	Mean dependent var	3.10E-17
Adjusted R-Squared	-0.024390	S.D. dependent var	2.157329
S.E. of regression	2.183479	Akaike info criterion	4.445111
Sum squared resid	195.4708	Schwarz criterion	4.527028
Log likelihood	-93.56989	Hannan-Quinn criter.	4.475319
F-statistic	5.96E-15	Durbin-Watson stat	1.939034
Prob (F-statistic)	1.000000		

Appendix A: Stationarity Tests for Residuals of Cointegration Unit Root Tests for Residual u2 (KPSS)

Table A2

Null Hypothesis: U2 is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		LM-Stat
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.098023
Asymptotic critical values*:	1% level	0.216000
	5% level	0.146000
	10% level	0.119000
Residual variance (no correction)		7.496194
HAC corrected variance (Bartlett kernel)		18.84280

KPSS Test Equation
Depent Variable: U2
Method: Least Squares
Date: 03/23/17 Time: 23:57
Sample (adjusted): 1972 2014
Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob
C	-0.458443	0.859551	-0.533352	0.5966
@TREND("1970")	0.021498	0.033269	0.646185	0.5217

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Appendix A: Stationarity Tests for Residuals of Cointegration Table A2
Unit Root Tests for Residual u2 (KPSS) (continued)

Variable	Coefficient	Variable	Prob
R-squared	0.009844	Mean dependent var	0.0252268
Adjusted R-Squared	-0.013731	S.D. dependent var	2.783304
S.E. of regression	2.802348	Akaike info criterion	4.943182
Sum squared resid	329.8325	Schwarz criterion	5.024281
Log likelihood	-106.7500	Hannan-Quinn criter.	4.973257
F-statistic	0.417556	Durbin-Watson stat	0.736600
Prob (F-statistic)	0.521675		

Jarque-Berra

	U1	U2
Jarque-Berra	6.421954	2.297484
Probability	0.040317	0.317035

Appendix B: Equations used in Analysis of Shadow Economy

$$\ln gdp = \alpha_1 (agr\_gdp) + \alpha_2 (dt) + \alpha_3 (idt) + \alpha_4 (cpi) + \alpha_5 (pubemp) + u_1 \dots \dots \quad 1)$$

$$curr-pub = \beta_1 (agr\_gdp) + \beta_2 (dt) + \beta_3 (idt) + \beta_4 (cpi) + \beta_5 (pubemp) + u_2 \dots \dots \quad 2)$$



Haylea Campbell, Ben Weisman, Peter Sands (Harvard Kennedy School), Tom Keatinge (Royal United Services Institute): Limiting the use of cash for big purchases: assessing the case for uniform cash thresholds



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Executive Summary

For all the hype about electronic payment systems, cash remains by far the world's most popular mechanism. However, over the past year we have seen an intensification of the discussion about the role of cash in society. Cash has great advantages: it is familiar, simple to use and ubiquitously accepted. However, cash also has downsides. Because cash transactions leave no record, cash plays a critical role in money laundering, tax evasion and terrorist financing.

This debate generates strong feelings, to the extent that it is sometimes depicted

as a “war on cash”. Some decry moves to curtail cash usage as an unwarranted encroachment on individual liberty and a manifestation of an over-reaching state. Others see physical cash as a costly remnant of a pre-digital age that we should get rid of as soon as is feasible. Yet it is also possible to hold a position between these extremes: acknowledging the continued value of cash in modern society, whilst seeking ways to curb its misuse.

In 2016 we witnessed a number of policy initiatives aimed at curbing the illicit use of cash. For example, the ECB decided to stop issuing the €500 note due to concerns about its role in illicit finance. India implemented a radical “demonetisation” strategy, abolishing the 500 and 1000 rupee notes in an effort to tackle the scourge of “black money”. Various governments promoted innovative digital payments systems to replace cash, accelerate financial inclusion and reduce benefit fraud.

One less dramatic innovation that has been gradually gaining favour in Europe and a few countries elsewhere is the notion of cash thresholds, legal limits on the size of transaction for which cash can be used. Proponents of cash thresholds see them as a way to constrain the worst abuses of cash for illegal purposes, while causing minimum inconvenience to legitimate users. The logic is that almost all legal usage of cash involves relatively small transaction values, while a high proportion of large value transactions conducted in cash are connected to money laundering, tax evasion, or some other illegal activity. Cash thresholds are therefore seen as a way of making cash less useful to criminals, without reducing its value to law-abiding citizens.

The purpose of this paper is to provide a critical assessment of the case for such cash thresholds, and also to evaluate whether such thresholds should be set at a uniform level across countries. This is a live policy debate within the EU. Some EU countries, such as France, Belgium and Italy, have already introduced cash thresholds, at levels varying between €1,000 and €15,000. In other EU countries, such as

Germany, the idea has triggered fierce opposition. Thus far, the arguments for such legislation, at least at EU level, have been largely framed within the broader objective of implementing a common counter terrorist financing strategy.¹ The arguments against have typically focused on the infringement of privacy and individual liberty and the belief that such thresholds are a step towards eliminating cash altogether. Yet there does not appear to have been much in the way of a considered assessment of the arguments for and against such thresholds looking more broadly at the potential impact on tax evasion and financial crime, the possible disruption of legitimate economic activity, and taking account of considerations like individual privacy.

The goal of this paper is to provide such an assessment. Our approach has involved a combination of: an in-depth literature review of papers and reports from academics, governmental bodies, law-enforcement agencies, think-tanks and other non-governmental organisations; analyses of available data sources such as payment diary surveys; and interviews with policy experts in governments, central banks, law-enforcement agencies and academia.

¹ European Commission, 'Communication for the Commission to the European Parliament and the Council on an Action Plan for strengthening the fight against terrorist financing' (February 2016), <<http://www.statewatch.org/news/2016/feb/eu-com-action-plan-terr-financing.pdf>> (herein referenced as The EU CTF Action Plan)

We have structured the remainder of this paper in six parts to provide:

1. A summary of **the role of cash in financial crime**, as an enabler of tax evasion, corruption, terrorist finance and money laundering.
2. An outline of **the policy options to curtail the illicit use of cash**, to provide context for cash thresholds.
3. An overview of **the current status of cash thresholds in Europe**.
4. An overview of **the current status of cash thresholds elsewhere in the world**.
5. Our assessment of **the case for uniform cash thresholds**.
6. Our **conclusions and recommendations**.

Our **key conclusions** can be simply summarised:

- First, while there is very limited hard empirical evidence that cash thresholds are effective in deterring financial crime, **there is a robust underlying logic for why cash thresholds should have a beneficial impact in curbing the illicit use of cash**. Criminals like cash because it is so widely accepted, anonymous and virtually impossible to track. Cash thresholds make it harder for them to move large volumes of money into or out of the legal economy.
- Second, **cash thresholds are likely to have most impact on tax evasion and money-laundering connected to organised crime, but relatively limited direct impact on terrorist finance or petty crime**. Cash thresholds make it harder to avoid taxes on large value purchases. Cash-based tax evasion, through avoiding VAT or sales taxes and under-reporting profits, is the largest source of tax evasion in most countries. Cash thresholds also make it much harder and more expensive to launder the cash proceeds of organised crime. Criminals can break up large sums into many smaller transactions (known as “smurfing”), but this is more costly and slower. Cash thresholds would have limited direct impact on terrorist operations since these typically involve relatively low value financial transactions. However, to the extent that cash thresholds impede organised

crime, such measures could help undermine the financing of terrorist organisations.

- **There appear to be very limited downsides to implementing cash thresholds in terms of the impact on legitimate economic activity or concerns about individual privacy.** The overwhelming majority of legitimate cash transactions are below the levels at which cash thresholds would be imposed. High value cash transactions which are not motivated by some illegal purpose appear to be rare and only relevant to a very small, wealthy proportion of the population. Privacy concerns, while legitimate, seem of less relevance to high value transactions, since a large proportion of transactions of this magnitude require some recording of personal details in any case.
- **Cash thresholds appear to be an attractive policy option for curtailing the illicit use of cash with limited adverse effects or implementation risks.** If set at a level well above the purchase price of most consumer durables, but low enough to capture the purchase of vehicles and luxury items, such thresholds should impact money-laundering and tax evasion with very little inconvenience to law abiding citizens.
- **There is a strong case for making such thresholds uniform in a common currency area, such as the Eurozone, but a much weaker case across countries with different currencies.** There is evidence that the imposition of cash thresholds in the specific Eurozone countries has driven money-laundering transactions into neighbouring countries.
- **It should be possible to generate better evidence of the impact of cash thresholds,** particularly if tracking measures are established as part of the threshold implementation. For example, analysis of VAT returns of sectors involved in high value transactions before and after the imposition of thresholds could provide insights into the impact on tax evasion and money laundering.

Based on these conclusions, **we recommend:**

- The EU should pursue the introduction of a uniform cash threshold, at least within the Eurozone.
- Other countries should consider the introduction of cash thresholds as a complement to existing measures to combat financial crime.
- FATF should catalyse consideration of cash thresholds amongst its members, facilitating the transfer of best practices in implementation and impact analysis.

The Role of Cash in Financial Crime

Despite the advances in electronic payments, cash continues to play an enormously important role in society in facilitating legitimate economic activity. It is still by far the dominant payment mechanism as measured by number of transactions, if not by value.² However, there is also clear evidence that cash remains the vehicle of choice for criminal gangs laundering money domestically, regionally and internationally ; that cash payments are a primary mechanism of tax evasion and that cash plays a key role in terrorist finance. This should be no surprise. From a criminal perspective, cash offers an unbeatable set of attributes: as Sands et al and Rogoff describe in two 2016 publications, the fact that cash transactions are universally accepted, irreversible, and anonymous, while leaving no transaction record, makes them superior not only to all types of bank transactions, such as credit cards or wire transfers, but also to Bitcoin and gold.³ Figure 1 below compares the key attributes of payment options from a criminal's perspective.

The advantages of cash from a criminal perspective are well described in Europol's report, 'Why is Cash still King?', which was published in 2015 and is arguably the most authoritative law enforcement literature on the topic of how criminal groups use cash to facilitate money laundering, both in Europe and globally.⁴ Europol's report succinctly explains the link between crime and cash, stating that 'cash in itself is not a method of laundering the proceeds of crime, nor is it an illegal commodity; rather it is an entirely legal facilitator which enables criminals to inject

² Ibid

³ P. Sands et al., 'Making it Harder for the Bad Guys: The Case for Eliminating High Denomination Notes', M-RCBG Associate Working Paper Series (No. 52), February 2016, <<https://www.hks.harvard.edu/centers/mrcbg/publications/awp/awp52>>; Rogoff, Kenneth. The Curse of Cash. Princeton University Press, 2016, < <http://press.princeton.edu/titles/10798.html>>

⁴ Europol, 'Why is cash still king?'(2015), < <https://www.europol.europa.eu/publications-documents/why-cash-still-king-strategic-report-use-of-cash-criminal-groups-facilitator-for-money-laundering> > (herein referenced as Europol Cash Report)

Attributes of different payment mechanisms from criminal perspective

	Payor/ payee anonymity	Lack of traceability	Ubiquity of acceptance	Immediacy of value transfer	
Bank transfer	No	No	Needs payor and payee to have bank accounts	Typically 1-3 days	
Non bank wire transfer	No	No	Through agent	Increasingly real time	
Bitcoin	Yes	No	Very limited	Instant	
Gold	Yes	Yes	Limited	Yes	
Diamonds	Yes	Yes	Very limited	Yes	
Cash	Yes	Yes	Accepted everywhere	Yes	

Source: Sands et al, „Making it Harder for the Bad Guys,” p. 10

illegal proceeds into the legal economy with far fewer risks of detection than other systems.⁵ The anonymity of cash and the fact that it leaves no transaction record are key to the widespread use of cash in money laundering. As Europol’s most recent Serious and Organised Crime Threat Assessment states, cash smuggling is still identified as one of the main ways in which money is laundered in Europe.⁶

The Financial Action Task Force (“FATF”) is the global standard-setter and international authority on the effective implementation of legal, regulatory and operational measures to tackle money laundering and counter terrorist financing. In its October 2015 report, ‘Money Laundering Through the Physical Transportation of

⁵ Ibid, p. 9

⁶ Europol, ‘European Union Serious and Organised Crime Threat Assessment’ (March 2017), < https://www.europol.europa.eu/sites/default/files/documents/socta2017_0.pdf>

Figure 1

	Irreversibility of value transfer	Value constancy	Transaction cost/spread	Physical convenience
	No	High	Variable	Yes
	Sometimes	High	Variable	Yes
	Yes	Extremely volatile	Extremely low	Yes
	Yes	Volatile	High	Heavy and bulky
	Yes	Volatile	Very high	Very compact
	Yes	High	Low	Can be heavy and bulky for large values

Cash’, FATF acknowledges that cash is ‘still the preferred method of settlement for goods and services for billions of people in the world today’.⁷ FATF notes that these transactions are for the most part legitimate, and that people like to use cash for many reasons, ranging from ease of use, universal acceptance, cultural considerations and weaknesses in banking infrastructure in some countries and regions.⁸

However, like Europol, FATF also highlights the role of cash in money laundering. FATF estimates the amount of money laundered annually through the smuggling of cash across international borders to be ‘between hundreds of billions and a

7 FATF, ‘Money Laundering Through the Physical Transportation of Cash’ (October 2015), p. 3, <<http://www.fatf-gafi.org/media/fatf/documents/reports/money-laundering-through-transportation-cash.pdf>>

8 Ibid

trillion US dollars per year.⁹ To put this figure in perspective, the total value of cash outstanding in the world amounts to about US \$4 trillion.¹⁰ Thus, despite widespread legitimate use, a significant proportion of the world's physical cash, and particularly of high denomination bank notes, is being used for illicit purposes.

Much of the recent focus on illicit financial flows in Europe has focused on terrorist finance. In the "Communication for the Commission to the European Parliament and the Council on an Action Plan for strengthening the fight against terrorist financing," the European Commission notes the use of cash in terrorist finance. Cash plays a role in funding terrorist operations, where anonymity and the lack of a transaction record help terrorists evade detection. Cash also plays a role in organised crime activities – such as participation in drug and human trafficking—and secret donations that fund terrorist organisations.

Less prominent in the political debates about cash, but of huge relevance to governments' fiscal positions, is the role of cash in tax evasion. In most countries, cash-based tax evasion is a primary driver of the "tax gap" – the difference between the tax flows the tax system should theoretically yield versus what the government actually receives. For example, in the EU, lost tax revenues from VAT evasion amount to around €160bn per year.¹¹ Much of this is through customers paying for goods and services in cash, which is often either unreported or under-reported. Evidence suggests that smaller businesses in both the U.S. and Europe, and even more in the developing world, under-report a significant proportion of their cash revenues to avoid VAT or sales taxes and to understate profits and thus

⁹ FATF, 'Money Laundering Through the Physical Transportation of Cash' (October 2015), p. 3, <<http://www.fatf-gafi.org/media/fatf/documents/reports/money-laundering-through-transportation-cash.pdf>>

¹⁰ Ibid, Executive Summary

¹¹ European Commission, 'Study and Reports on the VAT Gap in the EU-28 Member States: 2016 Final Report' (23 August 2016), p. 8, <https://ec.europa.eu/taxation_customs/sites/taxation/files/2016-09_vat-gap-report_final.pdf>

reduce corporate tax.¹² Payment of wages in cash also enables employers to avoid social insurance charges and employees to avoid income tax.¹³ Unsurprisingly, when the U.S. Internal Revenue Service sought to improve tax compliance through more extensive auditing, they primarily targeted “self-employed workers who deal largely in cash,” even when the overall focus of the crackdown was on higher-income individuals.¹⁴

Some would argue that the huge social benefits cash provides in facilitating everyday economic activities in the legitimate economy overwhelm the negatives of cash, in terms of its role in enabling illicit activities like money laundering, terrorist finance and tax evasion; and therefore that proposals to eliminate or even reduce the use of cash are misplaced. Yet this perspective misses a crucial difference between the legal and illegal uses of cash. While there are differences between countries, reflecting history and cultural traditions, payment diaries and surveys conducted by central banks indicate that law-abiding citizens almost always use cash for smaller transactions, increasingly switching to other payment mechanisms such as credit and debit cards, checks, and bank transfers as transaction values increase. In most countries, the majority of people would make large transactions (e.g., over €1000) using a non-cash payments instrument.¹⁵ Equally most people hold their savings, not in cash but in bank accounts or forms of mutual funds.

By contrast, criminals hold, move and transact large volumes in cash. Of course

¹² See, e.g.: Susan Morse, Stewart Karlinsky, and Joseph Bankman, “Cash Businesses and Tax Evasion,” *Stanford Law & Policy Review* 20:1 (2009), <<https://law.stanford.edu/wp-content/uploads/sites/default/files/publication/259083/doc/slspublic/Morse%20Bankman%20Karlinsky%20StanLPolyRev37.pdf>

¹³ Abbi Kedir, Meryem Duygun Fethi, and Colin Williams, “Evaluating Tax Evasion in the European Union: a case study of the prevalence and character of ‘envelope wage’ payments,” University of Leicester Department of Economics Working Paper No. 11/33 (June 2011), <<https://www.le.ac.uk/economics/research/RePEc/lec/leecon/dp11-33.pdf>>

¹⁴ Tom Herman and Rachel Emma Silverman, “IRS to Increase Audits Next Year,” *Wall Street Journal* (23 November 2005), <<https://www.wsj.com/articles/SB113269901725904537>>

¹⁵ European Central Bank, ‘Consumer cash usage: A cross-country comparison with payment diary survey data’ (June 2014), <<https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1685.pdf>>

there is a lot of petty illegal activity conducted in cash, such as small bribes and the underreporting of tips but, unlike in the legal world, criminals also use cash for large transactions and to hoard and move their illicit gains. As countries continue to strengthen anti-money laundering (AML) policies for the banking sector, many criminals find it increasingly difficult to effectively launder ill-gotten proceeds from crime through traditional techniques. Purchases of high-value goods offer illicit actors the ability to integrate their cash into the legitimate economy without raising AML flags. This is why high denomination bank notes are disproportionately used for illegal activities and why a significant share of large cash transactions are likely to be connected to illicit activity.

Given this skew in usage patterns, it seems logical to focus efforts to curb the illicit use of cash on measures that make it harder to move, store and transact large volumes. Eliminating high denomination notes or imposing cash thresholds makes it harder for criminals to use cash to conceal large cash volumes whilst minimising the impact on the legitimate use of cash.

Policy Options to Curb the Illicit Use of Cash

To assess the case for cash thresholds, it makes sense to examine other policy options. Recent measures taken to curtail the illicit use of cash largely reflect this focus on large transactions and the movement and storage of large volumes of cash.

Eliminating High Denomination Notes

In May 2016, the European Central Bank (ECB) announced that the €500 note would no longer be issued from the end of 2018, due to 'concerns that the bank-note could facilitate illicit activities'.¹⁶ This impetus for this decision sprang from the

¹⁶ European Central Bank, 'ECB ends issuance and production of EUR 500 note' (4 May 2016), <<https://www.ecb.europa.eu/press/pr/date/2016/html/pr160504.en.html>>

intense desire within the EU to take decisive action on terrorist financing following the Paris attacks. The logic of ending the production of high denomination notes such as the €500 was set out in “Making it Harder for the Bad Guys: the case for Eliminating High Denomination Notes” by Sands et al. in February 2016 and was also strongly supported by Europol.¹⁷ The essence of the argument is that high denomination notes are increasingly rarely used for legitimate purposes, but heavily used by criminals since they enable large sums to be moved, stored and transacted covertly. Whilst not the highest value bank note in the world (for example, the SING\$ 5000 and CHF 1000 are more valuable) the €500 has by far the largest outstanding stock (worth over €300bn) and there is ample evidence of its use in drug trafficking and other crimes.

It is worth noting that the ECB has adopted a very gradual approach to removing the €500 note. Issuance will continue until 2018 and the €500 note will remain legal tender indefinitely. As yet there appear to be no plans to accelerate withdrawal from circulation of the existing stock once issuance ends. Such an approach minimises the risk of inconvenience to legitimate users of the €500 note, but also undermines the potentially disruptive impact on criminal business models.

Imposing Reporting Requirements on Bulk Cash Movements

Whilst relatively few countries have introduced cash thresholds, many have well established reporting requirements for cash transactions of certain types and values. Some countries have thresholds that apply only to transactions conducted with financial institutions, whereas others address high-value purchases from retailers and other businesses. Such reporting requirements have a dual purpose: first, they provide a record of such transactions to financial intelligence units and

¹⁷ Bloomberg, ‘Europol Director Sees Case for Scrapping High-Value Banknotes’ (8 February 2016), <<https://www.bloomberg.com/news/articles/2016-02-08/high-value-banknotes-should-be-binned-to-fight-crime-sands-says>>

other law enforcement agencies; and second, by the very fact of requiring such a record, they make it more difficult for criminals to launder cash.

There are well established mechanisms requiring the declaring and reporting of large cross-border flows of cash. In the Eurozone €10,000 or equivalent must be declared, and elsewhere in the world the threshold is typically US\$10,000. However, the efficacy of such reporting requirements can be questioned for two reasons: first, huge volumes of cross-border cash smuggling continues undeclared; and second, even where declarations are made, and reports filed, there is usually little action. This is partly because in some jurisdictions there is no legal basis for further investigation, and partly because of the sheer volume of such reports. In the US, for example, the Financial Crimes Enforcement Network ("FinCEN") received almost 16 million reports on cash transactions over \$10,000 in 2006.¹⁸ Financial intelligence units like FinCEN struggle to process such volumes. Moreover, most financial intelligence units are designed to assist in criminal investigations, but not to conduct investigations themselves; in the case of FinCEN, reports are received and processed, but there is no capacity to investigate until they are approached by another law enforcement agency, like the FBI.¹⁹ In addition to the overwhelming volume of reports, there is the problem that there is nothing inherently illegal about using significant amounts of cash. Thus, were law enforcement and tax agencies to seek to build criminal cases on currency transaction reports, they would need far more information than is typically given on such a report.

Reporting requirements for large volume domestic cash transactions vary by jurisdiction. In some countries, companies using high volumes of cash are designated High Value Dealers ("HVD") and are subject to specific reporting requirements.

¹⁸ Committee on Financial Services, 'Suspicious Activity and Currency Transaction Reports: Balancing Law Enforcement Utility and Regulatory Requirements' (10 May 2007), <<https://www.gpo.gov/fdsys/pkg/CHRG-110hhrg37207/html/CHRG-110hhrg37207.htm>>

¹⁹ Ibid

Such regulations vary in scope and efficacy. For example, in the UK, any business that accepts cash payments over €15,000 must register as a HVD and carry out anti money laundering checks. However, even the UK Government's National Risk Assessment on Money Laundering and Terrorist Financing suggests the true number of businesses accepting payments of over €15,000 is higher than the number of businesses which have registered.²⁰ A November 2015 Transparency International report, entitled 'Don't Look Won't Find', examined the UK's AML regime and specifically highlighted the luxury goods sector and HVDs as an area of weakness.²¹ The luxury goods sector submits a remarkably low number of Suspicious Activity Reports to authorities.²² In the EU, the forthcoming Fourth Anti-Money Laundering Directive²³ requires those receiving €10,000 or more to declare the transaction, with the logic that large cash payments are 'highly vulnerable to money laundering and terrorist financing'.²⁴

Banks are also required to identify suspicious cash transactions, such as repeated large volume deposits or withdrawals, using sophisticated transaction surveillance systems to generate alerts. Where further investigation suggests an alerted transaction could be linked to money-laundering, the bank is obliged to file a Suspicious Transaction Report ("STR"). Whilst an STR can yield valuable intelligence, it is widely recognised that this system is fairly ineffective. There are two fundamental problems. First, the sheer volume of alerts and STRs overwhelms the capacity of law

20 HM Government, National Risk Assessment on Money Laundering and Terrorist Financing (Oct 2015) p.59; see UK Money Laundering Regulations 2007, s. 3(12)

21 Transparency International, 'Don't Look Won't Find: Weaknesses in the Supervision of the UK's Anti-Money Laundering Rules' (November 2015), < https://transparency.eu/wp-content/uploads/2016/11/TI_UK_Dont_Look_Wont_Find.pdf>

22 Ibid, p. 57

23 Directive (EU) 2015/849 of the European Parliament and of the Council of 20 May 2015 on the prevention of the use of the financial system for the purposes of money laundering or terrorist financing, amending Regulation (EU) No 648/2012 of the European Parliament and of the Council, and repealing Directive 2005/60/EC of the European Parliament and of the Council and Commission Directive 2006/70/EC

24 Ibid, (6)

enforcement agencies. Most STRs are not investigated. Second, STRs are generated from the transaction data of individual banks, rather than from data pooled across banks. Sophisticated criminals disperse their transactions across multiple banks to avoid arousing suspicion. These issues are particularly acute with cash transactions since – unlike with transactions through bank accounts- it is impossible to piece together the trail of transactional activity.

Promoting Electronic Alternatives to Cash

Alongside measures to constrain the use of cash, many countries have actively supported the development of electronic alternatives, such as contactless cards, mobile payment systems, or electronic benefit disbursement schemes. By actively promoting alternatives to cash, governments both reduce the appeal of paper currency while also bolstering financial inclusion in order to minimise the potential negative effects of policies to reduce the value of cash to criminals. Many national and local governments now provide transfer payments to citizens exclusively through electronic means, with some, like Denmark, providing free bank accounts and debit cards in order to ensure low-income unbanked households are able to access their funds.

Sweden has arguably done more than any other country to encourage the adoption of electronic alternatives to cash. Sweden has one of the lowest levels of cash outstanding relative to GDP (at 1.8%, compared to 10.1 % for the Eurozone and 7.4% for the United States) and cash usage is declining as consumers and businesses increasingly use electronic alternatives for all types and sizes of payments.²⁵ The Riksbank, Sweden's central bank, announced in November 2016 that it hopes to be the first major central bank in the world to launch its own digital currency, the

²⁵ Kenneth Rogoff, *The Curse of Cash*, Princeton: Princeton University Press (2016).

ekroner.²⁶ After eliminating Sweden's highest-denomination note (the 1,000 krona note, worth approximately €105), the government also smoothed the transition to electronic payments through measures like distributing card-reading devices to churches and homeless people to enable them to receive donations.²⁷ Denmark has similarly seen demand for cash decline, facilitated in part by the introduction of Mobile Pay, a mobile app that enables Danes to make payments to businesses or other individuals.²⁸

These developments are not limited to highly developed countries. In Kenya it has become the norm to make payments using mobile-money, with The Economist reporting in 2015 that more than two-thirds of the adult population use the system M-PESA, with an annual transaction volume equivalent to 25% of GDP.²⁹ The suite of demonetisation efforts in India has included measures to promote opening of bank accounts and has led to a surge in the use of various electronic payment platforms.³⁰

The logic here is ultimately to render cash unnecessary by ensuring that consumers and businesses have access to a wide range of flexible payment and value storage options with minimal transaction costs. Take-up of such systems varies enormously from country to country, reflecting differences in technology, culture and incentives. However, it is increasingly true that viable electronic alternatives to cash exist in almost all markets, including the developing world.

²⁶ The Wall Street Journal, 'Sweden's Central Bank Considers Digital Currency' (16 November 2016), <<https://www.wsj.com/articles/swedens-central-bank-considers-digital-currency-1479296711>>

²⁷ Kenneth Rogoff, *The Curse of Cash*, Princeton: Princeton University Press (2016).

²⁸ *Ibid*.

²⁹ The Economist, 'Why does Kenya lead the world in mobile money?' (2 March 2015), <<http://www.economist.com/blogs/economist-explains/2013/05/economist-explains-18>>

³⁰ Wade Shepard, "After Day 50: The Results from India's Demonetization Campaign Are In," *Forbes* (3 Jan 2017), <<https://www.forbes.com/sites/wadeshepard/2017/01/03/after-day-50-the-results-from-indias-demonetization-campaign-are-in/2/#fb7622a64e63>>

Pursuing a Multi-Pronged Approach

The most far-reaching of recent initiatives to stop the illicit use of cash and accelerate the switch to electronic payment methods has been India's "demonetisation" programme, launched in November 2016. This combined the abrupt withdrawal of the 500 and 1000 rupee notes as legal tender, with the imposition of cash reporting limits, cash thresholds and the accelerated roll out of electronic payment schemes. While it is too early to judge the full impact of these dramatic interventions to tackle "black money", it appears that they have triggered a significant shift towards electronic payment alternatives, but at considerable cost and disruption, particularly for the more impoverished who rely on the informal economy. Both the strategy and execution seem somewhat flawed. Removing India's highest value bank notes, the 500 and 1000 rupee notes, only to replace them with a 2000 rupee note seems illogical.³¹ The short timeframe for withdrawal plus limited availability of alternatives (other denominations or electronic), plus the lack of preparedness of the banks exacerbated the disruption.

Imposing Cash Thresholds

Set against these policy options, cash thresholds, the subject of this paper, look to be a relatively low risk, yet potentially effective option for constraining illicit cash usage. Cash thresholds are often seen as politically easier to implement than eliminating high denomination notes, and potentially less disruptive to legitimate cash usage, but more effective than simply imposing incremental reporting requirements on banks or HVDs. However, despite having been introduced in a few countries in Europe and elsewhere, cash thresholds are often overlooked as a policy option. In the remainder of this paper we describe the current status of cash thresholds in Europe and elsewhere in the world, then offer a considered

³¹ Royal United Services Institute, 'The Global War on Cash: Another Front in the Fight Against Corruption and Crime' (2 December 2016), < <https://rusi.org/commentary/global-war-cash-another-front-fight-against-corruption-and-crime>>

assessment of their merits and of the case for adopting consistent thresholds across countries.

Current Status of Cash Thresholds in Europe

As Figure 2 shows, twelve EU member states have already implemented cash thresholds at various levels. In the wake of recent terrorist attacks there is increasing discussion about whether a uniform threshold should be imposed across the EU. Europol has recommended that all EU member states consider ‘the introduction of common cash payment thresholds’ in order to tackle the prevalence of money being laundered through the cash purchase of high value items.³² Europol cites the thresholds enacted by Spain, Italy, Greece and France as good practice.³³ In a similar vein, the EU Counter Terrorist Finance Action Plan envisages examining the case for EU-wide restrictions on cash payments above a certain amount.³⁴

Most recently the European Commission published a ‘Proposal for an EU initiative on restrictions on payments in cash’ on 23 January 2017. This initial impact assessment positions the matter as a potential legislative initiative that will inform Commission planning in 2018.³⁵ In setting out this proposal, the Commission argues that lack of harmonisation across EU member states allows criminals and terrorist financiers ‘to bypass the restrictions by moving to the Member States, which have not introduced any restrictions, while still conducting their illegal activities in the “stricter” Member State.’³⁶ Whilst acknowledging that the imposition of a uniform cash threshold would have a potentially disruptive impact on some sectors of the

³² Ibid, 36

³³ The limits imposed by each of these states can be found in the table in Part B.

³⁴ EU CTF Action Plan

³⁵ European Commission, ‘Inception Impact Assessment: Proposal for an EU initiative on restrictions on payments in cash’ (23 January 2017), <http://ec.europa.eu/smart-regulation/roadmaps/docs/plan_2016_028_cash_restrictions_en.pdf>

³⁶ Ibid, p. 2

Figure 2

EU Member State	Cash Transaction Limit
Belgium	EUR 3,000
Bulgaria	9,999 Leva (approx. EUR 5,110)
Croatia	EUR 15,000
Czech Republic	CZK 350,000 (approx. EUR 14,000)
France	EUR 1,000 (Residents) EUR 10,000 (Non-Residents)
Greece	EUR 1,500
Italy	EUR 2,999.99
Poland	EUR 15,000
Portugal	EUR 1,000
Romania	RON 10,000 (approx. EUR 2,260)
Slovakia	EUR 15,000
Spain	EUR 2,500 (Residents) EUR 15,000 (Non-Residents)

economy, the Commission believes that the potential negatives would be mitigated by the fact that cash usage across Europe is declining as more citizens use non-cash payment mechanisms more regularly. According to ECB figures for 2015, each EU inhabitant had an average of 1.5 payment cards and the number of card

transactions rose by 11.5% to 53 billion, with a total value of €2.6 trillion.³⁷ The Commission also contends that the impact on efforts to combat both money laundering and tax fraud would be positive.³⁸

However, any move towards uniform cash thresholds in the EU would need to overcome the sharp disparities between member states in usage and attitudes towards cash. These are clearly revealed in the cross-country comparison of payment diary survey data published by the ECB in June 2014.³⁹ Although there has been a 'breath-taking transformation' in the use of non-cash payment methods across Europe, cash remains heavily used in some countries, such as Austria and Germany. In these countries consumers prefer to use cash across all transaction value quartiles (from low value to high value payments) in stark contrast to countries like The Netherlands or France, as shown in Figure 3 below, which is taken from the ECB's 2014 study on consumer cash usage⁴⁰:

There is significant divergence across EU member states on cash thresholds. In some EU countries, such as France, Belgium, Spain and The Netherlands, cash thresholds appear to be widely accepted and relatively uncontroversial, partly because there is widespread adoption of electronic payment instruments, particularly for larger transactions, and partly because of the consensus around the need to take action to counter illicit finance. In others, such as Germany, there is much more debate about them. In countries like the UK there has been scarcely any debate about the concept.

³⁷ European Central Bank, 'Press Release: Payments statistics for 2015' (26 September 2016), <<http://www.ecb.europa.eu/press/pdf/pis/pis2015.pdf>>

³⁸ Ibid (29), p.5

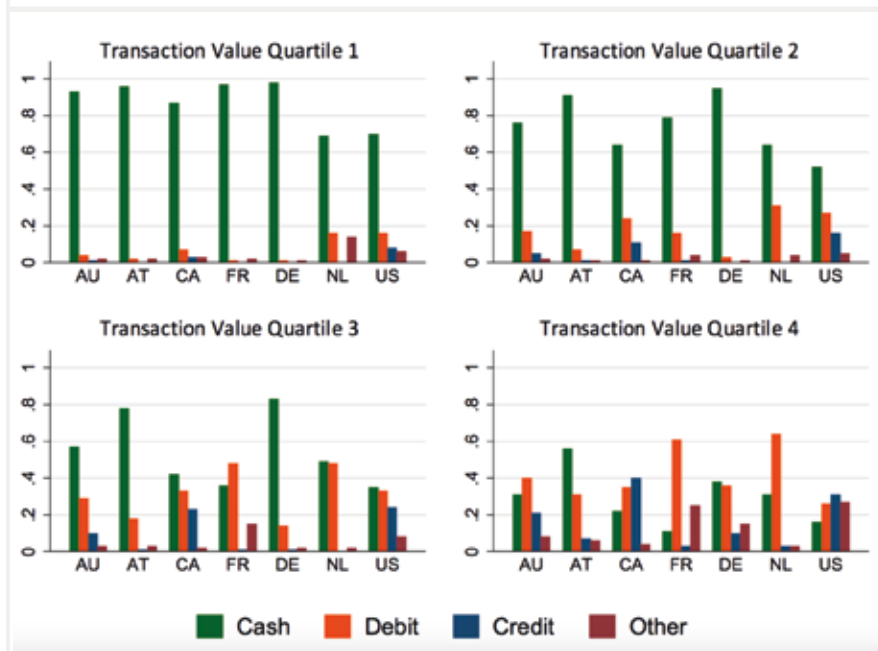
³⁹ European Central Bank, 'Consumer cash usage: A cross-country comparison with payment diary survey data' (June 2014), <<https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1685.pdf>>

⁴⁰ Ibid, p. 47

Consumer Payment Choice by Transaction Value

Figure 3

(in Australia, Austria, Canada, France, Germany, Netherlands, United States)



Note: Quartiles represent the distribution of transaction values within each country, and thus cover different ranges of dollar/euro values for each country (e.g., for the United States, Quartile 1 includes transactions of US \$0 to \$12.30, Quartile 2 includes transactions of \$12.31 to \$22.70, Quartile 3 includes transactions of \$22.71 to \$39.80, and Quartile 4 includes transactions of more than \$39.80). Source: ECB, "Consumer Cash Usage" (2014)

France

France has been a leader within the EU on many aspects of the debate on actions to constrain the illicit use of cash, with a particular focus on tackling terrorist finance. Following the January 2015 terrorist attack in Paris, France introduced a €1000 cash threshold, with the French Minister of Finance, Michel Sapin, asserting as the reason that 'low-cost terrorism feeds on fraud, money laundering and petty

trafficking.⁴¹ In order to minimise the potential harm to tourism, the threshold for foreign visitors was set at €10,000.⁴²

Belgium

Belgium first introduced a cash threshold, set at €15000, in January 2004. The level was reduced to €5000 in April 2012 and to €3000 in January 2014. However, legal enforcement only began in 2011, and before enforcement the ban was poorly observed. While there has been no overall assessment of impact, through their enforcement activities the Belgian authorities have seen many cases of attempts to hide the origin or destination of the money. This includes money laundering, including from the drug trade, tax fraud and trading in stolen jewels. Belgium has also witnessed some diversion of illicit activity to other countries.⁴³

Germany

Germany has seen perhaps the most vocal opposition to the introduction of cash thresholds. In February 2016, when the German Government proposed the introduction of a €5,000 limit, political parties across the spectrum and the leading German daily newspaper, *Bild*, protested against the move.⁴⁴ Experts within the country are sceptical of the benefits of such a threshold; with the economist Friedrich Schneider of Linz University telling *Die Zeit* newspaper that a ban on cash transactions would only reduce illegal labour by 2-3%.⁴⁵

41 Reuters, 'France steps up monitoring of cash payments to fight 'low-cost terrorism'' (18 March 2015), <<http://www.reuters.com/article/us-france-security-financing-idUSKBN0ME14720150318>>

42 Ibid

43 In correspondence between the author and Christian Bourlet (Directeur, Direction générale de l'inspection économique - Contrôles services financiers et prévention du blanchiment – Belgium)

44 International Compliance Association, 'All change on cash? Tackling money laundering through cash transaction limits in Germany' (6 May 2016), <<https://www.int-comp.org/insight/2016/may/06/all-change-on-cash-tackling-money-laundering-through-cash-transaction-limits-in-germany/>>

45 The Guardian, 'German plan to impose limit on cash transactions met with fierce resistance' (8 February 2016), <<https://www.theguardian.com/world/2016/feb/08/german-plan-prohibit-large-5000-cash-transactions-fierce-resistance>>

More recently, the case for introducing cash thresholds has again arisen, with the German Customs Investigation Bureau ("GCIB") revealing in a study that Germany has become a more popular destination for those seeking to launder money due to cash thresholds elsewhere in Europe.⁴⁶ Enforcing a cash threshold is supported by German Finance Minister, Wolfgang Schäuble, with a spokeswoman for the German finance minister stating that the recent GCIB study demonstrates that there is a 'suction effect'.⁴⁷ Yet while Schäuble is in favour, the issue is far from uncontroversial with other members of his party, the Christian Democratic Union (CDU) and its sister party, the Christian Social Union (CSU). CSU financial policy expert Hans Michelbach has bristled at the idea of being 'patronised by the government' and has referred to the cash limit as 'the stuff of the devil'.⁴⁸ Such language indicates the intense emotions informing the debate. Many in Germany see restrictions on the use of cash as unwarranted restrictions on individual liberty and the policy objective of shifting transactions to electronic means as dangerously threatening to individual liberty.

Italy

The political dynamics of cash thresholds in Italy offer a striking contrast. Prime Minister Mario Monti introduced a cash threshold of €1,000 in December 2011, ostensibly to curb tax evasion.⁴⁹ Monti wanted a 'revolution' in the way Italians thought about and conducted cash payments.

However, in 2015, then-Prime Minister Matteo Renzi introduced legislation to raise the threshold to €2,999, a move met with fierce resistance from anti-corruption

⁴⁶ Handelsblatt Global, 'An El Dorado for Money Launderers' (17 February 2016), <<https://global.handelsblatt.com/finance/germany-an-eldorado-for-money-launderers-446094>>

⁴⁷ Ibid

⁴⁸ Ibid

⁴⁹ Bloomberg, 'Italy's Cap on Cash Payments' (8 December 2011), <<https://www.bloomberg.com/news/articles/2011-12-08/italys-cap-on-cash-payments>>

campaigners in the country.⁵⁰ The reasons for this move were ostensibly to encourage the use of cash in the country in an attempt to spur spending during the country's recession.⁵¹ This decision was highly controversial, even within his own government,⁵² as it was seen as emblematic of the government's declining commitment to combatting tax evasion and the informal economy.⁵³

The cash threshold was increased despite indicative evidence⁵⁴ that the €1,000 limit was having a beneficial impact on curtailing the illicit use of cash within Italy, a country with a much larger underground economy than many of its EU counterparts (official estimates suggest the informal economy constitutes about 17% of total GDP.⁵⁵ Whilst the estimated size of the UK's non-observed economy is 2.3% of GDP and France, 6.7% of GDP.)⁵⁶ Banca d'Italia analysis underscores the role of cash in organised crime and corruption and suggests that the cash threshold has had an impact on syndicate money laundering, reducing the usage of high denomination notes.⁵⁷

⁵⁰ LSE EUROPP, 'Raising limits on cash payments sends the wrong signal in Italy's fight against corruption' (26 November 2015), <<http://blogs.lse.ac.uk/europpblog/2015/11/26/wrong-signals-in-the-anti-corruption-fight-why-italy-must-not-raise-the-limit-for-cash-payments/>>

⁵¹ The Economist, 'Show me the money' (5 December 2015), <<http://www.economist.com/news/europe/21679490-matteo-renzi-wants-encourage-people-use-more-cash-bad-idea-show-me-money>>

⁵² The Paypers, 'Italy: Renzi raises cap on cash use to EUR 3,000' (15 October 2015), <<http://www.thepayers.com/payments-general/italy-renzi-raises-cap-on-cash-use-to-eur-3-000/761745-27>>

⁵³ Ibid

⁵⁴ See: Banca d'Italia, 'An econometric analysis of Italian municipalities' (2016), <https://uif.bancaditalia.it/pubblicazioni/quaderni/2016/quaderni-5-2016/QAR_Analisi_e_Studi_n_5_INTERNET.pdf>

⁵⁵ Ibid, p. 5

⁵⁶ OECD, 'The Non-Observed Economy in the System of National Accounts' (June 2014), <<https://www.oecd.org/std/na/Statistics%20Brief%2018.pdf>>

⁵⁷ In an interview with author (5 January 2017)

Switzerland

Outside the EU, in January 2016 Switzerland introduced a cash threshold of CHF 100,000 (approx. €94,000),⁵⁸ arguably too high to have any impact on combatting financial crime. This perhaps reflects Swiss ambivalence on the topic, which is also reflected in continued issuance of the CHF 1000 note.

Although there are persistent differences in cash usage, the divergence of attitudes towards cash thresholds across Europe appear more of a reflection of cultural and historical differences about the role of cash than hard facts about the nature of large value cash transactions.⁵⁹ Reflecting on the differences in spending habits of different nations, economist Charles Goodhart emphasises the need to take account of cultural differences, introducing measures like cash gradually and perhaps initially at a higher level than would be ideal, with a view towards reducing them over time.

Current Status of Cash Thresholds Elsewhere in the World

Outside Europe, there are relatively few examples of countries that have instituted cash transaction thresholds. Jamaica, Mexico, Uruguay, and India have mandated hard thresholds on the amount of cash that can be used in certain types of transactions. Israel, Russia, and Vietnam have proposed legislation to do the same. Although it is difficult to measure the impact of these measures, these cases – and the debate that has surrounded them – are instructive.

⁵⁸ The Swiss Federal Council, 'Entry into force of Federal Act for Implementing Revised FATF Recommendations of 2012' (29 April 2015), <<https://www.admin.ch/gov/en/start/documentation/media-releases.msg-id-57064.html>>

⁵⁹ In an interview with author (19 January 2017)

Jamaica

In 2013, Jamaica amended its Proceeds of Crime Act to prohibit cash transactions over 1,000,000 Jamaican dollars (approximately US \$8,000).⁶⁰ This limit was selected after a debate in the Parliament, during which the originally proposed J\$500,000 was increased (but not to the alternatively proposed J\$2,000,000) in order to accommodate the alleged day-to-day cash needs of many small and medium-size businesses.⁶¹ During the debate, the government argued for the need to create a paper trail in order to facilitate tax collection, as well as to reduce the ability of criminals to transact. Many in the opposition argued that this would force individuals and small businesses to absorb fees for a wide range of bank services, which had previously been avoided by using cash.⁶² Since this policy was adopted, there have been several cases of individuals prosecuted for violating the threshold, indicating that enforcement is possible, even in relatively less developed contexts.⁶³

Mexico

In 2013, Mexico introduced two thresholds for cash payments: 500,000 pesos (approximately US \$25,000) for real estate transactions, and 200,000 pesos (approximately US \$10,000) for automobiles, luxury goods, and lottery tickets.⁶⁴ The law also requires real estate brokers and other cash recipients to report the form of payment for transactions above the limit to the country's Specialized Unit in

⁶⁰ The Jamaica Star, 'Legal eagle: There is a limit to cash transactions' (15 August 2016), <<http://jamaica-star.com/article/features/20160815/legal-eagle-there-limit-cash-transactions>>

⁶¹ Jamaica Information Service, 'House Approves Legislation to Place \$1 Million Limit on Cash Transactions' (17 October 2013), <<http://jis.gov.jm/house-approves-legislation-to-place-1-million-limit-on-cash-transactions/>>

⁶² The Jamaica Gleaner, 'J\$1 Million Is Enough Cash' (1 November 2013), <<http://jamaica-gleaner.com/gleaner/20131101/business/business91.html>>

⁶³ The Loop Jamaica, 'Men fined \$300,000 for exceeding cash transaction limit' (29 August 2015), <<http://www.loopjamaica.com/content/men-fined-300000-exceeding-cash-transaction-limit>>; The Jamaica Observer, 'Your banking movements may be criminal' (21 July 2015), <http://www.jamaicaobserver.com/columns/Your-banking-movements-may-be-criminal_19219751>

⁶⁴ Forbes, 'Large Cash Transactions Banned In Mexico' (17 October 2012), <<http://www.forbes.com/sites/jonmatonis/2012/10/17/large-cash-transactions-banned-in-mexico/#5ab534376631>>

Financial Analysis. This law follows a 2010 limit on foreign exchange cash transactions, the effects of which were likely limited by both the relative ease with which cash moves over the U.S./Mexican border, as well as the relatively high level of cash usage in the Mexican economy (for example it is reported that it is 'routine to see all-cash purchases of high-end items such as real estate, airplanes, horse farms and expensive art'⁶⁵). While opposition has been limited, there has been some questioning of whether this limit is legal according to previously adopted Mexican law guaranteeing no restrictions on the use of the peso note.⁶⁶

The combination of the foreign cash thresholds (which keep more illicit cash outside of the formal banking sector) with the cash transaction threshold stands to reduce significantly the value of cash to illicit actors. Importantly, Mexican and U.S. officials see their ability to impede illegal cash flows across the border as very limited.⁶⁷ The 2013 restrictions, assuming they are enforced effectively, may have some significant impact on the ability of criminals to use illicit funds, particularly in the purchase of real estate. There is some anecdotal evidence that the law has affected the real estate market in Sinaloa, a state notorious for its affiliation with a major cartel, where real estate brokers, jewellery stores, and car dealerships all reported significant decreases in sales after the law's introduction in 2014 (although there was also a significant decline in the value of the peso that year).⁶⁸ However, given the relatively high threshold (approximately equal to per capita GDP for the non-real estate limit), there is likely still substantial activity taking place with illicit cash.

⁶⁵ Los Angeles Times, 'Mexico limits dollar transactions' (15 June 2010), <<http://articles.latimes.com/2010/jun/15/world/la-fg-mexico-dollar-20100616>>

⁶⁶ Mondaq, 'The Challenges of Anti-Money Laundering Legislation In Mexico' (1 September 2015), <<http://www.mondaq.com/mexico/x/423984/Money+Laundering/Having+received+international+praise+for+their+success+in>>

⁶⁷ WashingtonPost, 'Mexico targets money laundering with plan to limit cash transactions' (26 August 2010), <<http://www.washingtonpost.com/wp-dyn/content/article/2010/08/26/AR2010082605355.html>>

⁶⁸ Debate, 'Ley antilavado impactó actividad inmobiliaria' (16 December 2014), <<http://www.debate.com.mx/economia/Ley-antilavado-impacto-actividad-inmobiliaria-20141216-0091.html>>

Uruguay

Uruguay introduced a US \$5,000 limit on cash transactions in 2015 as part of a Financial Inclusion Law designed to increase transparency, improve financial access, and strengthen government finances.⁶⁹ The law was accompanied by other measures to boost the adoption of cashless payments, including a requirement for both taxes and salaries to be paid electronically by 2017.⁷⁰ So far, these measures seem to have been successful at reducing cash transactions without cutting off citizens' access to payments.⁷¹ A side benefit appears to be an expected boost to bank lending stemming from an increase in peso deposits and electronic transaction volumes.⁷² There appears to be relatively little opposition to the limit, perhaps due to the accompanying measures which increase financial inclusion (as well as the belief that most high-value cash payments in Uruguay are conducted by visitors from neighboring countries, such as Argentinean real-estate purchasers). However, despite improvements to the anti-money laundering regime such as the cash limit, there are still serious concerns regarding the laundering of funds from transnational crime in Uruguay, illustrating the need for effective enforcement of such policies.⁷³

69 Buenos Aires Herald, 'Uruguay bans all cash payments over US\$ 5,000 as of next year' (27 August 2014), <[http://www.buenosairesherald.com/article/168152/uruguay-bans-all-cash-payments-over-us\\$5000-as-of-next-year](http://www.buenosairesherald.com/article/168152/uruguay-bans-all-cash-payments-over-us$5000-as-of-next-year)>

70 Uruguay: 2014 Article IV Consultation Staff Report <https://books.google.com/books?id=kpd-8CAAQBAJ&pg=PA25&lpg=PA25&dq=uruguay+cash+transaction+limit&source=bl&ots=e39CPeV9Y-D&sig=-1c8eAVPUTf9DzWq7Tqv19d0PYo&hl=en&sa=X&ved=0ahUKEwj3Y30p6TSAhXn24MKHTx-6CLQ4ChDoAQg1MAU#v=onepage&q=uruguay%20cash%20transaction%20limit&f=false>

71 The Financial Express, 'Towards a less-cash society: Why informed users, stakeholders are a must' (6 October 2016), <<http://www.financielexpress.com/opinion/1-towards-a-less-cash-society-why-informed-users-stakeholders-are-a-must/407784/>>

72 IMF, 'Uruguay: Selected Issues Paper' (February 2016), <<https://www.imf.org/external/pubs/ft/scr/2016/cr1663.pdf>>

73 U.S. Department of State, '2016 International Narcotics Control Strategy Report – Uruguay' (2016), <<https://www.state.gov/j/inl/rls/nrcrpt/2016/vol2/253439.htm>>

India

As part of the broader “demonetisation” strategy and following the recommendation of a Special Investigation Team appointed by the country’s Supreme Court, India’s Finance Minister, Arun Jaitley, proposed a ban on all cash transactions above 3 lakh (300,000 rupees, or approximately US \$4500) effective 1 April 2017.⁷⁴ India’s recent ‘demonetisation’ push has thus far focused on attempting to rid the country of ‘black money’ by invalidating older-series 500 and 1000 rupee (approximately US \$7.50 and US \$15, respectively) notes. Compared to the note invalidation, the proposed cash threshold has been received more favourably, in large part because it imposes fewer direct costs on low-income rural Indians, given that the limit is set at a relatively high level (well over twice per-capita GDP). However, many rural farmers are concerned that they will not be paid for their crops, since they often do not know or trust their buyers and checks do not provide the same assurance as cash.⁷⁵ On the other hand, there is concern that the limit has been set at a level that is too high to be effective at targeting either tax evasion or laundering of ill-gotten funds.

Russia

In February 2017, Kremlin spokesman Dmitry Peskov indicated that Russia is likely to introduce cash thresholds, following the lead of other countries. Despite Deputy Prime Minister Igor Shuvalov’s statement in January that such limits were ‘pointless’, senior Russian officials now seem supportive of the idea that a transaction limit could reduce tax evasion and money laundering.⁷⁶

74 The Times of India, ‘Ban on cash transaction over Rs 3 lakh good; cash holding limit could have been better: SIT’ (1 February 2017), <<http://timesofindia.indiatimes.com/india/ban-on-cash-transaction-over-rs-3-lakh-good-cash-holding-limit-could-have-been-better-sit/articleshow/56914336.cms>>

75 The Indian Express, ‘Union Budget 2017: Rs 3 lakh cash transaction limit will add to woes of horticulture, poultry sectors’ (2 February 2017), <<http://indianexpress.com/article/business/budget/union-budget-2017-rs-3-lakh-cash-transaction-limit-will-add-to-woes-of-horticulture-poultry-sectors/>>

76 Bloomberg, ‘Kremlin Backs Limits on Cash Purchases, But Not Yet, Peskov Says’ (21 February 2017), <https://www.bloomberg.com/politics/articles/2017-02-21/kremlin-backs-limits-on-cash-purchases-but-not-yet-peskov-says?cmpid=socialflow-twitter-business&utm_content=

Assessing the Case for Uniform Cash Thresholds

In this section we assess the case for imposing uniform cash thresholds by: first, assessing the case for cash thresholds; and second, the case for setting uniform thresholds across different countries. We then examine some of the counter-arguments made against cash thresholds.

The Case for Cash Thresholds

Whilst there is anecdotal evidence of the beneficial impact of cash thresholds in curtailing financial crime there is little in the way of hard data to prove their efficacy. This is not surprising, since cash transactions cannot be directly measured. We cannot directly record either the baseline of illicit transactions above the threshold level, nor the reduction through imposition of the threshold. However, the lack of compelling empirical evidence should not undermine the case for imposing such thresholds. We would make four points in favour of cash thresholds:

1) There appear to be very limited downsides to imposing such thresholds

a. In all countries, the overwhelming majority of cash transactions are for small values, so cash thresholds will make very little difference to most individuals' use of cash on an every day basis. Looking at data from payment diaries and surveys across various countries, it becomes clear that while payments in cash dominate lower-value transactions, preference for cash decreases as transaction value increases.⁷⁷ In the ECB's 2008 payment survey, one of the only analyses that considers very high-value payments, there is a sharp drop-off in reported use of cash between purchases in the €200-1000 range (with 20% of respondents using cash, on average) and purchases of more than €10,000 (with 4% of

⁷⁷ John Bagnall, David Bounie, Kim P. Huynh, Anneke Kosse, Tobias Schmidt, Scott Schuh, and Helmut Stix, "Consumer Cash Usage: A Cross-Country Comparison with Payment Survey Data." Federal Reserve Bank of Boston, Working Paper No. 14-4, 8 May 2014.

respondents using cash, on average).⁷⁸ The ECB survey confirms the degree of variation between countries: while no French respondents report using cash for purchases of more than €10,000, 10% of Austrians claim to use cash for these purchases (compared to 29% using cash for purchases in the €200-1000 range). While these numbers indicate that there is likely some legitimate high-value activity taking place in cash, the sharp drop-off illustrates that there is a relatively limited set of legitimate consumers opting to use cash for such large purchases. The ECB attributes some of this activity to limits on card usage imposed by some consumers' banks. Rogoff argues that these payments are likely encouraged by business owners in order to circumvent VAT payments; he also notes that in the nine years since these surveys, there has likely been further penetration of electronic payments in all these countries.⁷⁹

Percentage of survey respondents always or often using cash for different kinds of purchases, by country

Figure 4

	Average	BE	DE	ES	FR	IT	LU	NE	AT
Purchases less than €20	87	84	91	90	80	91	77	65	82
Purchases between €30 and €100	55	48	69	64	15	77	27	20	60
Purchases between €200 and €1000	20	18	21	30	3	31	10	8	29
Purchases over €10,000	4	5	4	6	0	4	3	4	10

Source: ECB, "The Use of Euro Banknotes" (2011)

⁷⁸ European Central Bank, "The Use of Euro Banknotes: Results of Two Surveys among Households and Firms," ECB Monthly Bulletin (April 2011), <https://www.ecb.europa.eu/pub/pdf/other/art2_mb201104en_pp79-90en.pdf>

⁷⁹ Rogoff, The Curse of Cash.

b. In almost all countries, convenient and cost-effective electronic payment alternatives are available for larger value payments. In the advanced economies, credit and debit cards, bank transfers and checks are readily available, certainly for those with the resources to be buying goods or services valued in the thousands of dollars or euros. Whilst payment surveys do not appear to capture this fact, because high value payments in cash are typically too rare to register, it is likely that a very small proportion of individuals are making high value payments in cash (and an even smaller proportion for legitimate reasons). Even in Germany and Austria, the countries in Europe most attached to cash, consumers report relatively low use of cash (between 30 and 40%) for transactions in the highest value quartile (of all transactions), compared to over 90% for transactions in the lowest two quartiles and around 80% for those in the third quartile.⁸⁰ The lower end of transaction value in the highest quartile ranges from US \$25.30 in Australia to US \$35 in France to US \$42.60 in Germany (in other words, 75% of all transactions fall below these amounts), a fraction of current or proposed cash thresholds. Moreover, even in Germany, consumers' perceived acceptance of non-cash payments also increases - from 28% in the first quartile to 87% in the highest quartile - which suggests that if forced to use non-cash payments for the much larger sums envisaged for cash thresholds, the vast majority of consumers would be content.

Combining these points the argument for there being a very limited downside looks compelling: large transactions (e.g. >€2000) represent a tiny proportion of overall transactional activity; few people use cash for such transactions and electronic alternatives are readily available.

⁸⁰ Bagnall et al., "Consumer Cash Usage."

- c. We also contend that these arguments hold force when considering business-to-business transactions, not merely consumer-to-business payments. The ECB's 2008 payment survey underscores the relative unimportance of cash for businesses' expenditures, with 38% of companies not paying any expenses in cash. Of those who report any cash expenditure, two-thirds report spending less than €1,000 per month in cash, and an additional 27% report spending between €1,000 and €10,000 in cash per month.⁸¹ Since these amounts are monthly totals that likely include many small transactions, the indication is that few businesses in Europe, if any, are making legitimate cash payments that would exceed the proposed thresholds.
- d. Whilst some argue against imposing such thresholds on the grounds that this will compromise individual privacy, since prohibiting the use of cash will make it more difficult to make large value purchases anonymously, many of the goods and services an individual buys over a figure such as €2,000 or €3,000 involve some kind of record or title in any case. It is worth considering what individuals purchase for a figure over this magnitude. Apart from very high-end luxury goods, such as fashion and jewellery, individual purchases over such a figure typically relate to the purchase of vehicles (e.g. cars, motorcycles), rent payments, property, flights and holidays, construction services or other personal services such as medical care. For most people, these are infrequent purchases and usually involve some kind of title, insurance or contract.

81 European Central Bank, "The Use of Euro Banknotes."

2) There is a strong argument that imposing such thresholds will disrupt money laundering and tax evasion.

- a. There is plenty of evidence from law enforcement agencies that criminals use large value cash purchases to launder money, buying consumer durables and property that are then resold legitimately and co-mingling illicit funds with legal income.⁸² Whilst cash thresholds do not prevent large volume money laundering, they do make it more costly and inefficient since criminals will have to disaggregate their funds into smaller amounts (known as “smurfing”). Cash thresholds will not deter criminals who are presumably already comfortable with breaking the law, but will deter retailers or other legitimate business who are unwitting accomplices to money-laundering (or willing to turn a blind eye but not to be actively involved). Law enforcement officials in countries that have imposed such thresholds believe they are having a positive impact. International law enforcement agencies such as Europol and FATF argue in favour.
- b. There is significant evidence of consumers, retailers and other suppliers using cash payments to avoid tax, particularly VAT and other sales taxes. Indeed the VAT cash gap for the EU amounts to roughly €160bn per year.⁸³ With VAT levels at around 20% in many EU countries, the incentives for such evasion are very powerful. Moreover, payments received in cash to avoid VAT will not be recorded in the recipient business’ accounts and thus contribute to understating of profits for corporate tax purposes. The imposition of cash thresholds will not impact low level tax evasion of this kind, but will affect big ticket cash based tax evasion. In fact, analysis of VAT receipts for the sectors of the economy most directly affected by cash thresholds (e.g., luxury goods, construction, second-hand cars) before and after their imposition might yield useful insights into

⁸² See, e.g.: Europol, “Why is Cash Still King?”

⁸³ European Commission, ‘Study and Reports on the VAT Gap in the EU-28 Member States: 2016 Final Report’ (23 August 2016), p. 8, < https://ec.europa.eu/taxation_customs/sites/taxation/files/2016-09_vat-gap-report_final.pdf>

the impact of thresholds. We are not aware of any such analyses having been conducted, but believe this is an avenue worth pursuing. Indeed it would make sense to set up the data collection for such analyses as part of the implementation of thresholds. (We have set out our initial thinking on this approach in Appendix A).

3) Cash thresholds can complement other measures to curb the illicit use of cash.

- a. In some jurisdictions, cash thresholds may be politically easier to implement than the elimination of high denomination notes, particularly where these are seen to have historical or symbolical significance. In jurisdictions where both policies are pursued, cash thresholds will help accelerate the withdrawal from circulation of the outstanding stock.
- b. Cash thresholds may largely replace the onerous and ineffective reporting requirements imposed on HVDs. If large cash transactions are prohibited, then there is no longer a need to report on them.
- c. Cash thresholds will stimulate sectors providing high value goods and services to ensure ready availability of non-cash payment mechanisms. In most cases, these are already present, but removing the cash option will force banks and retailers to tackle any remaining impediments (such as ad valorem merchant pricing of credit card transactions, which is sometimes cited as a reason luxury good retailers prefer cash)
- d. Cash thresholds will force large value transactions onto electronic payment mechanisms, where they can be recorded and tracked. As a senior specialist in Financial Intelligence at Europol put it, cash thresholds will have an impact on combatting financial crime: either by stopping the transaction, or by enabling law enforcement to access records that trace the origin and beneficiary of funds.⁸⁴

⁸⁴ In correspondence with the authors (6 March 2017)

4) Cash thresholds can be initially calibrated to minimise any perceived downside risk, then reduced over time

- a. Whilst there is no precise science to setting the threshold level, it makes sense to establish it at a value that is greater than most everyday purchases, including consumer durables such as televisions and clothing, but low enough to capture vehicles, property and luxury goods. In advanced economies this will be in the low thousands of dollars and euros.
- b. Setting the initial threshold at a relatively high number, such as €3,000, will minimise any perceived risk of negative consequences (at the expense of being less effective in disrupting financial crime). If combined with the kind of impact analysis suggested in Appendix A, plus potentially the introduction of reporting requirements for cash payments at a lower level (e.g., €2000) an evidence base can be built to support reducing the threshold over time.

Taking these considerations together, we would argue that there is a strong case for imposing cash thresholds. However, we would make one caveat. While cash thresholds are likely to be effective in disrupting criminal money laundering and tax evasion, they are unlikely to have much of a direct impact on terrorist finance. Terrorist operations typically involve relatively small transactions that would not be affected by the threshold. Yet cash thresholds might have an indirect impact on the financing of terrorist organisations to the extent that these rely on organised crime and money laundering.

The Case for Setting Uniform Thresholds across Countries

While differentiated policies between countries always present a risk of regulatory arbitrage, with undesirable activity moving from more restrictive jurisdictions to those that are laxer, the Eurozone presents a unique challenge in the case of cash thresholds. Given the relative ease with which people and capital move between countries within the Eurozone, inconsistent cash thresholds have limited impact in reducing the value of cash to criminals (although potentially some impact on tax

evasion). Criminals looking to launder cash by making large value cash purchases will simply take their euros to a country without a cash threshold. Hence the European Commission focus on uniform cash thresholds.

There is evidence that this concern is merited. According to a recent report of Germany's Customs Investigation Bureau obtained by *Handelsblatt*, "cash derived from illegal transactions is increasingly brought to Germany from other countries that have cash limits."⁸⁵ The study's findings were confirmed by the German Finance Ministry, which called it a "suction effect," as well as by the Bundesbank.⁸⁶ While the legitimate use of cash in Germany remains higher than in many other European countries, there is also extensive money laundering through high value cash payments. The Finance Ministry contends that illegally obtained cash is widely used to purchase houses, fine art, cars, and other luxuries.⁸⁷ In an effort to introduce a threshold that somewhat reduced the opportunities for arbitrage, but acknowledged the opposition, the Finance Ministry proposed a threshold of €5,000. However, this was rejected.⁸⁸

From the other perspective, the Belgian authorities have seen evidence that the imposition of cash thresholds has displaced money laundering from Belgium to elsewhere.⁸⁹

⁸⁵ Frank Drost, "An El Dorado for Money Launderers." *Handelsblatt*, 17 February 2016. <<https://global.handelsblatt.com/finance/germany-an-eldorado-for-money-launderers-446094>>.

⁸⁶ Drost, "An El Dorado for Money Launderers."

⁸⁷ Jess McHugh, "Money Laundering Reaches \$113B in Germany as Organized Crime Flourishes." *International Business Times*. 21 April 2016. <http://www.ibtimes.com/money-laundering-reaches-113b-germany-organized-crime-flourishes-2357205>

⁸⁸ Jess McHugh, "Money Laundering Reaches \$113B in Germany as Organized Crime Flourishes." *International Business Times*. 21 April 2016. <http://www.ibtimes.com/money-laundering-reaches-113b-germany-organized-crime-flourishes-2357205>

⁸⁹ In correspondence between the author and Christian Bourlet (Directeur, Direction générale de l'inspection économique - Contrôles services financiers et prévention du blanchiment – Belgium)

Potential Counter-Arguments Against Cash Thresholds

A number of counter-arguments are made against the imposition of cash thresholds. These fall into four main categories: 1) by forcing consumers to use non-cash payments for some transactions, cash thresholds reduce consumer freedom and impinge on privacy; 2) cash thresholds will have very limited impact because criminals will continue to break the law; 3) there are certain groups of people who would be disproportionately harmed by cash thresholds; and 4) electronic payment methods can be more expensive than cash for certain types of large transaction.

In several countries, particularly Germany, Austria, and the United States, **opposition to cash thresholds is primarily based on the argument that they reduce both freedom and the right to privacy.** For example, in 2016, German MP Konstantin von Notz tweeted that “cash allows people to remain anonymous during day-to-day transactions. In a constitutional democracy, that is a freedom that has to be defended.”⁹⁰ We accept that this sentiment has some legitimacy, but transactions above €2,000 or €3,000 are far from “day to day.” Cash thresholds will not affect the vast bulk of transactions. Such thresholds will constrain the small number of consumers who would prefer to use cash and thus remain anonymous when making large purchases. However, for most legitimate high-value transactions complete privacy is not maintained, even if the payment is made in cash. In the cases of automobiles and real estate, for example, purchasers are required by law to transfer the title to their name, thereby eliminating anonymity. For many other high-value purchases, such as art and jewellery, consumers opt to insure the items involved, sacrificing privacy in pursuit of security. It seems hard to argue that there is an indisputable right to privacy when it comes to making purchases, and it seems reasonable for the government to put some thoughtfully calibrated limits on this anonymity when there is a compelling case for doing so. Reducing the ability of

⁹⁰ Brendan de Beer, “Portugal to impose cash limit,” The Portugal News Online. 8 June 2016. < <http://theportugalnews.com/news/portugal-to-impose-cash-limit/38462>>.

criminals to launder significant sums of illegally gains or stopping tax-evading businesses from concealing substantial revenues, would appear to be two such compelling reasons.

The second set of arguments against cash thresholds contends that they are not likely to be effective at reducing crime: because such measures target people who are already comfortable breaking the law, there is little reason to assume that they will not continue to do so in order to evade the threshold. Though legitimate, this line of argument ignores a major reason why thresholds are likely to be effective: many businesses unknowingly launder funds on behalf of criminals. If criminals are laundering money by purchasing high-value items from perfectly legitimate businesses (e.g., high-end jewellery stores and art dealers) using illicit cash, thresholds will have an impact by prohibiting these law-abiding businesses from accepting substantial sums of cash. For the retailer, it is one thing to turn a blind eye to the possible origins of the cash used in an otherwise perfectly legitimate transaction, quite another to break a legally binding threshold by accepting the cash. Moreover, enforcement should not be too difficult: either regularly, on a sample basis, or on demand, firms could be asked to demonstrate corresponding electronic transactions for every customer transaction over the threshold level.

In the case of tax evasion, cash thresholds require tax-evading businesses to abide by a new law in addition to the tax codes they are already violating. While it is reasonable to question whether they will comply, there is reason to believe adhering to a cash threshold will be different from reporting cash income to tax authorities. Whereas cash revenues are notoriously difficult to monitor by authorities, it is relatively easy for law enforcement to observe violations of a cash threshold. Moreover, while in many countries it is commonly accepted practice for small businesses to underreport cash receipts, violating a criminal law of this kind would represent a more serious violation that many small businesses might be reticent to engage in.

The third type of argument involves the potential that **cash thresholds could have disproportionate impacts on several groups of people, notably low-income unbanked households and foreign tourists**. Yet unlike some policy options to curb the illicit use of cash, thresholds would appear to be relatively less burdensome on these groups. Low-income households are the least likely to be making high-value purchases, and thus should be relatively unaffected by this policy. If they are unbanked due to their income (rather than ideology), making a high-value purchase is a reasonable occasion for joining the formal banking sector. For lower-value transactions, or simply holding cash, thresholds have no impact. Foreign tourists will be subject to the same regulations regarding the amount of cash they are able to bring into and out of the country, as well as any limits on foreign exchange that may exist. While foreign tourists would be subject to the same threshold as local citizens, and therefore may be unable to make large payments in cash, we do not see this as likely to be a particularly serious limitation in advanced economies, given the prevalence of electronic payment options. In any case, it is possible to create a different threshold for non-residents as Spain and France have done. However, the risk with creating such a carve-out is that it creates a potential loophole to be exploited by organised crime.

The fourth set of arguments relates to the relative costs of making large transactions in cash. Here the contention is that in some circumstances it can be more expensive for the customer or retailer to use an electronic alternative, creating a perfectly legitimate reason for them to prefer to use cash. While there are considerable methodological difficulties in making like-for-like comparisons between the system-wide costs of cash versus electronic alternatives, a number of studies conclude that from the perspective of the system as a whole, cash can be more costly.⁹¹ However, it is true that circumstances can arise where for a specific transaction; the actual or perceived costs could be lower for cash. The most commonly cited example is the ad valorem merchants fee for making credit card payments, which at typical levels of {2-3%} can represent a significant sum on a high value purchase. Jewelers sometimes cite this as a reason for preferring cash. Yet while less explicit, the full costs of receiving cash, including handling and counting, “shrinkage” and bank deposit fees are typically similar or higher. Yet there may be a case in some countries for the authorities to encourage cut-offs or tapering of ad valorem fees to remove this consideration.

⁹¹ The literature is largely in agreement that the social costs of cash exceed those of other payment methods; some argue that private costs of cash may also be greater, particularly over certain value thresholds. See, e.g.: Olivier Denecker, Florent Istace, and Marc Niederkorn, “Forging a Path to Payments Digitization,” McKinsey & Company (March 2013); Bhaskar Chakravorti and Benjamin D. Mazzotta, *The Cost of Cash in the United States*, The Institute for Business in the Global Context, Tufts University (September 2013); Carlos Arango and Varya Taylor, “Merchants’ Cost of Accepting Means of Payment: Is Cash the Least Costly?” Bank of Canada Review (Winter 2008-2009); Fumiko Hayashi and William R. Keeton, “Measuring the Cost of Retail Payment Methods,” Federal Reserve Bank of Kansas City Economic Review (Second Quarter 2012); David Humphrey, Magnus Willeson, Goren Bergendahl, and Ted Lindblom, “Benefits from a Changing Payment Technology in European Banking,” *Journal of Banking and Finance* 30:6 (June 2006); Mats Bergman, Gabriela Guibourg, and Bjorn L. Segendorf, “The Costs of Paying – Private and Social Costs of Cash and Card Payments,” Riksbank Research Paper Series No. 212 (October 2007).

Conclusions and Policy Recommendations

Cash thresholds represent a pragmatic way to tackle the illicit use of cash with very limited downsides. Our **key conclusions** can be simply summarised:

- While there is very limited hard empirical evidence that cash thresholds are effective in deterring financial crime, **there is a robust underlying logic for why cash thresholds should have a beneficial impact in curbing the illicit use of cash**. Criminals like cash because it is so widely accepted, anonymous and virtually impossible to track. Cash thresholds make it harder for them to move large volumes of money into or out of the legal economy through transactions with legitimate actors.
- **Cash thresholds are likely to have most impact on tax evasion and money-laundering connected to organised crime, but relatively limited direct impact on terrorist finance or petty crime**. Cash thresholds make it harder to avoid taxes on large value purchases. Cash-based tax evasion, through avoiding VAT or sales taxes and under-reporting profits, is the largest source of tax evasion in most countries. Cash thresholds also make it much harder and more expensive to launder the cash proceeds of organised crime. Criminals can break up large sum into many smaller transactions (known as “smurfing”), but this is slower and more expensive. Cash thresholds would have limited direct impact on terrorist operations since these typically involve relatively low value financial transactions. However, to the extent that cash thresholds impede organised crime, such measures could help undermine the financing of terrorist organisations. Petty crime and tax evasion would be largely unaffected by cash thresholds.

- **There appear to be very limited downsides to implementing cash thresholds in terms of the impact on legitimate economic activity or concerns about individual privacy.** The overwhelming majority of legitimate cash transactions are below the levels at which cash thresholds would be imposed. High value cash transactions which are not motivated by some illegal purpose appear to be rare and only relevant to a very small, wealthy proportion of the population. Privacy concerns, while legitimate, seem of less relevance to high value transactions, since a large proportion of transactions of this magnitude require some recording of personal details in any case.
- **Cash thresholds therefore appear to be an attractive policy option for curtailing the illicit use of cash with limited adverse effects or implementation risks.** If set at a level well above the purchase price of most consumer durables, but low enough to capture the purchase of vehicles and luxury items, such thresholds should impact money-laundering and tax evasion with very little inconvenience to law abiding citizens.
- **There is a strong case for making such thresholds uniform in a common currency area, such as the Eurozone, but a much weaker case across countries with different currencies.** There is evidence that the imposition of cash thresholds in the specific Eurozone countries has driven money-laundering transactions into neighbouring countries. Where countries have different currencies, the case for harmonisation seems less compelling since arbitraging the differences would require cash to cash currency conversion.

- **It should be possible to generate better evidence of the impact of the implementation of cash thresholds**, particularly if the tracking measures are established as part of the threshold implementation. For example, analysis of VAT returns of sectors involved in high value transactions before and after the imposition of thresholds could reveal the impact on tax evasion and some indicators of impact on money laundering.

Based on these conclusions, **we recommend:**

- **The EU should pursue the introduction of a uniform cash threshold, at least within the Eurozone.**
- **Other countries should consider the introduction of cash thresholds as a complement to existing measures to combat financial crime.**
- **FATF should catalyse consideration of cash thresholds amongst its members, facilitating the transfer of best practices in implementation and impact analysis.**

Money laundering, terrorist finance and tax evasion impose huge costs on society. While by no means a “silver bullet”, cash thresholds represent a practical and relatively low risk policy tool to help tackle this problem. Compared to other measures taken to tackle financial crime, such as the imposition of anti-money laundering regulations and penalties on banks, the establishment of Financial Intelligence Units, or the elimination of high denomination bank notes, cash thresholds have received much less policy attention. This needs changing. While we concede that there is very limited hard evidence of beneficial impacts, we believe cash thresholds are an attractive policy option, complementing other actions taken to curb financial crime, and with very limited downsides.

Appendix A

Strengthening the Case for Cash Thresholds with Data Collection

Although it is difficult—for obvious reasons—to see directly the effects of cash limits in publicly available data, it is possible to hypothesize what the data would reveal were cash thresholds to have their desired impact. Focusing specifically on data from tax agencies, using either VAT/sales tax reports and/or receipts, one should expect to be able to test three hypotheses: 1) for firms that accept high-value cash payments and underreport revenues to avoid taxes, a cash limit should increase tax receipts; and 2) for firms that accept high-value cash payments from illegitimate (or unknown) sources, a cash limit should lead to a decrease in tax receipts; and 3) for most firms and most transactions there should be no change in tax receipts (this would underline our argument that there should be minimal impact on most citizens' economic lives).

The first hypothesis focuses on firms that like to receive high-value cash payments to reduce their tax burden. They may encourage customers to pay in cash by offering some sort of incentive, which may be explicit or informal. Common cases include consumer-facing small businesses like residential contractors, auto repair shops, and small jewellery stores. By underreporting cash income, which is particularly common for small businesses⁹², such firms reduce the amount they pay in VAT or sales tax (and ultimately in corporate income tax). If a cash threshold is imposed, we should expect to see an increase in reported large transactions and an increase in VAT or sales tax.

⁹² S. Morse, S. Karlinksy & J. Bankman, 'Cash Businesses and Tax Evasion', *Stanford Law & Policy Review* (Vol. 20:1 2009), <<https://law.stanford.edu/wp-content/uploads/sites/default/files/publication/259083/doc/slspublic/Morse%20Bankman%20Karlinksy%2020StanLPolyRev37.pdf>>

The second hypothesis focuses on firms that allow for high-value cash payments from customers who wish to be anonymous or to disguise the origins of their money – in other words, firms that knowingly or unwittingly facilitate money-laundering. Some of these firms may overlap with those in the first category, but some may be entirely legitimate and fully reporting their income for tax purposes. Examples would include luxury car dealers, larger jewellery companies, art dealers, and in some jurisdictions, real estate brokers. Since illicit customers—many of whom are cash rich and unable to launder funds elsewhere—would no longer be able to pay for high-value items fully in cash, we should expect some decrease in large transactions and thus in VAT and sales tax. However, such firms might experience an increase in cash transactions under the threshold level.

The third hypothesis focuses on firms that receive very few high value purchases, or already receive most high value payments via electronic means. These firms should see relatively little change.

Our view is that it should be possible to construct sample-based analysis to complement overall statistics, to build a much richer picture of the impact of cash thresholds. Tax authorities typically have access to highly granular data reflecting the reported sales of individual businesses and sectors of the economy, and are therefore well-positioned to work with financial intelligence units before and after the implementation of a cash threshold to design and manage this analysis.

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The views expressed in this publication and any errors or omissions are solely the responsibility of the authors.

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The blessing of cash³



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Abstract

This study investigates the benefits of cash in a general context. First, we explicitly address the arguments of cash critics, who are calling for cash to be abolished altogether. Second, we show that cash plays a crucial role in the current two-tier banking system. Third, we are discussing a number of selected benefits of cash, inter alia its use in financial crisis and the provision of privacy. We conclude that the abolition of cash would have major drawbacks and could

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entail undesirable consequences.

1 Introduction

Since MasterCard declared “war on cash” in 2005 (Adams, 2006), propositions have been repeatedly put forward in favour of a cashless society or at least to limit or impede the use of cash. These calls were voiced not just by card companies but also by banks and, more recently, increasingly by academics, especially from the United States. The US economist Kenneth Rogoff and others propose doing away with cash completely or making it much less attractive (see Rogoff, 2014, 2016, and, representative of other authors, Agarwal & Kimball, 2015; Buiter, 2009; Goodfriend, 2000).⁴ In 2010, the European Commission initially published a recommendation that there should be no restrictions on the use of euro banknotes and coins as legal tender within the euro area. The retail trade sector should, as a rule, accept cash payments and not apply surcharges for payments in cash (European Commission, 2010). However, in January 2017, the European Commission changed tack and put forward a proposal for an initiative to restrict cash payments at EU level (European Commission, 2017).

However, the focus here is not on legal issues but on providing an economic analysis of the proposals put forward by those in favour of abolishing cash. On a meta level, one could argue that in a competitive environment, the choice of payment medium should be left up to market forces. As long as cash is in use, this indicates that cash offers efficiency gains and that there is no need for government intervention in this regard (Berentsen & Schär, 2016, 14; Krueger, 2016; National Forum on the Payment System, 2015, 1). However, there are others who claim that competition between cash and cashless payment instruments does not function properly

⁴ A less radical proposition is to abolish high denomination banknotes (see Rogoff, 1998; Sands, 2016; van Hove, 2007).

and that there is market failure. The following section takes a detailed and critical look at all these arguments. Subsequently, we show that cash has a crucial role in a 2-tier banking system and that abolishing cash is not just about changing a detail in the payment system. Finally, we are discussing selected benefits of cash: use of cash in financial crisis, data protection and privacy, the role of cash in the retail payment market.⁵

2 Arguments against cash

2.1 The shadow economy argument

One criticism repeatedly levelled at cash for quite some time and which still echoes today is that it is used for illegal activities in the shadow economy and encourages moonlighting and money laundering, in particular. In order to limit these activities, some claim that it would be best to abolish cash altogether (see, for instance, Bussmann, 2015; Rogoff, 2016, Part 1) or to restrict the use of cash (see, for instance, Sands, 2016; Sands et al., 2017). The negative effects associated with activities in the shadow economy include distortions to the production structure, tax shortfalls, lower employment in legal sectors and incitement to commit criminal offences (including terrorism). There is no doubt that cash plays an important role in criminal activities as a means of payment – and possibly also as a store of value – for instance, in drug dealing. Yet, whether abolishing cash (or high denomination banknotes) would actually make a significant contribution to reducing crime is at least questionable.

The first argument against doing away with cash in order to limit shadow economy activities is that the effect would be extremely limited if only one currency area took such a step. The shadow economy would instead increasingly turn to other currencies, such as the US dollar, Swiss franc, Japanese yen or British pound

⁵ See Krueger & Seitz (2017) for a more comprehensive treatment of these issues

sterling. While it is true that the absence of cash would make tax evasion and the funding of illegal activities more difficult, there is no a priori guarantee that this would actually give tax revenue the anticipated boost. Shadow economy activities are in no way caused by the existence of cash. The reason has rather to do with high taxes and social security contributions, excessive regulation and high unemployment. In this respect, the shadow economy can also be seen as an indicator for excessive government regulation and a defence mechanism on the part of citizens. The shadow economy acts as a “regulatory safety valve” (Schneider & Enste, 2000, 88-90). In such cases, the shadow economy enables a relatively high output level despite excessive taxes and regulations.

It should not be forgotten that the majority of transactions settled in cash are legal. Moreover, especially large-scale crime that involves huge sums of money often prefers cashless means of payment (Mai, 2016). By using complicated and convoluted cross-border chains of transactions, criminals are remarkably adept at concealing the origin of their funds.⁶ Empirical studies which conclude that only a small share of cash is used for (legal) transactions are interpreted as meaning that the remainder of cash is used for criminal purposes alone. For instance, Buiter (2009, 23) claims: “The only domestic beneficiaries from the existence of anonymity-providing currency are the underground economy – the criminal community”.⁷ However, this neglects the fact that cash is also hoarded (used as a store of value) and is in demand from other currency areas (see, for instance, Bartzsch et al, 2011a, b). And if the characteristics of cash make legal transactions easier, it then follows that

6 There are very few academic studies and analyses on this point. However, in this regard it is telling that anti-money laundering measures and anti-terror financing regulations refer mainly to cashless payment instruments. For further information, see the proposals by the Financial Action Task Force “FATF”, www.fatf-gafi.org.

7 It is sometimes noted that many banknotes are found to have traces of cocaine. However, according to information from the police, this has a simple explanation. Banknotes are processed using machines. If cocaine is found on individual banknotes, this is transferred to other notes during machine processing (Drexler, 2003).

restricting said characteristics will also lower the number of these transactions. Introducing a cash limit has a similar effect, as can be seen, for instance, in the automotive industry.

Abolishing cash would also trigger the search for alternatives with similar features. These may take the form of private (un)official means of payment such as bitcoins, vouchers, regional currencies (eg the “Chiemgauer” in Germany), trade bills or cheques. This could give rise to entirely new business models.

Current estimates on the scope of shadow economic activities, too, show that there is apparently no correlation between the intensity of cash use and the size of the shadow economy. According to estimates by Schneider & Boockmann (2016), in Germany the size of the shadow economy was equal to 11% of GDP in 2015. This amounts to approximately €340 billion. Assuming a velocity of circulation of 10 implies that the shadow economy’s stock of cash amounts to €34 billion.⁸ Given that the Bundesbank’s cumulated net issuance alone stood at over €550 billion at the end of 2015, only 6% of that would be attributable to shadow economy activities. With regard to high denominations, it must be noted that these are also used abroad and as a store of value. In addition, the scope of the shadow economy in countries which do not have large denominations (eg the United Kingdom or the United States) is not necessarily any smaller. On the other hand, the Swiss CHF 1,000 banknote has the highest nominal value of advanced economies, compared to which Switzerland’s shadow economy activities are exceptionally low by international standards. By contrast, Sweden – which comes closest to a cashless

⁸ It is often assumed that the velocity of circulation is identical in the official and the shadow economy (see, eg, Thiessen, 2011). If we assume that the stock of cash in Germany makes up around 35% of German net issuance (see Bartzsch et al, 2013), we obtain an amount of €194 billion. Consequently, the velocity of circulation with respect to nominal private consumption would come to around 8, while that with respect to nominal GDP would be 15.

society – has a much larger shadow economy than Germany (Schneider & Boockmann, 2016).

All in all, it can therefore be concluded that cash is probably used to a smaller extent in the context of criminal activities than is often suspected and that abolishing or limiting cash would not be as effective as desired in curbing crime (Mai, 2016; Schneider, 2016; Schneider & Linsbauer, 2016). Besides, an electronic payment instrument which has all the features of cash would be a dream come true for everyone operating in the shadow economy, as well as for terrorists. Initial indications of such a development have already been observed in connection with bitcoins and ransomware.

2.2 The monetary policy argument

The existence of cash automatically entails an effective lower bound for the risk-free nominal interest rate.⁹ It has become apparent over the past few years that this lower bound is not necessarily zero due to storage, insurance and risk costs (“carry costs”). Assuming that the marginal costs of holding funds in a bank account are zero, the nominal interest rate cannot fall below the negative rate for the carry costs of cash. Therefore, the nominal interest rate will dip only slightly into negative territory and this negative territory is also likely to be different depending on the country and type of bank, especially depending on the depositor and investor structures in place (see the situation in Switzerland compared with the euro area). Yet an extremely negative macroeconomic development may, under certain circumstances, require lower nominal negative interest rates. Buiter & Rahbari (2015), for instance, assume that central banks would occasionally be forced to lower interest rates to between -5% and -10% (see also Rogoff, 2016, ch. 8). The existence of cash would erase this option, as there would always be the alternative

⁹ That is unless cash exists in the form of stamped currency (“Schwundgeld”) or a fee is charged for using cash. See Goodfriend (2000) and Agarwal & Kimball (2015).

of falling back on this interest-free medium. However, this would not be an abrupt process, as the expectations regarding the duration of negative interest rates and the costs of holding cash are distributed heterogeneously across economic agents. Nevertheless, the use of cash as store of value would limit the scope for interest rate cuts. Following this line of argumentation, abolishing cash would certainly expand the scope of monetary policy. Abolishing only large denominations like the €500 banknote would achieve this, too, as the smaller denominations are associated with higher transport and storage costs.

Thus, the expansionary monetary policy stance at the zero lower bound should be made more effective and achieve an even greater impact if governments were to abolish cash. However, this is also the medium with which people can ultimately “defend” themselves against this policy. Mersch (2016) referred to those who hold this view as “alchemists” as they seem to believe that every macroeconomic crisis could be tackled if the interest rate could just be lowered sufficiently.

In any case, the impact would be relatively minor, not least because there would be considerable evasive shifts towards other currencies whenever cash was abolished in one currency area only. Moreover, the public would attempt to use alternative transaction mediums and stores of value which are not subject to negative interest rates. For example, there is always the option to switch to vouchers, use cheques without depositing them immediately, make advance tax payments or early repayments of loans (McAndrews, 2015). Furthermore, it is not implausible that the demand for gold and other precious metals would rise considerably. Real estate, too, would probably be in high demand. These markets might experience significant price bubbles, resulting in financial instabilities and imbalances. To circumvent the restrictions, behavioural changes and arbitrage activities would result. They would also create incentives for “financial innovation” to guarantee an interest rate of at least zero. These incentives would be greater, the longer the negative interest period lasts and the more pronounced it was. This is consistent with

Bech & Malkhozov (2016) who argue that if rates were to remain negative for a prolonged period, at some point the effective lower bound would increase as economic agents adapt to the new environment and as innovations will prevail, which reduce the costs associated with holding cash. This is supported by the fact that most of the costs of cash holdings are of a fixed nature. Ultimately, the level of the lower bound on interest rates would depend on whether and how banks succeed in pushing deposit rates, too, into negative territory (Alsterlind et al, 2015).

The monetary policy argument seeks to strip the public of the freedom to choose between different forms of money, as a result of which deposits can be subjected to (unlimited) negative interest rates to the effect that saving is discouraged, consumption increased and investment encouraged.¹⁰ Proponents of this argument believe that economic activity would be stimulated in a sustainable manner. However, this raises the issue of whether the measure is commensurate to the problem, particularly in the euro area, and what side effects it might have (Borio & Zabai, 2016; Jobst & Lin, 2016).¹¹ For instance, the problems in the euro area appear to be of a structural, rather than a cyclical, nature. In addition, there are alternative transmission channels at work around the lower bound on interest rates. What comes to mind in this context are the signalling, exchange rate, trust and portfolio channels (Ulbrich, 2016). Using a New-Keynesian macro model, Rognlie (2015) points out that optimal monetary policy must weigh the distorting effects of negative interest rates against the potential positive business cycle effects. The interest rate elasticity of cash demand plays a key role in this context. Abolishing cash only makes sense under extreme assumptions.

¹⁰ However, the relationship between interest rate cuts and savings is ambiguous, even in theory, because the income effect may outweigh the substitution effect.

¹¹ Following this line of thought, cash would help to defend against policy errors.

A policy of negative interest rates might also be criticized from a more general perspective. Rösl & Tödter (2015) calculate the welfare effects in the form of excess burdens and show how damaging it is to place tax-like negative interest rates on money holders and savers. Moreover, Schreft & Smith (2000) analyse a zero interest rate monetary policy without government intervention (eg in the form of a ban on cash payments). They present evidence that the demand for cash will remain high in such a situation (or increase very sharply) even if the transactions demand for cash continues to decline over time for fundamental reasons. The zero interest rate monetary policy is therefore (empirically) inconsistent with a secular decrease in transaction balances.

Finally and under the realistic assumption that the zero or negative interest rate policy is but a temporary phenomenon in exceptional situations and with ambivalent effects, the response to it ought not to be an absolute and, in principle, irreversible measure in the form of a permanent abolition of cash.

2.3 The speed argument and security aspects

A further argument which is brought forward by critics of cash is that the use of cash at the point of sale stretches out the payment process (eg Der Spiegel, 2015). An increase in cashless payments could thus save time and, by extension, costs and resources. Surely, all of us will have had our own experience in this regard.

In the Bundesbank's first payment behaviour study for 2008, 90% of the respondents indicated that they perceived cash to be a convenient and quick medium of payment (Deutsche Bundesbank, 2009b). In the last study of this kind for Germany (Deutsche Bundesbank, 2015), a distinction was made between exclusive cash payers and exclusive card payers. Of the former group, 33% perceived cash as a safe and 29% as a quick medium of payment. The corresponding figures for the card payers stood at 26% and 27%, respectively, ie at an only marginally lower level. According to the EHI Retail Institute (Siedenbiedel, 2016), in Germany

payment at the point of sale by cash is still much quicker than by card (see also Fung, 2015, for Canada, and Jonker, 2016, 39, for the Netherlands).¹² In Denmark's Nationalbank's cost of payments survey (2012, 50) it was found that the difference in payment time for cash and card payments is almost insignificant, although the time can vary considerably from retailer to retailer.

Schuh & Stavins (2015) subdivide the speed aspect (without explicitly considering cash) into several dimensions and find that only certain aspects significantly affect the choice of payment medium in a statistically significant way. Yet the settlement speed of a payment at the point of sale is a decisive factor. Nevertheless, a faster payment process does not necessarily reduce the overall time at the cash desk. For instance, this is the case if the goods were scanned even faster. Consequently, the packaging of the goods still counts towards the overall time taken regardless of whether it occurs post-payment or during a (longer) payment process.

Overall, no general conclusions can be drawn with regard to the argument of speed. Nevertheless, it does not appear that cash payments are slower or that consumers perceive them as such.

Besides speed, however, the security of the payment or of the payment instrument, too, plays an important role. The perception of security affects payment behaviour, with consumers reacting very sensitively to a change in this perception and even reports in the media, eg of card fraud (Kosse, 2013). The security issues that a transition to a cashless world would entail are often underestimated (Krueger & Seitz, 2015). We only need to think of how intensively and how diversely cash is still used to see what a nation-wide introduction of electronic payment systems would imply. Above all, everyone would need to be able to make and receive payments in such a system – “everyone” including persons with limited cognitive

¹² Data for 2004 can be found in Rüter (2004).

abilities as well as criminals. If cash no longer existed, each and every one of us – except for small children and legally incapable persons – would have to be able to send and receive cashless payments. In order for everyone to be able to access such a system, it must be very easy to use. And to ensure a smooth settlement of payments, the system ought to work offline as well, ie without being connected to a bank or any other payment service provider. The offline functionality is urgently needed, on the one hand, as a fall-back solution for when communication networks are down and, on the other, because a system based 100% on online authorization would probably be extremely costly. To date, the only medium able to combine ease of use, offline availability, anonymity and convenience is cash. There have been repeated attempts to provide systems of this kind, but accomplishing the above-mentioned combination has shown only limited success. Bitcoins, for example, are neither particularly easy to use nor are they convenient (the payee must wait several minutes until the authenticity of the bitcoins is confirmed). In addition, doubts have been raised over whether it is, indeed, impossible to trace who carried out a bitcoin payment (see Koshy et al, 2014).

With bitcoins, it has already crystallized that not only technological security but also protection from theft is key in this context. Bitcoin owners must trust their own hardware (PC, notebook, tablet, smartphone and the software installed on the respective device) and/or service providers that “store” and manage bitcoins. Of course, security problems may be remedied over time through innovation, but it would be a mistake to believe that payment systems will eventually outgrow the security-related challenges. As soon as a system grows, so too do the incentives for fraud. ECB data (2015, 20) show that card fraud is relatively high in the two largest European card markets, the UK and France, which recorded 201 and 143 card payments per capita in 2014. At just over 0.06% and 0.07% of the payment volume, respectively, damages in both countries are much higher than in Germany or Italy, for instance (damages of just over 0.02%), where cards are not used as intensively (per capita card payments in 2014: 40 and 33, respectively). Moreover,

Sweden, the country which has progressed the farthest towards becoming a cash-less society, has realized that the number of card frauds (and money laundering activities) has risen significantly over the past few years (Mai, 2016, 11f). It is therefore a justified fear that a general electronic payment instrument that becomes established as a substitute for cash would be particularly vulnerable to criminal attacks. Such a system would be highly attractive to fraudsters because they cannot simply be excluded from using it. Once cash were abolished, access to electronic payment systems would become something of a basic right.

2.4 Cash as beneficiary of inefficient pricing?

Many economists argue that cash is treated more favourably through inefficient pricing. The core of the argument is as follows. The use of cash is free of charge. As a result, cash is used too intensively, comparable to the “tragedy of the commons” (Van Hove, 2007, 29). “Free of charge” means that cash withdrawals at ATMs tend not to cost anything, that cash payments do not entail a transaction fee and that there is often not even a charge for cash deposits to accounts. However, the argument claims that providing this service does, in fact, entail costs which are not or only insufficiently taken into account in the selection of payment instrument. Cash users are the ones who decide how much cash is withdrawn and which instrument is used for retail payments. But because they are not confronted with these costs, they have no incentive to take them into consideration. This leads to inefficient decisions and an inefficient use of payment instruments, in particular.¹³

Regulators are therefore called upon to intervene and introduce cost-based prices. Initially, this argument sounds plausible – like the direct application of results from a standard economics textbook. What it does not take into account, however, is that the payment market is a two-sided market (Baxter, 1983; Rochet & Tirole, 2003). In such markets, the standardized regulatory approach can lead to ineffi-

¹³ The costs of cash payments and card payments will be the focus of module 3.

cient results (Wright, 2004). For example, cost-based pricing in two-sided markets is not necessarily efficient (Krueger, 2009; Wright, 2004).¹⁴ If the costs entailed by card issuers are very high, for instance, cost-based prices could lead to only a small number of consumers wishing to own a payment card. As a consequence, hardly any card payments would be made. At the same time, it is possible that the benefit of card payments for retailers and consumers together is greater than the overall cost. In this vein, card payments would actually yield a net benefit, which cost-based prices would prevent in such a case.

Interestingly, it can be observed on a number of two-sided markets that prices are mainly or even exclusively levied on one side of the market. A classic example is telecommunications, with the dominant model in many countries being that the caller pays. A similar asymmetry in pricing can be seen with many other payment instruments besides cash. With card payments, too, transaction fees are generally only paid by the payee (ie the retailer). From that perspective, cash is not the only medium which customers do not pay to use. Nevertheless, it cannot be ruled out that the price of zero might be inefficient and that the frequency at which consumers select cash is less than optimal. If this were the case, there would also be disadvantaged parties – ie retailers and/or banks. But it is up to them to counter a potential “overuse” of cash through their pricing policy. Banks could introduce a fee for withdrawing cash or – if the legal situation prevents them from doing so¹⁵ – reduce the supply of this service (see, for example, the situation in Sweden). Retailers could levy a surcharge on those payment instruments that are costly to them or offer a markdown on those payment instruments that are less cost-intensive by

¹⁴ Often, it is not even clear what “cost-based” really means. The processing of a payment is a service that is rendered for two parties at the same time. As such, any division of costs is random to a certain extent. To name an example, when a payment terminal reads the card data and sends them to the card issuer to be authorized, does the authorization represent a service for the retailer or the card holder? And who should bear the costs

¹⁵ The Federal Court of Justice issued a ruling in 1983 limiting any possibility of German banks introducing charges for withdrawing cash.

comparison.¹⁶

Some argue that the heavy use of cash rests on the central bank's issuing of and their involvement in processing cash. Some authors believe that cash is somehow "subsidized" (ten Raa & Shestalova, 2001).¹⁷ However, it is difficult to see just how that might be. The whole argument appears to be based on a misconception of the cash-issuing business. Issuing cash generates income in the form of seigniorage, which accrues in its entirety to central banks. This income can be seen as an implicit fee for users of cash. Central banks use this income to cover the costs of producing and processing cash. However, as a rule, these costs are only a small fraction of this income, meaning that issuing cash is generally a very lucrative business for central banks (and thus, ultimately, for governments and economies).¹⁸ Commercial banks (private banks, savings banks, cooperative banks) assume the major part of costs for distributing cash. They provide customers with access to cash and accept it again from them. In return, direct compensation for such services is relatively low. This is probably due to legal restrictions on fees for cash services.

However, commercial banks can charge customers a fee for depositing cash and they do receive a type of implicit fee in the form of interest foregone on transferable deposits. It is, not least, by giving customers largely free access to cash that enables banks not to pay interest on current accounts.

Still, because it is central banks that earn seigniorage on cash and banks are

16 In the United Kingdom, the Consumer Rights (Payment Surcharges) Regulations 2012 cap such surcharges. The Reserve Bank of Australia has also introduced similar regulations; see Reserve Bank of Australia (2016).

17 Leinonen (2016) follows a similar line, arguing that the prices charged by central banks for processing low-value banknotes probably do not cover the cost thereof.

18 Van Hove (2007) criticizes that this constitutes a conflict of interests. As issuers of cash, central banks are a market player yet, on the other hand, they also regulate the payment system.

allowed to levy only few direct charges on cash services, commercial banks have an incentive to promote cash substitutes on the market. In this respect, the current fee structure in payment transactions works against cash.

Therefore, it is not surprising that banks and card issuers spend huge sums promoting payment cards (for instance, Visa and MasterCard regularly sponsor the World Cup and the Olympic Games). However, there is no such thing as marketing for cash.

Given these incentives, the Leinonen (2016) argument that having no fees for cash leads to an “overuse” of cash (and an underuse of cards) is flawed. The reverse is true. To the extent that banks would like to charge a fee for cash services but are not allowed to, the pricing system works against cash – at least in the long run.

3 Consequences for a two-tier banking system

(“A bank is where the money is”)

Doing away with cash would very probably lead to major changes in the existing two-tier banking system, cash being the only instrument that allows banks in this system to convert their liabilities vis-à-vis non-banks into central bank money. If cash ceased to exist, private non-banks would no longer have access to central bank money, effectively rendering them “captive” in the commercial banking system. If, say, the private non-banks were to lose confidence in the commercial banks, this conversion of deposits into cash would no longer be possible. Deposits could then only be scaled back by reducing debt vis-à-vis the banks and converting bank deposits into other assets. In the euro area, any loss of confidence in the banks of a single member state could also be countered by transferring deposits to other euro-area countries.

Withdrawing cash is the only direct way for non-banks to withdraw funds from the banking system. The special role of cash lies in the fact that it constitutes a broadly accepted means of redeeming banks' liabilities vis-à-vis non-banks. While the reduction of debt vis-à-vis the banks indeed reduces bank deposits, it is not a viable alternative for non-banks without any debt. Buying assets from banks assumes that banks are also keen to sell assets and that they have sellable assets at their disposal. Since liquid assets are needed as collateral for refinancing and since loans make up the lion's share of assets, this option is not likely to be of much use to non-banks. To a certain extent, the option to transfer deposits to banks in other countries constitutes a special case that can arise in currency unions. Greek investors made great use of this option (Krueger, 2013). However, it rests on the assumption that banks retain the confidence of foreign investors.¹⁹ Moreover, those banks that lose deposits need to have access to alternative sources of funding, because a bank that loses deposits on a vast scale is frequently also no longer able to secure funding from the money market. The Greek banks were, for instance, forced to rely on ELA funding from the Bank of Greece which, in turn, was sourced from TARGET loans within the Eurosystem. Both types of funding (ELA operations and TARGET loans) enabled Greek investors to transfer deposits to other euro-area countries abroad.

If doing away with cash were to make it impossible to convert deposits at commercial bank into central bank money, there would be mounting pressure to consider the options listed below.

- Bank deposits wholly covered by central bank money ("narrow banking").
- Deposits in central bank accounts available to everyone.
- Digital central bank money (e-euro).

¹⁹ With regard to those German investors who lost faith in Germany's banks in 2008, the question arises as to which euro-area banks they ought to have trusted with their money.

In the case of a narrow banking solution, certain bank deposits would have to be wholly covered by central bank money²⁰, with the banking system divided into “deposit-taking or payment transaction banks” and “investment or commercial banks”. Narrow banking systems have been proposed on repeated occasions (Bossone, 2001).

Rather than establishing a narrow banking system that affords non-banks an indirect access to central bank money, non-banks could also be allowed to maintain deposits of their own at the central bank. In this way, central banks would enter into direct competition with commercial banks.

Lastly, it is also conceivable that central banks would issue electronic cash (central bank e-money) in place of physical cash, in which case the two-stage banking system could, in principle, continue to exist more or less unchanged. Instead of banknotes, non-banks would stock a certain volume of central bank e-money, though payment transactions would continue to be effected mainly via giro accounts held at the commercial banks, which would undertake to convert overnight deposits into central bank e-money “upon request”.

As things stand, no experience has been gathered with any of the three systems that would be helpful in assessing their functional viability. Even so, each system has its advocates, due to the following factors:

- the loss of confidence suffered by commercial banks after 2008,
- the dwindling use of cash,
- diminishing access to cash in countries such as Sweden,
- technological advances (Bitcoin etc).

²⁰ It has also been suggested that it should be permitted to keep other assets, such as government bonds, at the central bank, instead of reserves (Bossone, 2001, 8).

In some countries, enterprises and households have already voiced their demand for a fundamental change to the system. For instance, Talanx Insurance tried (in vain) to secure the right to hold a Bundesbank account by taking the matter to court (Süddeutsche.de, 2010). In Switzerland, a narrow banking initiative has been set up, its aim being to amend the Swiss constitution so as to make it mandatory for overnight money held at banks to be wholly covered by central bank money.²¹

But central banks, themselves, are likewise turning their attention to this matter. In the light of the dwindling use of cash, the Swedish Riksbank is already considering whether it should start issuing electronic money (e-krona) (Skingsley, 2016). Meanwhile, the Bank of England, too, has been intensely involved with this topic (Broadbent, 2016; Bank of England, 2015).²²

At this juncture, it is difficult to foresee where these deliberations will lead, not least because cash is still used intensively and concrete plans to actually abolish it are not on anyone's agenda at present. The Swedish Riksbank is keen to emphasize that e-krona should not be viewed as a substitute for cash but as a complement (Skingsley, 2016). The same goes for the Bank of England. Governor Carney has stressed that there are no plans to do away with cash (Broadbent, 2016).

Nevertheless, it is possible in this context to assess the consequences of a drastic decline in the use of cash, and perhaps its complete abolition. Astonishingly, central banks' importance would not necessarily decrease but, under certain circumstances, actually increase. This applies irrespective of which "replacement products" might be offered in the event of cash being abolished, be it deposits in

²¹ For more information on this, please consult www.vollgeld-initiative.ch/ The Swiss Federal Council spoke out against this initiative in 2016. As regards the standpoint of the Swiss National Bank, see Jordan (2016).

²² The success of Bitcoin has ultimately prompted many economists to consider digital central bank money.

narrow banks, deposits in central bank accounts for everyone or digital central bank money.

It is reasonable to assume that the size of the central bank's balance sheet would increase significantly in all three scenarios (Kooths, 2016). If sovereign money were chosen as the solution, banks' reserves would increase sharply. If central bank accounts were also made accessible to non-banks, then deposits held at the central bank would compete with deposits at commercial banks. Especially in times of uncertainty, non-banks would undoubtedly make extensive use of the option of keeping their money safe at the central bank. If e-euro were offered by central banks, then cash would be replaced by central bank e-money, though probably not on a one-to-one basis. Central bank e-money might therefore compete with cash and commercial banks' overnight deposits as well (Broadbent, 2016).

The exact strength of such competition would depend heavily on the specific design of the new central bank products. Depending on the design of the new system (ie its conditions, including the interest rates applied and its ease and scope of use), it could lead to a wide-scale substitution of bank deposits. It is even conceivable, that the ability of the commercial banking system to create credit would be seriously impeded (Broadbent, 2016; Skingsley, 2016; Tolle, 2016).

It is hard to gauge the extent to which non-banks would make use of this facility. Supposing overnight deposits in the euro area were subject to the 100% reserve rule, this would oblige the banks to hold reserves of €5.6 trillion, based on today's volumes. To achieve this, banks would have to sell assets in this amount, while the Eurosystem would be obliged to purchase assets. Alternatively, the Eurosystem could furnish the banks with loans. The magnitude of these transactions would be equivalent to the value of about one half of the assets held by the commercial banks. Such effects could also be incurred if the non-banks were to decide in favour of central bank accounts or central bank e-money.

Abolishing cash could therefore ultimately mean that the Eurosystem's balance sheet (2016 balance sheet total approximately €3.5 billion) would once again enlarge considerably.²³ The question of how the assets side of the balance sheet is to be arranged would then be of enormous macroeconomic importance. Consequently, it is not by chance that the President of the Swiss National Bank, in the event that the narrow banking resolution is passed, warned of a looming "politicization of monetary policy" (Jordan, 2016, 7). The same may be said regarding the other two options (central bank accounts for non-banks, digital central bank money).

The consequences for the commercial banking sector would be just as serious. The commercial banks' balance sheets would possibly contract massively and the ability to generate credit would be limited – in the worst case scenario, it would disappear entirely. This could have painful ramifications for the real economy. The central banks concerned with digital central bank money or opening up central bank accounts to non-banks therefore see a need for considerably more research and clarification (Bank of England, 2015; Skingsley, 2016).

Even if the balance sheets of commercial banks were to suffer less, there is still another reason why abolishing cash could have wide-ranging consequences for the banking system. Banks frequently view cash as a burden because issuing and collecting cash is associated with considerable costs and the process only generates minimal directly attributable income. However, it is frequently overlooked that the role of banks in the cash cycle is one of the essential features that sets banks apart from other financial service providers in the eyes of their customers. The infamous US bank robber Willie Sutton expressed this fact pithily when he said,

²³ There has already been an initial balance sheet extension, which took place in the aftermath of the financial market and sovereign debt crises.

“A bank is where the money is.” (Sutton’s law) (Wikipedia, 2015).

For him, “money” means “cash”. He is not alone in equating money and cash; most people think of cash when they speak about “money”.²⁴ If cash were actually abolished, there would not be any “money” in the bank any more. This raises the question:

“If there is no more money in the bank, is the ‘bank’ still a bank?”

In this case, what would become of the nice business model of issuing non-interest-bearing liabilities (“sight deposits”)? Competition would increase on the liability side of a bank’s business. From the customer’s perspective, branch banks, direct banks and other intermediaries would be offering investment products that differ little from each other.

4 Selected benefits of cash

4.1 Role of cash in financial crises

One aspect that is sometimes overlooked is the role played by cash in times of crisis. As a general rule, the demand for cash rises in the wake of a financial crisis (see the situation following the collapse of Lehman Brothers, or events in Greece in 2015). Such a run on banks is usually viewed as a threat to the financial system. Conversely, however, it is also true that bank customers are greatly relieved to recognize that they actually can access “their money” (Negueruela, 2014).²⁵ In a system in which only electronic money exists, it would be virtually impossible for

²⁴ The “Hofgarten” beer garden in Aschaffenburg is a good example. Until recently, the menu stated: “We only accept money payments – no plastic!”

²⁵ In Germany, other factors played a role, too. This was demonstrated, for instance, in 2008 when the Federal Government declared bank deposits as safe, which the general public interpreted as a government guarantee.

non-banks to withdraw funds from the banking system on a broad basis in the event of a crisis of confidence. Some people could of course reduce their bank deposits by acquiring assets from other economic agents. However, this would push up the level of bank deposits held by the sellers, thus confronting them with the problem of having to acquire assets with these increased bank deposits ("hot potato effect"). This could, in turn, result in sharp fluctuations in financial market prices, which would probably exacerbate the crisis. What is more, in case electronic payments were to be interrupted (due to technical disruptions, strikes, etc), cash could still be used to execute certain payments. In a purely electronic system, it is possible that no payments could be made at all. During such periods of crisis, cash would serve as a transaction medium, a medium of exchange and store of value of last resort. In the case of a currency for which there is also an international demand, such as the euro or the US dollar, this function of cash applies to both domestic and foreign demand. Its status as legal tender and the fact that it is issued exclusively by the central bank are also helpful factors, as they promote general acceptance and confidence among users.

The situation in Germany following the collapse of Lehman Brothers on 15 September 2008 is a good case in point here.

As already mentioned, cash in circulation in the course of a week, month or year follows a regular seasonal pattern. However, the standard pattern for cash demand in 2008 changed considerably as a result of the financial market crisis. The end of September and early October 2008 saw an increase in demand for cash compared with the previous year and a change in the weekly pattern of daily in-payments and out-payments (Deutsche Bundesbank, 2009a, 56f). Demand for cash did not return to normal again until 24 October 2008, which was the first time that the out-payment balance was smaller than that for the same period one year earlier. Daily out-payments in October 2008 were largely at a level comparable to the high demand for cash in the period before Christmas. However, it was striking that the

sharp increase in out-payments was not offset by a higher number of in-payments, as is usual in the month of December. For example, on 10 October 2008 – the day with the highest volume of out-payments during the financial crisis (€4.2 billion) – recorded in-payments stood merely at €1.5 billion.

The most marked increase was in the number of large denominations, which are particularly well suited as a store of value. Even before the onset of the crisis, a slight upturn in the year-on-year demand for €500 banknotes was detectable in the period up to September 2008. Between September and October 2008, this demand grew at a much faster pace than it had done one year earlier. Net out-payments of €500 banknotes amounted to €11.4 billion in October 2008 alone (Deutsche Bundesbank, 2016, 34f). By comparison, net cumulated out-payments of this denomination throughout 2008, excluding October, amounted to €10.3 billion. Between October 2007 and October 2008, the volume of €500 banknotes in circulation in Germany went up by around €21 billion (€40 billion in the euro area as a whole). The demand for €100 banknotes likewise rose by a considerable margin in October 2008. Outflows of banknotes in October did not find their way back to the Bundesbank by the end of the year. In the case of €500 banknotes, this did not occur until the end of 2010 (see Bartzsch et al, 2015, FN 28). Unlike the high-denomination banknotes, net out-payments of small denominations (ie notes worth €5 to €50) – which primarily enter circulation through withdrawals from ATMs – stayed close to the previous year's level in 2008.²⁶ All in all, net issuance of notes in Germany went up by just under €20 billion in October 2008, while the Eurosystem as a whole posted an increase of around €44 billion.

The higher demand for small denominations observed in October 2008 and its

²⁶ Structural banknote demand models therefore need to incorporate an impulse dummy for the fourth quarter of 2008 (Bartzsch et al, 2015, section 5.2). In RegARIMA time series models, the financial crisis has to be captured using several dummy variables (Bartzsch et al, 2015, section 5.3).

subsequent decline to a level similar to that recorded prior to the financial market crisis suggest that this was basically a temporary effect. At the very least, these denominations were not hoarded in large quantities, and flowed back to the Bundesbank relatively quickly. The augmented cash balances in the vaults of the credit institutions that are chiefly maintained for making regular outpayments also went back down in November 2008. Nevertheless, during the crisis, a string of individual banks had to contend with a greatly increased demand for cash, above that experienced by other banks. This can hardly be explained by the domestic hoarding and transaction motive alone. Hence, there is good reason to believe that the demand from abroad for banknotes (ie from outside the euro area) also increased. One indication of this is the fact that the share of €500 banknotes in cash outflows in the international wholesale banknote market is generally very high.

To examine this assertion more precisely, the movements on accounts held by foreign banks at the Bundesbank and banks engaging in foreign business were analysed; a considerable percentage of these account movements were used to supply foreign credit institutions with cash (Deutsche Bundesbank, 2009a, 57). These account movements probably reflect the demand from abroad that is transmitted via this official channel. According to this indicator, in October 2008, the entire volume of out-payments of banknotes by the Bundesbank was distributed fairly evenly between domestic and foreign withdrawals. The rising demand for euro banknotes for the purpose of storing value induced by uncertainty and precautionary motives in the wake of the financial crisis was consequently equally driven by domestic and foreign demand.

4.2 Data protection and privacy

Data privacy is a valuable commodity. This was confirmed in Germany at the supreme court level when the Federal Constitutional Court issued its ruling on the 1983 census – if not before (Federal Constitutional Court, 1983). Since cash is a means of protecting privacy – Kahn et al (2005) argue that “cash is privacy” – there

could thus be legal barriers to abolishing cash. Whether and to what extent the abolition of cash is legally permissible, however, is beyond the scope of this study.²⁷ In addition to the legal considerations, however, there are also a number of economic issues linked to abolishing cash.

- a. Given the current flood of personal data, does it actually make a difference whether or not cash exists?
- b. To what extent does cash allow us to protect our personal data?
- c. Is the highest level of data protection always in our own interest?
- d. What are the consequences of not keeping data anonymous?
- e. Could there be an electronic replacement for cash?

This section will examine these five questions in closer detail.

- a. Does it actually make a difference whether or not cash exists?

In modern, connected and digitalized societies, citizens can already be monitored to a large extent – through internet activities, closed-circuit TV in public areas, use of mobile phones, and use of a variety of electronic payment methods.²⁸ It could therefore be argued that recording a small amount of additional payment data would make no difference. However, this is not a compelling point of view, since, to date, the recording of payment data has been far from comprehensive. Ultimately, most payments in Germany are still made in cash and therefore cannot be traced by third parties. Krueger & Seitz (2014, 27) estimate that 32 billion cash transactions took place in Germany in 2011. As a statistical average, this would mean no less than 400 cash transactions²⁹ per German citizen, although this

²⁷ For more information, see Hirdina (2016), Papier (2016) and Siekmann (2017).

²⁸ Birch (2014, 43) suggests that, in future, although it will be possible to protect one's privacy online, it will not be possible to do so in the real world.

²⁹ This was in contrast to just 36 card payments per German citizen in 2011. By the end of 2014, this figure had risen to 40.

estimate is somewhat on the conservative side. If all these transactions were processed electronically, and were therefore potentially open to monitoring, citizens would become “transparent”. Privacy in the stricter sense would cease to exist.

b. To what extent does cash allow us to protect our personal data?

Because paying in cash means there is no need to involve a third party, both parties can keep the payment secret – and sometimes the underlying transaction, too. This is known as “payment anonymity”.

Nor do the payer and the payee need to know anything about each other. The payment can therefore be made with both sides remaining anonymous (anonymity of participants). However, the degree to which anonymity can be maintained also depends on the transaction in question. If a customer buys a used iron at a flea market, both the seller and the buyer can remain anonymous (bilateral anonymity). If a consumer buys an umbrella from a retailer, he can remain anonymous to the retailer (unilateral anonymity). The retailer’s identity, on the other hand, is known. If a customer buys a cupboard and has it delivered to his house, he is no longer anonymous either. There are therefore many situations in which it is not possible for both parties to remain anonymous. In these cases, paying in cash can at most ensure payment anonymity. So cash payment alone does not guarantee complete anonymity for those involved.

Payment anonymity is particularly important. Admittedly, it also plays an important role for criminals. But payment anonymity also plays a key role in the relationship between citizen and state. It is with good reason that Dostoyevsky, who said that “money is minted freedom”, is often quoted in this context. Otmar Issing adapted this saying, emphasising that “cash is minted freedom” (Issing, 2014). The fierceness of the current debate and the strong opposition to abolishing cash in many countries – they are by no means confined to Germany – probably stems from people’s fear of ever-increasing government control.

c. Is the highest level of data protection always in our own interest?

Data protection and anonymity may be useful in certain situations, but it is by no means true that anonymity is always an advantage. In many cases, the person making a payment wants to have a record of this payment, either for themselves or as proof of purchase which they can present to the other party or to third parties. There are also situations – distance selling, for example – in which the ability to contest a payment can be useful. Anonymity and the subsequent lack of proof of payment and ways of lodging a complaint are a disadvantage in these instances. It is also often beneficial for payers or payees to have a “payment history”. This allows them easier access to credit, for example (Roberds & Schreft, 2009).

Therefore, it does not always make sense to strive for the highest possible degree of anonymity. Instead, it is more important to ask whether, in principle, people should have the option of using an anonymous payment method that delivers “efficient confidentiality of personal data” (Roberds & Schreft, 2009). Of course, from a macroeconomic perspective, the efficient level of anonymity is likely to be nearer 100% than 0%.

d. What are the consequences of not keeping data anonymous?

As outlined above, anonymity is only important for a limited range of transactions. However, people’s behaviour would change if anonymity were no longer given. It is often assumed that anonymous transactions are almost exclusively of the illegal kind (Buiter, 2009; Sands, 2016), but there is no empirical evidence to back this hypothesis. In the debate about withdrawing the €500 banknote from circulation, ECB Executive Board Member Yves Mersch said: “European Central Bank officials want to see evidence that high-denomination euro banknotes facilitate criminal activity rather than relying on unproven assertions” (Schneeweiss, 2016). The head of the ECB’s Currency Management Division also stated that there is no statistically proven link between criminal activity and the use of cash, or, in fact, between the size of the shadow economy and cash (FAZ, 2016).

In 2002, Drehmann et al (2002) wrote: “There are many reasons why people may prefer anonymity – many of which are connected with “bad” behaviour.” But “bad” does not always mean “illegal”. It can also include the small human weaknesses we are prone to. Economic agents do not necessarily want these documented in full in the form of proof of payment. Ultimately, it should not be forgotten that governments, too, can behave “badly” and that cash provides a certain amount of protection against this (see also Berentsen & Schär, 2016).

Because anonymity is often asymmetrical – the buyer remains anonymous while the seller does not – doing away with anonymous payment options would put buyers, in particular, at a disadvantage. As a result, fewer (legal) transactions would be carried out and evasive action would be taken (Kahn et al, 2005). This would lead to a loss of efficiency and additional burdens (deadweight losses) that extend beyond the pure abolition of cash. These have a similar effect to distortionary taxes. In any case, fewer transactions would take place without cash. This is also indicated by the fact that cash even has a certain role to play in distance selling.³⁰ The “click and collect” method of online shopping (including an alternative for paying with cash) is becoming increasingly popular. Even Amazon is planning to open stores,³¹ and initiatives such as www.barzahlen.de are offering new cash payment options in the field of e-commerce. This can be theoretically substantiated using a search model according to the New Monetarist Economics school of thought (for details, see the overview in Schmidt & Seitz, 2014, Section 4).

4.3 Independence of foreign card providers

Payment systems are part of a country’s basic infrastructure, and it is essential that they operate smoothly if the economy of a currency area is to function. Payment systems currently comprise credit transfers, direct debits, cash, payment cards as

³⁰ In this context, of course, the aim of using cash is also to increase security and control.

³¹ See Spiegelonline (2016).

well as online payment systems. The retail trade sector chiefly uses cash or cards. To date, national debit card systems dominate card payments in most European countries. However, the Europeanisation of payment transactions (keyword “SEPA”) has led to national systems in some countries being replaced by the international card schemes MasterCard and Visa; for example Luottokunta in Finland and PIN in the Netherlands. Although not necessarily politically desired, it is possible that MasterCard and Visa will take an extremely strong hold of the European payments area (see also Judt & Krueger, 2013).

As long as cash continues to play a key role in payment transactions, competition in the card market is important, but only to a limited extent as both payers and payees (in the retail trade sector in particular) have the option of using cash instead. Yet if cash were to disappear, payers would be reliant on using cards. On the one hand, this would inflate card providers’ market power (Lepecq, 2015) and, on the other hand, in the case of international systems, give rise to dependence on foreign governments. The abuse of market power can be kept in check by European competition authorities. However, European governments have no direct influence on interventions by US supervisory authorities into MasterCard and Visa’s card transactions. The following are examples of such interventions that have already taken place.

- In 2014, the United States of America issued sanctions against Russia. As a result of these sanctions, Visa and MasterCard blocked credit cards issued by four Russian banks for several days. During this time, cardholders were unable to carry out payment transactions both in Russia and abroad (PaySys, 2014).³²
- The United States’ Cuba embargo also had an impact on payment transactions in Europe (PaySys, 2011). Following pressure from the US government, PayPal threatened to close the accounts of any European customers selling Cuban

³² This episode prompted Russia to set up its own card payment system (PaySys, 2014).

products (Fuest, 2011). Online retailers (outside of the US, too) were not only required to ensure that PayPal could not be used to pay for Cuban products; they were also required to remove all Cuban products from their virtual shelves. This understandably met with some resistance on the part of retailers.

These examples show just how important it is for the settlement of card payments to be subject to national law. Otherwise, there is a danger of payment systems being shut down in part or entirely due to political decisions abroad.

Abolishing cash would amplify the trend towards international systems. If cash no longer existed, foreign visitors would still need to pay for goods and services. This could take place in two ways.

1. Foreigners could be granted fast and easy access to a domestic payment instrument.
2. The acceptance of international payment instruments could be extended across borders.

Option 1 may be feasible, but doubts still abound. A number of factors (ever stricter “know your customer” regulations, the refugee problem, a large number of short-term visitors, etc) would impinge an even half-way satisfactory implementation of this option. This leaves only option 2, where international systems would have to extend their acceptance across borders. Through the regulation of interchange fees for payment cards, international cards have already become more attractive than national procedures – including the German “Girocard” system. If international cards obtain the same level of acceptance as national ones, customers may well ask why they actually need two cards. Should they come to the conclusion that one is sufficient, it is fairly safe to say that they would opt for the international card as it can also be used abroad.

European politicians are currently trying to prevent such a response. Their aim is to have at least one European card system alongside MasterCard and Visa. Yet both payments regulations and competition policy have actually resulted in the opposite (Judt & Krueger, 2013). A duopoly of the two large international card systems seems more and more likely. This thus makes the question of whether cash will remain a competitor of cards even more important.

4.4 Alternative to a narrow oligopoly

Although today's retail customers can choose from a wide range of brands of payment systems, the principle choice is: cash or card?³³ If cash is not an option, in most cases the customer can use only a card to make a payment. At first glance, this may not appear critical as far as competition is concerned; after all, the number of card payment systems on offer has risen sharply over the past few years. Even at a discount store, customers in Germany have the option of paying with the mainly domestic "Girocard" card, Maestro and MasterCard cards (both MasterCard brands) and V Pay and Visa cards (both Visa brands). Sometimes it is possible to use American Express as well. In addition, many retailers also use electronic direct debits (ELV). One could therefore claim that competition is sufficient even without cash. However, two factors restrict the validity of this claim.

- a. The European market is currently undergoing a phase of consolidation and it is possible that only a few card payment systems will survive. Some countries have already lost their domestic card systems (for instance, the Netherlands and Finland).
- b. The card market is two-sided. In such a market, competition does not necessarily produce the result intended by competition policy. For instance, it has been observed on many an occasion that competition between card systems has

³³ In some countries, such as France, the cheque is still a widely used alternative

actually led to higher fees for retailers.³⁴ If cash ceased to exist, in such situations retailers would no longer have the option of refusing to accept cards (or at least threatening to do so).

If cash were abolished, the options available to payment service users (in particular, customers and retailers) would be greatly limited. This would likely have grave consequences for the functioning of competition in the retail payment market.

5 Summary, conclusions

It seems that paper money no longer really fits into today's digital age. As early as 20 years ago, James Gleick (1996) claimed that, "Cash is dirty ... Cash is heavy ... Cash is inequitable ... Cash is quaint, technologically speaking ... Cash is expensive ... Cash is obsolete."

Despite this, cash as a product has held its own surprisingly well. Admittedly, the share of cash in total payments is falling. Even so, the demand for cash continues to rise unabated in many countries (see, eg, Jobst & Stix, 2017; Ashworth, 2017). There is therefore no sign of cash meeting an imminent demise. The reasons for this lie in the many advantages that cash offers, which are related to its unique features. Cash can be used anonymously; it can be used without any further involvement of service providers; the payer and recipient do not need to be "online" in any form; it can be used for both small and large amounts; payment is simple, convenient and quick; payment is definitive (it cannot be cancelled); and cash is relatively counterfeit-proof. At present, there are no electronic payment instruments which offer all of these advantages.

³⁴ MacFarlane (2005) complains that increasing competition in the card market has continuously pushed up interchange fees. Guthrie & Wright (2007) show that competition between card systems can lead to highly asymmetrical prices. This argument applies to two-sided markets in general (Wright, 2004).

Recently, however, some have been emphasising the disadvantages of cash and calling to restrict – or even abolish – its use. Critics point out that cash is very useful in conducting illegal transactions and laundering the proceeds of crime. They also complain that the “zero interest rate” on cash makes it difficult for monetary policy makers to push the policy rate very far into negative territory.

All in all, however, three points are clear. First, a policy aimed at abolishing cash is dangerous and risky as it would not remedy the problems mentioned above. Second, such a policy is impracticable as cash would need to be abolished more or less across the world. Third, the idea cannot be implemented until the issue of security has been resolved. Should cash be abolished in spite of these problems, we can expect alternative, non-electronic payment instruments to be used instead. Inefficiencies are also likely to arise as part of this process. “Given the desire to hold assets outside of the financial system and the potentially disciplining effects of the existence of such instruments, it would be clearly welfare-reducing to outlaw cash.” (Berentsen & Schär, 2016, 17). Prescribing the means of payment that the general public should use would seem to be at odds with the principles of a free market economy. In this vein, cash alone can truly be considered “coined liberty”. The best form of protection from both state and private sector abuse of market power is competition. This also applies to currencies and means of payment (Rösl & Seitz, 2015). It is difficult to shake off the impression that, for some market participants and politicians, the proposal to abolish cash is a welcome distraction from the true causes of the problems it is ostensibly designed to solve (shadow economy, zero interest rate policy, lack of structural reforms). In general, it would seem that the intention is to do away with a long-established institution that has proven successful over many centuries without giving the matter much forethought. Before taking such a step, it is important to consider whether there are other and better solutions.

The current idea of “simply” getting rid of cash just because there are theoretical

models which show that the world would work better without it brings to mind Hayek's criticism of constructivism, in which he speaks of "the innocent sounding formula that, since man has himself created the institutions of society and civilisation, he must also be able to alter them at will so as to satisfy his desires and wishes" (Hayek, 1978, 3). Hayek was extremely sceptical of this point of view, as he saw the institutions that make it easier for humans to live together as being the products "of human action but not human design" (Hayek, 1978, 5).

Finally, in this context, we should also make mention of the sociological and psychological research which shows that using cash triggers a surge of happiness or positive emotions (Ruberton et al, 2016; van der Horst & Matthijsen, 2014) and that a unique "sociology of cash" exists (Llewellyn, 2015). It may be that the intensive use of cash simply reflects the public's preferences (see also Wakamori & Welte, 2017).



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Epilogue

Helmut Hammes
Deutsche Bundesbank



This third International Cash Conference was entitled “War on Cash: Is there a Future for Cash?” Following the concept of the previous Cash Conferences in 2012 and 2014, experts in particular from academia and central banks were invited to exchange views on cash-related subjects. Lectures were presented by renowned researchers as well as central bank experts. Furthermore, we were very proud to allure Professor Friedrich Schneider and Peter Sands as keynote speakers. It was the first time that we invited two keynote speakers with very contrary opinions. Also for the first time, we had to divide a part of the conference into two parallel sessions because of the many papers that were presented. The Oesterreichische Nationalbank was attending this conference as our guest of honour.

Our aim is to improve the understanding of cash payment economics based on recent academic research and to help identify possible developments and dynamics that will shape the future cash payments landscape. During the three-day’s conference we experienced lively in-depth discussions on highly topical and

relevant cash issues. One should not underestimate the numerous and valuable informal dialogues during welcome reception, coffee breaks, lunch, dinner and the boat trip.

We have heard very interesting lectures and presentations and have experienced some exciting and partly controversial debates. Members of the audience used the opportunity to challenge assumptions, methods and findings of individual speakers, and these presenters had to defend their work. The papers presented here made clear that cash is a field of research that overlaps with many other areas, such as cashless payments, monetary policy and criminology. This underscores the importance of research on the subject of cash. However, we experienced that also this cash conference can only serve as one further step on the path towards a continuing academic analysis of cash. This will be a long-term process and will entail continued efforts on all our parts.

In order to sustain our contribution to research on the subject of cash in the future, we intend to hold further such conferences. For next year, we start already the preparations for a Cash Symposium, which has another format. Besides speeches from academia and public authorities also the German associations in the cash cycle will actively take part. This event will be accompanied by the media. And, the language will be German. But, likely in 2019, we intend to organize a further cash conference in a similar format as this year's conference. According to our assessment, it makes sense to hold such a conference at two-year intervals in order to allow the relevant academic community to generate substantiated, high-quality research in the intervening period.

Photographs

Welcome Reception Steigenberger Inselhotel Constance

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Photographs

Welcome Reception on 24 April 2017

Steigenberger Inselhotel Constance





Photographs

Welcome Reception Steigenberger Inselhotel Constance

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Official Dinner Schloss Montfort Langenargen

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Official Dinner on 25 April 2017

Schloss Montfort Langenargen





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Official Dinner Schloss Montfort Langenargen

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Dinner Island of Mainau

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Dinner on 26 April 2017

Island of Mainau





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Dinner Island of Mainau

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Dinner Island of Mainau

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Conference Programme

25 – 27 April 2017

Monday, 24 April 2017

Arrival and welcome reception at the Steigenberger Inselhotel in Constance

Tuesday, 25 April 2017

09:00 – 09:15 Welcome

Carl-Ludwig Thiele (Board member of the Deutsche Bundesbank)

Keynote Session

Chair: Stefan Hardt (Deutsche Bundesbank)

09:15 – 10:00 **The dark side of cash –**

facilitating crime and impeding monetary policy

Peter Sands (Harvard Kennedy School, United States of America)

10:00 – 10:45 **Abolishing cash: an effective instrument for**

fighting the shadow economy, crime and terrorism?

Friedrich Schneider (Johannes Kepler University Linz, Austria)

10:45 – 11:45 Discussion

11:45 – 13:15 Lunch

Session I **Cash demand (components and motives)**
Chair: Franz Seitz (Weiden Technical University of
Applied Sciences)

Session II **Survey-based studies on payment behaviour
(cash/non-cash)**
Chair: Helmut Stix (Oesterreichische Nationalbank)

13:15 – 14:00

Session I **The demand for cash in France: review of evidence**
Emmanuelle Politronacci (Banque de France)

Session II **An introduction to the diary of consumer payment choice:
estimates of the change in US cash use, 2012-2015**
Scott Schuh (Federal Reserve Bank of Boston)

14:00 – 14:45

Session I **The use of large denomination banknotes in Switzerland**
Jörn Tenhofen (Swiss National Bank)

Session II **Choice of payment instrument for low-value transactions
in Japan**
Hiroshi Fujiki (Chuo University, Japan)

14:45 – 15:15 Coffee break

15:15 – 16:00

Session I **The transaction demand for cash by households in the
euro area**
Nadya Jahn (European Central Bank)

Session II **Debit card payments overtake cash in 2015:
results from a longitudinal consumer payment diary study**
Nicole Jonker (De Nederlandsche Bank)

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- 16:15 – 18:30 Boat trip to Schloss Montfort (Langenargen) from Island of Mainau, including champagne reception
- 18.30 – 21.00 Dinner at Schloss Montfort
Speaker: Carl-Ludwig Thiele (Board member of the Deutsche Bundesbank)
- 21.00 – 23.00 Return transfer to Constance

Wednesday, 26 April 2017

Session I **Cash demand (components and motives) – continued**

Chair: Franz Seitz (Weiden Technical University of
Applied Sciences)

Session II **Survey-based studies on payment behaviour – continued**

Chair: Helmut Stix (Oesterreichische Nationalbank)

09.15 – 10.00

Session I **The future of cash in crisis and calm:
demand for US dollar banknotes**

Ruth Judson (Federal Reserve Board)

Session II **Consumer cash usage in the euro area:
evidence from the survey on the use of cash by
households**

Lola Hernandez (European Central Bank)

10.00 – 10.45

Session I **Domestic and foreign demand for euro banknotes issued
in Germany**

Matthias Uhl (Deutsche Bundesbank)

Session II **Pay cash, buy less trash – evidence from German payment
diary data**

Martina Eschelbach (Deutsche Bundesbank)

10.45 – 11.15 Coffee break

11.15 – 12.00

Session I **Transaction balances of small denomination banknotes:
findings from the introduction of ES2**

Nikolaus Bartzsch (Deutsche Bundesbank)

Session II **Cash-use discontinuities and the burden of coins**

Oz Shy (United States of America)

12.00 – 12.45

Session I **Addressing the limitations of forecasting banknote demand**

Callum Miller (Bank of England)

Session II **Adoption costs of financial innovation:
evidence from Italian ATM cards**

Kim Huynh (Bank of Canada)

12.45 – 14.15 Lunch

Session III **Presentations (guest of honour: Austria)**

Chair: Matthias Callen (Deutsche Bundesbank)

14.15 – 15.00 **Doomed to Disappear? –
the surprising return of cash across time and across
countries**

Helmut Stix (Oesterreichische Nationalbank)

15.00 – 15.45 **Technical innovations in cash processing – the future
cash cycle**

Stefan Augustin (Oesterreichische Nationalbank)

15.45 – 16.15 Coffee break

Session IV

Restrictions on cash payments/War on cash

Chair: Helmut Hammes (Deutsche Bundesbank)

16.15 – 17.00 **Decline management, the case of cash –
policy response in the Netherlands and the Nordic countries**

Bram Scholten (De Nederlandsche Bank)

17.15 – 18.30 Guided tour on Island of Mainau, including wine-tasting

18.30 – 21.00 Dinner on Island of Mainau

Speaker: Stefan Hardt (Director General, Deutsche Bundesbank)

21.00 – 21.45 Return transfer to Constance

Thursday, 27 April 2017

Session IV **Restrictions on cash payments/War on cash – continued**

Chair: Helmut Hammes (Deutsche Bundesbank)

09.15 – 10.00 **The surprising recovery of currency usage**

Jonathan Ashworth (Morgan Stanley)

10.00 – 10.45 **Moving towards “cashlessness” in an emerging economy:
a case study of latest policy steps in India**

Manjira Dasgupta (Maharaja Sayajirao University of Baroda,
India)

10.45 – 11.15 Coffee break

11.15 – 12.00 **Uniform cash thresholds: assessing financial crime
effectiveness**

Haylea Campbell (Royal United Services Institute, United
Kingdom)

Ben Weisman (Harvard University, United States of
America)

12.00 – 12.45 **The blessing of cash**

Franz Seitz (Weiden Technical University of Applied Sciences),
Malte Krüger (University of Applied Sciences Aschaffenburg)

12.45 – 13.15 Concluding remarks

Helmut Hammes (Deutsche Bundesbank)

13.15 – 14.15 Lunch

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