

Discussion Paper

Deutsche Bundesbank
No 12/2023

Long-term deposit funding and demand for central bank funds: Evidence from targeted longer-term refinancing operations

Adina-Elena Fudulache

(European Central Bank and Goethe University Frankfurt)

Martin R. Goetz

(Deutsche Bundesbank)

Editorial Board:

Daniel Foos
Stephan Jank
Thomas Kick
Martin Kliem
Malte Knüppel
Christoph Memmel
Hannah Paule-Paludkiewicz

Deutsche Bundesbank, Wilhelm-Epstein-Straße 14, 60431 Frankfurt am Main,
Postfach 10 06 02, 60006 Frankfurt am Main

Tel +49 69 9566-0

Please address all orders in writing to: Deutsche Bundesbank,
Press and Public Relations Division, at the above address or via fax +49 69 9566-3077

Internet <http://www.bundesbank.de>

Reproduction permitted only if source is stated.

ISBN 978-3-95729-943-7

ISSN 2749-2958

Non-technical summary

Research question

We examine the role of banks' funding structure, particularly their dependence on long-term deposits, on their decision to obtain longer-term funding from the central bank. Theory provides conflicting views regarding the link between a bank's long-term deposit funding and its decision to obtain longer-term funding. Extending funding maturity by obtaining (additional) longer-term funding by the central bank may allow banks to reduce their exposure to liquidity risk. However, banks with a sufficiently high level of long-term funding may be reluctant to extend their funding maturity to maintain their current asset and liability match.

Contribution

We contribute to earlier work that examined the effect of targeted longer-term operations (TLTRO) provided by the European Central Bank on bank trading and lending activity by focusing on the effect of banks' funding structure on their decision to obtain funds available via TLTRO. To pin down the causal effect running from banks' long-term deposit funding to their decision to obtain TLTRO funds, we use the share of seniors in banks' deposit market as an excluded instrumental variable. Building on earlier work, we exploit the fact that the share of seniors in a local banking market only affects a bank's long-term deposit funding structure, but has no other effect on the bank's decision to accept TLTRO funds. Finally, we explore the effects of TLTRO on changes in banks' dependence on deposit funding, market funding and other funding sources.

Results

Our results indicate that a greater share of long-term deposit funding is associated with a smaller likelihood of obtaining TLTRO funds. We further show that this effect is stronger for banks located in less competitive markets. Moreover, we find that banks reduce their issuances of debt financing and increase their money markets borrowing after obtaining TLTRO funds. These findings are consistent with the idea that banks with stable, long-term deposit funding may not want to increase their funding maturity presumably to maintain their current asset and liability match.

Nichttechnische Zusammenfassung

Fragestellung

Wir untersuchen in diesem Papier, inwiefern die Verbindlichkeitsstruktur von Banken deren Entscheidung, längerfristige Mittel bei der Zentralbank aufzunehmen, beeinflusst. Theoretische Überlegungen legen verschiedene Schlüsse nahe: Zum einen könnte eine Ausweitung der Laufzeit von Verbindlichkeiten durch die Aufnahme weiterer langfristiger Verbindlichkeiten Banken weniger anfällig für Liquiditätsrisiken aufgrund ihrer Kreditbeziehungen machen. Zum anderen könnte eine Laufzeitausweitung von Verbindlichkeiten eine bestehende Übereinstimmung (Match) von Aktiva und Passiva aus dem Gleichgewicht bringen und Banken dadurch anfälliger für Risiken machen.

Beitrag

Die Ergebnisse in diesem Papier tragen zu einem besseren Verständnis hinsichtlich des Wirkungsmechanismus gezielter längerfristiger Refinanzierungsgeschäfte (TLTRO) bei. Während bestehende Arbeiten vor allem den Einfluss von TLTRO auf Bankverhalten (v.a. Handelsgeschäfte und Kreditvergabe) untersuchen, analysieren wir hier die Motivation von Banken an TLTRO teilzunehmen und konzentrieren uns dabei auf den Einfluss von langfristigen Einlagen. Zur ökonometrischen Identifikation eines Kausalzusammenhangs ermitteln wir zunächst den Anteil an Senioren in einem Bankenmarkt und verwenden dies als ein Instrument in einem zweistufigen Schätzverfahren. Hierbei bauen wir auf bestehenden Forschungsarbeiten auf und nehmen an, dass der Anteil von Senioren in einem Bankenmarkt nur den Anteil an langfristigen Einlagen einer Bank bestimmt und keinen weiteren Einfluss auf die Teilnahme an TLTRO hat. Darüber hinaus untersuchen wir den Effekt von TLTRO auf Veränderungen in der Finanzierungsstruktur von Banken.

Ergebnisse

Unsere Ergebnisse zeigen, dass Banken mit mehr langfristigen Einlagen eher weniger an TLTRO teilnehmen. Dieser Effekt ist zudem stärker ausgeprägt, wenn Banken weniger Wettbewerb in ihrem Bankenmarkt erfahren. Des Weiteren finden wir, dass Banken ihre Finanzierungsstruktur nach dem Erhalt von TLTRO-Mitteln verändern, indem sie die Schuldaufnahme mittels emittierter Schuldtitel verringern und die Kreditaufnahme am Geldmarkt erhöhen.

Long-term deposit funding and demand for central bank funds: Evidence from Targeted Longer-Term Refinancing Operations*

Adina-Elena Fudulache, Martin R. Goetz

March 7, 2023

Abstract

We exploit variation in the share of seniors across European banking markets to construct an IV for banks' dependence on long-term deposit funding and find that greater long-term deposit funding reduces demand for long-term central bank funding via targeted longer-term refinancing operations (TLTRO). This effect is stronger when banks face less competition. Long-term central bank funding further motivates banks to reduce their dependence on debt issuance and increase their money markets borrowing. Our findings are consistent with the idea that banks' access to stable funding can crowd out their incentive to apply for (long-term) central bank funding.

Keywords: Monetary policy, bank funding, deposit financing

JEL Classification: E50, G20, G28

*Fudulache: European Central Bank and Goethe University Frankfurt, Sonnemannstraße 20, 60314 Frankfurt am Main, Germany, adina.elena.fudulache@ecb.europa.eu; Goetz: Deutsche Bundesbank, Wilhelm-Epstein Strasse 14, 60431 Frankfurt, Germany, martin.goetz@bundesbank.de
We are very thankful to Puriya Abbassi, Bo Becker, Arturo Diez-Caballero, Maria Encio, Janina Engel, Björn Imbierowicz, Ruth Magono, Nick Solonar, Evangelos Tabakis and seminar participants at Bundesbank for comments. The views expressed are our own and do not reflect those of the Deutsche Bundesbank, the ECB or of the Eurosystem.

1. Introduction

In this paper we examine the link between banks' funding structure and their willingness to borrow long-term from the central bank. Specifically, we examine how European banks' dependence on long-term deposit funding affects their decision to obtain funding from the European Central Bank (ECB) as part of the targeted longer-term refinancing operations.

Whether banks are willing to obtain longer-term funds and increase their funding maturity depends on the costs and benefits banks face when financing themselves with a longer maturity. Funding (new) credit or credit lines with stable long-term funding might help banks to their exposure to liquidity risk (Gatev and Strahan, 2006; Gatev et al., 2009). Li et al. (2019) show that bank funding stability is important for lending and banks with greater funding stability tend to lend longer. Similarly, Carletti et al. (2021) show that an increase in deposits is associated with an increase in long-term credit and credit lines. The funding maturity structure renders banks exposed to liquidity risk (Diamond, 1991) and banks may need to maintain a certain level of short-term funding to, for instance, alleviate informational asymmetries between borrowers and banks (Flannery, 1994) or to serve as a disciplining device for banks since depositors can withdraw deposits at short notice (Calomiris and Kahn, 1991). Moreover, since long-term deposits tend to be sticky, banks may want to maintain their current asset and liability match and not to extend their funding structure maturity (Stein, 1998).

Using information from large European banks and their decision to obtain funds via the European Central Bank's (ECB) targeted longer-term refinancing operation (TLTRO) program announced in March 2016, we find that greater long-term deposit funding is

associated with a smaller likelihood of obtaining TLTRO funds.¹ This also holds when we include country and credit quality fixed effects, as well as additional bank balance sheet characteristics, off-balance sheet funding, borrowing capacity in the program and prior TLTRO funding. Moreover, the results also hold if we implement a nonlinear logit regression model and a panel data regression exploiting the sequence of the four quarterly operations of the TLTRO-II program.

While OLS results indicate a robust negative link between longer-term deposit funding and a bank's decision to apply for targeted long-term funds from the ECB, they do not allow a causal interpretation. Latent factors, such as banks' lending opportunities may jointly affect the dependence on long-term deposit financing as well as banks' willingness to take up long-term funds from the central bank. To address this concern we construct an instrumental variable and implement a 2SLS estimation strategy.

We follow Becker (2007) and construct an instrumental variable (IV), based on the share of seniors a bank faces in its banking market, to identify the causal effect of a bank's dependence on long-term deposit funding on its decision to obtain TLTRO funds. Becker (2007) argues that heterogeneity in the demographic structure of banking markets can explain banks' dependence on deposit funding and shows that cities in the United States with a greater share of seniors tend to have higher deposit volumes. The fraction of seniors in a banking market may thus serve as an instrument for a bank's deposit funding share.

We collect (a) information on a bank's geographic spread via its branches across European regions and (b) information on the share of seniors in local banking markets

¹The first TLTRO program was introduced in 2014 and we analyze in our paper the effects of the second TLTRO program. Different to the first TLTRO program, banks could lock in funds with a specified maturity of four years in the second program.

to construct an IV at the bank-level. Similar to Becker (2007) we find that the share of seniors is relevant for a bank's dependence on long-term deposit funding. Since seniors are typically not active in the labor market anymore and/or affect credit demand, it serves as a valid instrument for deposit funding and only affects a bank's decision to obtain TLTRO funding via its effect on long-term deposit funding.

Using this bank-specific IV in a 2SLS estimation we confirm our earlier OLS findings and find that the share of long-term deposit funding exerts a negative effect on a bank's decision to obtain TLTRO funds. This effect is robust to different definitions of the instrumental variable and also holds when restricting attention to different subsamples. Our findings suggest that banks with greater long-term deposit funding may not want to extend their funding maturity by obtaining TLTRO funds. This is consistent with the idea that banks tend to manage a specific asset and liability match (Stein, 1998).

We examine our findings further and assess whether the effect of long-term deposits on obtaining TLTRO funds differ if banks are located in markets with weaker/stronger competition. Since lower competition in banking markets also renders long-term deposits stickier, we expect that the negative effect of obtaining TLTRO funds is even stronger for banks located in less competitive markets. We find evidence for this as the effect of long-term deposit funding on TLTRO funding is even more negative for banks located in areas with fewer competitors or with a greater banking concentration.

Finally, we explore how the participation in TLTRO funds impacts a bank's funding structure. We find that banks adjust their market financing sources following the receipt of TLTRO funds. Specifically, banks decrease their dependence on debt issuance and increase their reliance on money markets borrowing after obtaining funding from TLTRO.

Under the assumption that borrowing from money markets is less stable than financing via issuing debt, this is consistent with the idea that banks are adjusting their maturity to maintain a specific funding maturity.

Our findings contribute to work examining the effect of unconventional monetary policy, particularly targeted longer-term financing operations, on bank behavior.² Crosignani et al. (2020) find evidence for risk-shifting due to participation in the (unconditional) long-term refinancing operations and document that Portuguese banks increased their purchase of short-term domestic government bonds following the first operation. Carpinelli and Crosignani (2021) show that central bank liquidity support motivated Italian banks to also buy domestic government bonds and substitute missing wholesale funding. de Haan et al. (2021) finds that the allocation of TLTRO funds via the conditionality agreement reduced the likelihood of banks engaging in carry trades. Flanagan (2019) argues that TLTRO enhanced the stability of financial sector and represented a “stealth” recapitalization. Bednarek et al. (2021) find that banks borrowing from the ECB rebalance their loan portfolios towards ex-ante riskier firms. We contribute to this debate by showing that a bank’s dependence on long-term deposit financing, is an important factor for the bank’s decision to participate in TLTRO. Furthermore, we are the first to document and identify the impact of long-term deposit funding on bank’s endogenous participation decision in the TLTRO program and thus hope to also inform work regarding the optimal design of TLTRO.

Furthermore, our findings also inform research regarding the deposit channel of (conventional) monetary policy. Drechsler et al. (2017) present evidence that an increase

²Several papers have examined the effect of TLTRO on loan supply. See among others: Andrade et al. (2019); Andreeva and García-Posada (2021); Benetton and Fantino (2021). See also Altavilla et al. (2020) for a meta-analysis of studies examining the impact of TLTROs on loan growth .

in the federal funds rate leads to a widening of deposit spreads, followed by an outflow of deposits and a contraction of lending. Banks' deposit franchise further hedges them against interest rate risk (Drechsler et al., 2021). Our findings that banks located in areas with less competition are even less likely to apply for TLTRO funds when they depend on long-term deposit financing, suggests that bank competition also plays an important role for the transmission of unconventional monetary policy tools, specifically targeted long-term operations.

Our paper is organized as follows: section 2 provides an overview of targeted long-term refinancing operations in the Eurozone, section 3 presents data, sources and empirical specifications. Section 4 presents OLS results regarding the link between banks' funding structure and application for TLTRO. Section 5 discusses and presents our instrumental variable estimation strategy and results as well as results on the interplay between competition, long-term deposit funding and TLTRO participation. Section 6 presents the effect of TLTRO participation on banks' rebalancing of liabilities. Section 7 concludes.

2. Targeted Longer-Term Refinancing Operations

The ECB has gradually increased the maturity of its longer-term refinancing operations (LTROs) since the onset of the Financial Crisis.³ Although the maturity of LTROs has considerably increased at the peak of the European sovereign debt crisis with the introduction of two three-year operations in 2011, these monetary policy tools were “unconditional”, as banks' borrowing capacity was not linked to their ability or willingness

³The standard maturity of long-term refinancing operations is 3 months. See Article 55 of Guideline (EU) 2015/510 (ECB/2014/60).

to lend.⁴ To address concerns that these LTROs may have failed to sufficiently stimulate lending, the ECB introduced *targeted* long-term refinancing operations (TLTROs) in June 2014.⁵ Under TLTROs a bank’s borrowing allowance was linked to the volume of its portfolio of “eligible loans”.⁶ TLTROs aimed at supporting the transmission of the accommodative monetary policy to the real economy by (i) offering banks favourable borrowing conditions, and (ii) ensuring that the favourable funding conditions are passed on to the real economy by incentivizing lending. Banks could either apply directly for TLTRO funds or by forming a group of banks where, operationally, only a lead bank engages in the TLTRO modalities and manages the distribution of funds across participants.

Thus far, the ECB has implemented three different TLTRO programs.⁷ Under the first series of TLTROs (TLTRO-I), introduced in June 2014, banks could obtain funds from the ECB in eight different auctions until June 2016. The pricing of TLTRO-I funding was unconditional on bank lending performance, however both the final borrowing allowance and maturity of each operation depended on whether and by how much participating banks’ eligible lending exceeded a predefined lending benchmark. Participating banks could obtain up to 7% of their amount of eligible loans outstanding on 30 April 2014 in the first two auctions, with the possibility to increase their borrowing allowance by a up to three times the amount exceeding the benchmark in the last six auctions. All eight operations were set to simultaneously mature at the end of September 2018. If banks did

⁴Subject to enough eligible collateral availability to secure their borrowing banks could borrow as much as they needed,

⁵Particularly concerns that participating banks were engaging in carry trade behaviour (Acharya and Steffen, 2015; Drechsler et al., 2016) with the borrowed funds.

⁶“Eligible loans” comprised loans to non-financial corporations and households, other than loans for house purchases. Loans for house purchase were excluded from the definition of “eligible loans” as they were considered to be adequately served by the banking sector, but also due to macroprudential considerations.

⁷The third series of TLTROs (TLTRO-III), initially launched in September 2019 but further recalibrated following the Covid19 pandemic crisis outbreak is not part of the analysis of this paper.

not meet their predefined lending benchmarks, however, this entry long-term maturity was shortened through mandatory early repayments.⁸ In total, banks across the euro area borrowed EUR 432 bn from the ECB in the eight TLTRO operations.

In March 2016 the ECB announced the second series of four TLTRO operations (TLTRO-II) as part of a broader package of policy measures to stimulate lending to the real economy.⁹ There were three important differences in the design of these new TLTROs compared to TLTRO-I. First, participating banks could borrow, in all operations combined, up to 30% of the amount of their stock of eligible loans outstanding as of 31 January 2016, with no conditionality attached.¹⁰ Second, all operations had a maturity of four years from the time of settlement and the maturity was not tied to any predetermined benchmark figure. Thus, participating banks could lock-in with certainty four-year term funding at each entry-point in the program and have the flexibility to spread out the maturity structure of their borrowing over the space of 12 months.¹¹ Third, in the context of a further push of the policy rate in the negative rate, the cost of TLTRO-II funds was at the core of the lending incentive scheme of the program. Thus, the ECB changed the pricing of TLTRO-II funds to reward bank lending, by offering lower (negative) rates to banks that would improve their lending activity over a fixed period relative to a benchmark.¹² In addition, the TLTRO-II design kept the early exit option, also

⁸The first operation could have at best a four-year maturity while the remaining ones would have declining maturities. If banks could not exceed their lending benchmarks by 30 April 2016, they were required to exit two years earlier from the operation.

⁹Importantly, the ECB also announced a further push of the policy rate on the deposit facility (DFR) in the negative territory (cut to -0.4%) in March 2016.

¹⁰Minus any outstanding amount borrowed under the first TLTRO operations.

¹¹This feature was aimed at reducing concerns regarding potential "cliff effects" for the maturity structure of banks' funding arising from a simultaneous maturity for all operations, as designed in TLTRO-I.

¹²The entry (maximum) rate on the TLTRO-II funds was set at the main refinancing operation rate at the allotment date (0%). If participating banks' eligible lending had grown by more than 2.5% compared to their benchmark lending during a two-year lending assessment period this rate would reduce further

embedded in the earlier program,¹³ giving banks the flexibility to repay their borrowings earlier if TLTRO-II funding proved to be expensive relative to their market-based outside options.¹⁴ Similarly, participating banks could also call back funds borrowed under TLTRO-I in advance of the first TLTRO-II operation, allowing them to switch to better funding conditions under TLTRO-II. Figure A1 from the appendix further illustrates the TLTRO-II design and provides the technical details for the pricing of TLTRO-II funds, conditional on a bank's lending performance. The total amount of borrowed funds under TLTRO-II was EUR 740 bn.

We examine banks' decision to participate in TLTRO-II operations. As explained above the four TLTRO-II operations allowed banks in the euro area to tap into four-year term central bank funding of to up to 30% of their stock of eligible loans. This made TLTRO-II operations the longest ECB refinancing operations. Moreover, in the context of the (further) negative interest rate environment, TLTRO-II were the first refinancing operations conducted at negative rates. Furthermore, TLTRO-II was introduced at a time when EU regulators were preparing the implementation of the new regulatory measures for the stability of banks' funding profiles and which required banks to extend the duration of their liabilities to improve the maturity match with assets.¹⁵

to be as low as the deposit facility rate at the allotment date (-0.4%). If lending performance would be less than 2.5%, banks would face a linear rate between -0.4% and 0%. Only banks with unchanged or lower eligible lending compared to the benchmark would face a rate of 0%. The lending incentives through lower interest rates were also introduced to alleviate the main adverse side effects of the negative interest rate policy on financial intermediation due to the zero floor on deposit rates.

¹³On a quarterly basis, starting with two years after the settlement of each operation

¹⁴Typically compared to secured market-based funding, such as covered bond issuance (Flanagan, 2019; Vergote and Sugo, 2020).

¹⁵Namely, the CRR2/CRD5 package setting out the EU implementation of Net Stable Funding Ratio (NSFR) was first put forward by the the European Commission (EC) on 23 November 2016. In addition, on the banking supervision side, the SSM, as the newly established supranational supervisor, also started in 2016 to expand its supervisory priorities to (funding) liquidity risk. (See ECB Annual Report on supervisory activities 2015, 23 March 2016).

3. Data sources, description of variables and sample

3.1. Sources

To exploit and account for the relevant design and operational features of the TLTRO-II program, we combine data from several sources and databases managed by the ECB. We use information on a bank's participation and borrowing capacity under the program from templates each participating bank submitted as part of its reporting obligations prior to participation, together with the application forms for TLTRO-II groups. Further, we use the ECB's Market operations database (MOBDB) for banks' actual take-up in TLTRO-II as well as amounts outstanding under the former TLTRO program. In addition we use balance sheet data from the individual Balance Sheet Indicators (iBSI) database. We complement information on the on-balance sheet sources of funding available from iBSI with information on banks' off-balance sheet funding sources such as asset-backed securities (ABS) origination, from MOPDB. We also make use of the Register of institution and affiliates database (RIAD) maintained by the ECB and further data from MOPDB to control for other bank characteristics. To capture heterogeneity in bank's funding costs in the market, e.g. via debt issuance, we collect information on a bank's credit ratings for long-term senior unsecured debt provided by four credit rating agencies and stored under the Centralised Securities Database.

3.2. Variable definitions

We collect information on a bank's participation status in the program and total take-up up of TLTRO-II funds from the templates submitted to the ECB by participating

banks and MOPDB respectively. Specifically, we construct a dummy variable, taking on the value of one if a bank participated and obtained targeted long-term funding in any of the operations ($=1$ if *TLTRO-II*), or zero otherwise.¹⁶ Furthermore, we construct a continuous measure of a bank’s use of TLTRO-II funding and compute a bank’s total take-up in the four TLTRO-II auctions, scaled by the bank’s total assets in February 2016, i.e. the month prior to the announcement of TLTRO-II (*TLTRO-II take-up*).¹⁷

We compute the following four variables to capture a bank’s on-balance and off-balance sheet funding dependence: (1) *Long-term deposits / Total assets* is the share of long-term deposits from households and non-financial corporations, defined as all time and savings (redeemable at notice) deposits with an original maturity of more than one year or a notice longer than three months, respectively, scaled by total assets, (2) *Sight and short-term deposits / Total assets* is the share of sight (overnight) deposits as well as time and savings deposits from households and non-financial corporations with less than one year maturity¹⁸ or redeemable at a notice shorter than three months, scaled by total assets, (3) *Wholesale funding / Total assets*, defined as main liabilities - capital and reserves - deposits from households and non-financial corporations - public liquidity/funding¹⁹, scaled by total assets. This variable thus includes the sum of (a) debt issued, (b) money market borrowing, represented by interbank deposits and deposits from money market funds and (c) other wholesale borrowing.²⁰ To capture off-balance sheet funding reliance we include the outstanding amounts of ECB-eligible ABS originated, scaled by total assets

¹⁶We consider a bank as a participant if the bank has participated in the TLTRO-II program either directly (i.e. individually or as the lead institution group) or indirectly (i.e. as part of a group of banks). Our results are robust if we exclude banks that only indirectly received TLTRO-II funding.

¹⁷In case of group participation, we assume that a bank’s individual take-up of TLTRO-II funding is based on the bank’s contribution to the group’s total stock of eligible loans/borrowing allowance.

¹⁸We assume that repurchase agreements also have a maturity of less than one year.

¹⁹This consists of borrowing from the central bank and deposits from the government sector.

²⁰Particularly deposits from other financial institutions and non-euro area (external) counterparts.

(*ABS funding / Total Assets*).

To capture heterogeneity in bank size and business activity, we compute the natural logarithm of banking assets ($\ln(\text{Total assets})$) and the bank's total loans to non-financial corporations and households, scaled by its assets ($\text{Loans}/\text{Total assets}$). Moreover, we construct a bank's (non-risk-weighted) *Capital ratio*, i.e. Capital/Total assets, and its *Liquidity ratio*, i.e. Liquid assets/Total assets, to account for differences in capital and liquidity adequacy.²¹ Differences in bank supervision and regulation are captured using a dummy variable, taking on the value of one if the bank is subject to supranational (ECB direct) supervision, or zero otherwise ($=1$ if *SSM significance*). Since larger, global banks are subject to additional (macro-prudential) regulation we also include a dummy variable, taking on the value of one whether the bank qualifies as a Global Systemically Important Bank, reported in the annual lists published by the Financial Stability Board ($=1$ if *GSIB*).

Since targeted long-term operations provide caps on a bank's maximum amount that can be borrowed, we construct a bank's borrowing allowance as 30% of their eligible loans as of the end of January 2016, sourced from the TLTRO-II lending templates, scaled by total assets ($\text{Borrowing allowance} / \text{Total assets}$). For non-participating banks, we use iBSI data, namely a bank's stock of loans to non-financial corporations and households (excluding mortgages) to proxy their (unused) borrowing allowance.²² To gauge heterogeneity in banks' incentives to provide lending when obtaining TLTRO-II funds, we use iBSI information on the flows of eligible loans over the first TLTRO-II lending pe-

²¹We measure a bank's liquidity ratio by computing the sum of a bank's cash, government bond holdings and the monthly average of its excess central bank reserves and scale this by total assets.

²²Under all programs, the TLTRO dedicated reporting was anchored to the iBSI methodological framework, thus ensuring the comparability of the two reporting frameworks.

riod to construct the minimum necessary growth rate of eligible lending over the second (lending assessment) period securing TLTRO-II funding at the minimum rate (*Lending incentives/objectives*).²³

3.3. *Sample of banks and descriptive statistics*

By merging all the data sources, we obtain a sample of 278 European banks. Panel A of Table 1 provides summary statistics of our sample. About 58% of all banks in our sample participated (either directly or indirectly) in TLTRO-II auctions and obtained TLTRO-II funding amounting to about 3% of their total assets. Our data covers large banks in the euro area, represented by that fact that the average asset size of banks in our sample is about 78 bn EUR. Moreover, banks in our sample are well capitalized and report an average equity to asset ratio of 10.1%. Moreover, banks in our sample tend to finance themselves less with long-term deposits as about 4% of a bank's total assets are funded using long-term deposits, while sight and short-term deposits amount to 31%.

Panel B of Table 1 reports pairwise correlation coefficients as well as significance levels for the main variables in our sample. The table indicates that banks that obtain TLTRO funds tend to be (a) larger, (b) use more off-balance sheet financing and (c) are subject to supranational supervision. We do not find a significant association between a bank's on-balance sheet funding items and TLTRO participation. Banks that depend more on long-term deposit financing tend to have a greater loans to asset ratio, but do not display a statistically significant unconditional correlation with the decision to participate in TLTRO.

²³This measure is capped at a maximum of 2.5% lending growth/performance for the positive net lenders during the first lending period (Figure A1).

4. TLTRO-II participation and bank characteristics

4.1. Empirical specification

We examine determinants of banks' decision to participate in TLTRO-II operations and estimate the following cross-sectional regression model using OLS:²⁴

$$TLTROII_i = X_i' \beta + \alpha_c + \alpha_{cq} + \varepsilon_i, \quad (1)$$

where $TLTROII_i$ is a dummy variable, taking on the value of one, whether bank i applied for targeted long-term funding, or zero otherwise; X_i is a set of variables, based on a bank's characteristics and α_c and α_{cq} are country and credit quality fixed effects. To account for heterogeneity in banks' credit quality and financing conditions in the market, we include a set of dummy variables. Specifically, we use credit ratings for a bank's long-term senior unsecured debt and define four different *credit quality* bins based on the Eurosystem's credit assessment framework.²⁵

As explained earlier, the set of bank characteristics X contains variables capturing (1) differences in banks' funding structure,²⁶ (2) information on size, lending activity, capital and liquidity adequacy, (3) institutional differences and (4) TLTRO-specific parameters. We are particularly interested in examining how banks' dependence on long-term funding is associated with their decision and take-up of TLTRO-II funds.

²⁴Our results are similar if we implement a logit model when examining the link between bank characteristics and the decision to participate. See Table A1 in the appendix.

²⁵Our four credit quality bins consist of : (i) Credit quality step (CQS) 1 or 2, (ii) CQS3, (iii) Below CQS3 and (iv) non-rated. For more information on Eurosystem's credit assessment framework (ECAF) see <https://www.ecb.europa.eu/paym/coll/risk/ecaf/html/index.en.html>

²⁶Our control variables capture on- and off-balance sheet funding sources. The omitted on-balance sheet liability item consists of public funding/liquidity, such as central bank borrowing and government deposits.

4.2. Results

Table 2 reports regression results from estimating regression model (1) where we cluster standard errors at the bank’s direct supervisory-level, to account for correlations across banks subject to the same supervisory standards and scrutiny.²⁷ Our results indicate a negative and statistically significant coefficient on a bank’s share of long-term deposit funding and the take-up of targeted long-term funding. Regarding other factors, we find that (a) larger banks, significant institutions and GSIBs, (b) banks with a greater focus on lending, (c) banks with less wholesale funding and (d) banks with more financing via asset-backed securities²⁸ are more likely to turn to the ECB for TLTRO-II funding. In column (2) we control for a bank’s borrowing allowance under TLTRO-II to account for heterogeneity in a bank’s maximum capacity (subject to collateral availability) to draw funds from the program. We continue to find a negative and statistically strong significant link between a bank’s share of long-term deposit funding and TLTRO-II funding. In column (3), we also include our measure of lending objectives to control for the lending incentive scheme provided in the TLTRO-II program and, not surprisingly, find that banks with a greater lending incentive are also more likely to apply for TLTRO-II funding. We continue to find a statistically significant link between a bank’s long-term deposit funding share and the likelihood of applying for targeted long-term funds. In column (4) we include a variable capturing the amount of central bank funding received from the

²⁷Since the establishment of the single supervisory mechanism (SSM) in November 2014, a bank’s supervisor is either the ECB as the supranational supervisor for significant institutions in the euro area or the relevant national supervisor/competent authority for the less significant institutions. For banks exempted from the Capital Requirements Regulation, the relevant national governments or country specific established entities act as competent authorities regarding bank supervision.

²⁸To secure central bank funding banks can use self-originated ABS, if not placed in the market, as collateral. This may be able to explain the positive and significant coefficient.

earlier (TLTRO-I) program.²⁹ Banks with more outstanding borrowing from the first round of targeted long-term operations and thus with more funding that can be switched to TLTRO-II funds are also more likely to take part in TLTRO-II as indicated by the positive coefficient on this variable. Furthermore, we continue to find that a greater share of long-term deposit funding is associated with a smaller likelihood of participating in the TLTRO-II program. In column (5) we replace our dependent indicator variable with a continuous measure and use the total take-up of TLTRO-II funds, scaled by a bank's assets as the dependent variable. Similar to before we find that a greater dependence on long-term deposit financing is associated with a smaller total take-up of TLTRO-II funding. We also find that a bank's share of long-term deposit financing is associated with a smaller likelihood of participation in TLTRO-II (and quarterly take-up) when implementing a panel regression analysis where we exploit within bank differences in long-term deposit financing over time and participation decisions (and take-up amounts) in each of the four auctions (see appendix Table A2).

5. The impact of long-term deposit funding on TLTRO-II participation

Our cross-sectional OLS analysis indicates a robust, negative link between a bank's long-term deposit funding and its likelihood of obtain long-term funding via the TLTRO-II program. Latent factors, such as a bank's lending demand or funding constraints may jointly affect the dependence on long-term deposit financing as well as a bank's

²⁹Consistent with the TLTRO-II take-up amounts, we assume that group participants in the earlier TLTRO program distributed the group funding at bank-level according to each bank's contribution to the group borrowing allowance (fixed end of April 2014 for TLTRO-I).

willingness to take-up long-term funds from the central bank. To address this concern, we now construct an instrumental variable (IV) to identify the causal link running from a bank’s dependence on long-term deposits on its decision to obtain long-term funds via TLTRO-II.

5.1. Instrumental variable: Bank’s exposure to share of seniors

5.1.1. Preliminaries

Arguing that the demographic structure of a local banking market affects a bank’s ability to fund itself with deposits, Becker (2007) documents that the presence of a bank’s branches in areas with a higher share of seniors, i.e. people older than 65 years, can explain a bank’s dependence on deposit funding in the United States. Because seniors do not participate in the labor market or operate businesses, the share of seniors in a bank’s market is also a valid instrument for a bank’s deposit funding structure, but does not shape a bank’s loan demand.³⁰ Doerr and Kabas (2019) also find that banks with a greater exposure to areas with an ageing population experience an increase in deposits. The importance of more stable funding by seniors is not only limited to banks and Adhikari et al. (2021) document that publicly listed non-financial firms tend to finance themselves more with stable debt if they are located in areas with a greater share of seniors. Similarly, Mian and Sufi (2022) show that banks with a greater dependence on noncore liability funding also have a larger market share in areas with a younger population, indicating that a greater share of seniors is associated with more stable long-

³⁰Several papers utilized a bank’s geographical exposure to areas with higher share of seniors to instrument for a bank’s deposit funding share. See among others: Butler and Cornaggia (2011); Acharya and Mora (2015); Han et al. (2015)

term deposit funding for banks.

5.1.2. *Construction and variable*

We build on this work and utilize (a) information on a bank’s branch network and (b) the share of seniors in areas across Europe to construct a measure of exposure to seniors for each bank. In a second step we use this bank-specific exposure variable to instrument for a bank’s share of long-term deposit funding in a 2SLS estimation strategy. To construct this measure, we first collect information on the branch network of all banks in our sample from S&P Global Market Intelligence (formerly SNL Financial). S&P Global Market Intelligence provides point-in-time information on the location of all bank branches (e.g. via the Postal Code, City and Address). For each bank in our sample, we collect, where available, the list of all domestic depository branches together with their location information as of January 2021.³¹ We then map bank branches to areas in Europe based on the postal code information provided by S&P Global Market Intelligence and using the Eurostat’s NUTS-postal codes matching tables³² to identify the geographically smallest area (NUTS3) a branch is located in.³³ Figure 1 presents a map of all branches for banks in our sample across Europe. We consider the banking market of a bank to consist of all NUTS3 regions where the bank has branches in. Finally, we

³¹Unfortunately, S&P Global Market Intelligence only provides the latest information on a European bank’s branch network and we were therefore not able to collect information on a bank’s branch network in 2016. Nevertheless, we were able to obtain, from the former SNL Financial, the location information as of 2014 for a subset of 112 banks in our sample, out of which 90 also had their branch network reported in 2021. We do not find evidence that using information from 2021 to construct the IV might bias our results (see below).

³²We use the 2016 TERCET NUTS-postal codes matching tables available at <https://gisco-services.ec.europa.eu/tercet/flat-files>. If postal codes were not available in either of the two sources, the city information was used to map a branch location to a NUTS area.

³³Geographic regions in Europe are defined according to the NUTS (Nomenclature of territorial units for statistics) classification. NUTS3 is the smallest geographic unit with detailed, harmonized information across European countries. We use the NUTS 2016 classification which defines 1166 NUTS3 regions in Europe.

collect information on the demographic structure of each NUTS3 region in January 2016 from Eurostat and construct a bank’s exposure to seniors as follows:

$$\text{Share of seniors}_i = \sum_{m=1}^M \text{Share of branches}_{i,m} * \text{Share of seniors}_{m,i} \quad (2)$$

Where *Share of branches*_{*i,m*} is bank *i*’s share of branches operated in market *m* and *Share of seniors*_{*m,i*} is the number of seniors in market *m*, scaled by the total population served by the branch network of bank *i*. We also construct an additional IV using information at a broader area and compute a bank’s exposure to seniors using information on the share of seniors and the location of bank branches across (broader) NUTS2 regions.³⁴ We are able to construct this information for 205 banks out of 278 banks. On average, a bank’s share of seniors is about 7 % (Table 1). Table A3 in the appendix presents additional descriptive statistics at local market level (NUTS3/NUTS2 area) and bank-local market level for the number of branches and the demographic variables used in the construction of the IV.

5.1.3. Validity

Unfortunately, we were not able to collect from S&P Global Market Intelligence historical information on a bank’s branch network, but only information on a bank’s branch network as of early 2021. We now assess whether the use of a bank’s most recent branch network is a good approximation for its branch network prior to the announcement of TLTRO-II. Specifically, we are concerned that a share of seniors in a region affects the

³⁴While NUTS3 regions tend to comprise a population of 150,000 to 800,000, NUTS2 regions are larger and tend to have between 800,000 and 3 million inhabitants. There are 242 NUTS2 and 1,666 NUTS3 regions in Europe.

decision of banks to enter/exit that area which may bias our measurement of a bank's exposure to seniors prior to TLTRO-II.

For this purpose, we make use of an earlier data collection from the former SNL Financial, with information on the branch network in 2014 for a subset of 90 banks in our sample. To examine differences in our IV when we use different years of a banks' branch network to construct the IV, we compute a bank's share of seniors using information from a bank's 2014 branch network across NUTS3 regions and compare this variable with the measure based on the 2021 branch network. In Panel A of Table 3 we present summary statistics of our IV based on different vintages of the bank's branch network as well as t-tests examining whether the differences are statistically significant from each other. We do not find that the two IV-measures are statistically different from each other and the share of seniors a bank serves is virtually the same using both branch vintage years. In Figure 2, we further present a scatter plot of our IVs based on the distribution of branch network across different vintage years as well as a fitted regression line. The coefficient on the linear regression plotted in the left panel (NUTS3 local markets- based IV) is 0.993 with a t-stat of 97.50, indicating that the IVs based on the branch network reported in 2021 is a very good approximation for the share of seniors using information on the branch network in 2014.

Finally, we examine the entry/exit of banks in certain markets and compute the share of branches a bank has in each NUTS3 region in 2014 and 2021. We then compute for each bank-region the change in the relative presence of that bank in that region:

$$\Delta Share\ of\ branches_{i,m} = Share\ of\ branches_{i,m}^{2021} - Share\ of\ branches_{i,m}^{2014}, \quad (3)$$

where $Share\ of\ branches_{i,m}^{2021/2014}$ is the share of branches bank i operates in market m in 2021/2014. Using $\Delta Share\ of\ branches_{i,m}$ as a dependent variable we then estimate the following regression:

$$\Delta Share\ of\ branches_{i,m} = (\alpha_i) + \beta Share\ of\ seniors_m / \Delta Share\ of\ seniors_m + \varepsilon_{i,m}, \quad (4)$$

where $Share\ of\ seniors_m / \Delta Share\ of\ seniors_m$ is the share of seniors (change in share of seniors) in market m and α_i are bank fixed effects. The coefficient β indicates the relationship between the share of seniors in a market and a bank's relative presence in a market. Panel B of Table 3 reports regression results from estimating regression model (4) and we do not find a significant link between the change in a bank's relative presence in a market and the share of seniors or the change of seniors in that area. This suggests that the share of seniors in a region is not significantly associated with the change in a bank's presence in a certain market, mitigating concerns that using information from the distribution of branches in 2021 may introduce a bias in our IV-analysis.

5.2. *The effect of long-term deposit funding on targeted long-term funding*

We now explore the causal effect of long-term deposit financing on a bank's decision to participate in the TLTRO-II program and present first and second stage regression results in Table 4. Under the assumption that the share of seniors only affects a bank's participation in TLTRO-II via its exposure on long-term deposit, we can identify the causal effect of banks' dependence on long-term deposit financing on their participation

decision. The first stage regression of our 2SLS regression model is given as:

$$LT_b = \alpha_c + \alpha_{cq} + \gamma \text{Share of Seniors}_b + X'_b \rho + \epsilon_b, \quad (5)$$

where LT_b is bank b 's long-term deposit share, $\text{Share of Seniors}_b$ is b 's share of seniors (see equation (2)), X' are the earlier employed control variables for bank b ; α_c/α_{cq} are country- and credit-quality fixed effects, respectively.

Panel B of Table 4 reports first stage regression results.³⁵ We find a positive and statistically significant coefficient on a bank's share of seniors in its market, indicating that banks with a greater exposure to seniors due to their branch network tend to finance themselves more with long-term deposits. This is consistent with earlier work of Becker (2007), and Mian and Sufi (2022) who document a similar relationship using information from the United States. This effect also remains if we use our IV based on a broader geographical classification, i.e. NUTS2 regions (column 2). The F-Test of the excluded instrumental variable are above 10, indicating that the share of seniors in a banking market can significantly explain a bank's share of deposit financing. Panel A of Figure 3 represents the coefficient on our IV in first stage regression graphically, where we plot the partial effect of the IV on a bank's long-term deposit share. Specifically, we first determine deciles based on our IV and compute for each bin the average share of long-term deposits and plot these averages against the average value of our IV for each decile. The figure shows a positive relationship between the share of seniors a bank is exposed to and its long-term deposit funding.

³⁵For brevity, we report 2SLS regression results using our full set of controls and changing our dependent variable from an indicator variable to the continuous measure.

Our second stage regression results, reported in Panel B of Table 4, confirm our earlier findings obtained from OLS analysis. The negative and statistically significant coefficient on the share of long-term deposit shows that a greater dependence on long-term deposit funding leads to a reduction in the likelihood of participating in the TLTRO-II program. This also holds if we employ our IV based on a broader geographic classification (column 2) or replace the dependent indicator dummy variable with the continuous measure of TLTRO-II funding (columns 3 and 4). Panel B of Figure 3 shows the relationship between the exogenous component of long-term deposits funding and the likelihood of participating in a TLTRO-II operation graphically. Specifically, we use our IV to construct the exogenous component of a bank's share of long-term deposits and then compute average values for ten deciles based on the exogenous component. Similar to Panel A of Figure 3 we then present the partial effect of long-term deposit funding on the average likelihood of participating in the TLTRO-II program, accounting for the influences of all other variables. The pattern in Figure 3 (Panel A) shows that a larger share of long-term deposit financing leads to a greater reduction in the likelihood of TLTRO participation. Panel C of Table 4 reports reduced form regression results and we find that a higher share of seniors is associated with a smaller likelihood of participating in TLTRO-II program. For comparison, Panel D of Table 4 reports results from the OLS regression at the bank level, restricted to the sample of banks for which the instrumental variable is available.

5.3. *Robustness*

We examine the sensitivity and robustness of our findings to several influences here. First, we assess the sensitivity of our long-term deposit measure since this variable in-

cludes deposits from households and deposits from non-financial corporations. We are concerned that our IV is only weakly related to the share of long-term deposits provided by non-financial corporations based on economic arguments. Hence we differentiate our long-term deposit measure into long-term deposits provided by households and long-term deposits provided by corporations and re-estimate the earlier regression model (1). Panel A of Table A4 in the appendix reports 2SLS regression results where we replace our main independent variable with the share of long-term deposit from households. We continue to find that the share of long-term deposits from households exerts a negative effect on the likelihood of participating in TLTRO-II operations.

Second, we assess whether the mode of banks' participation drives our results. Specifically, banks could either participate in TLTRO-II operations directly or as part of a banking group. In Panel B of Table A4 in the appendix we present regression results where we only focus on banks that are direct participants in any TLTRO-II operation, i.e. either individually or as the lead of a group, while the indirect participants of the group are excluded.³⁶ We continue to find that a higher share of long-term deposit financing leads to a reduction in the likelihood of participating in any TLTRO-II operation.

Third, we modify the definition of our long-term deposit measure to not only include time deposits with an original maturity of larger than one year, but consider all time deposits to constitute long-term deposits. Panel C of Table A4 in the appendix reports regression results from 2SLS regression where we use this alternative broader measure of long-term deposit funding in our analysis. Again, we find that a greater share of core deposit financing reduces a bank's likelihood of participating in TLTRO-II. Similarly, the

³⁶For the leads of the groups, we use the TLTRO-II take-up, the borrowing allowance and TLTRO outstanding from the former program at the group level.

results do not change if we modify the definition of the long-term deposit measure in a narrower way, and we only consider customer deposits not included in the Broad money (M3) monetary aggregate³⁷ as long-term deposits (Panel D of Table A4 in the appendix).

Fourth, to revisit the concern that we do not have information on a bank’s branch network prior to TLTRO-II when constructing our IV, we estimate regression model (1) where we use the IV based on the branch network in 2014 for a subset of banks. While this information is only available for a subset of 112 banks, we are still able to identify a negative and statistically strong effect of long-term deposit funding on a bank’s decision to participate in TLTRO-II (Panel E of Table A4 in the appendix).

Fifth, we assess if our results are sensitive to the definition of *Seniors* employed in the construction of our IV and estimate regression model (1) where we construct the IV based on the the population older than 60 years. We continue to identify a negative and statistically strong effect of long-term deposit funding on TLTRO-II participation decision (Panel F of Table A4 in the appendix).

Finally, we examine whether our findings are affected by riskier banks and exclude non-investment grade (high-yield) banks, namely banks with a first-best rating lower than BBB-/CQS3 from our analysis. Panel G of Table A4 reports regression results when analyzing only the sub-sample of investment grade and non-rated banks. We continue to find that a greater share of long-term deposit financing leads to a reduction in the likelihood of participating in TLTRO-II.

³⁷Specifically, we use time deposits with an original maturity longer than two years and deposits redeemable at a notice longer than three months.

5.4. *Heterogeneous effects*

Our findings are consistent with the idea that banks with a greater dependence on long-term deposit funding are less in need of long-term financing and therefore are less interested in participating in TLTRO-II. (Retail) deposits are often characterized as being sticky as these deposits are insured by deposit insurance schemes and/or depositors do not discipline banks as banks can be very opaque (Chen et al., 2022) or simply exhibit limited recall (Kahn et al., 1999). Competition in the banking market can further contribute to the stickiness of deposits as depositors may be even less willing to withdraw their deposits if there are no alternatives present where they can re-deposit their funds. Examining the transmission of monetary policy, several papers indeed find that weaker banking market competition is associated with a weaker pass-through of interest rate changes since deposits in less competitive banking markets are less volatile (Kopecky and Van Hoose, 2012; Drechsler et al., 2017; Wang et al., 2022; Li et al., 2019). We build on these insights and expect that deposits in banks located in areas with less competition are even stickier than deposits in banks located in very competitive areas. Thus, the negative effect of long-term deposits on participation in TLTRO-II operations should be even stronger for banks active in less competitive markets. To analyze this we estimate the following regression model:

$$TLTROII_i = \beta_1 LT_i + \beta_2 LT_i \cdot C_i + X_i' \rho + \alpha_c + \alpha_{cq} + \varepsilon_i, \quad (6)$$

where $TLTROII_i$ is a dummy variable, taking on the value of one, whether bank i applied for targeted long-term funding, or zero otherwise; LT_i is bank i 's long-term deposits,

scaled by assets; C_i is a dummy variable, capturing the degree of bank competition; X_i are the set of earlier employed bank controls; α_c and α_{cq} are country and credit quality fixed effects. We implement two different measures of bank competition to capture whether a bank is located in a less competitive banking market: first, C_i takes on a value of one whether bank i 's average number of bank competitors is below the sample median, or zero otherwise. Second, C_i takes on the value of one whether the Hirschman-Herfindahl index (HHI), based on the number of branches, of bank i 's banking market is above the sample median, or zero otherwise. The coefficient β_2 indicates the differential effect of long-term deposits on the decision to participate in TLTRO-II operations if the bank is located in a less competitive market.

We report regression results from estimating regression model (6) where we instrument a bank's share of long-term deposits and its interaction with the competition indicator variable with the share of seniors in a banking market and the interaction of the share of seniors with the competition indicator variable. In Panel A we use a bank's average number of competitors to measure banking market competition.³⁸ In Panel B we measure banking market competition using the HHI based on the number of branches banks operate in a NUTS2-market.³⁹

The results in Table 5 show that banks with a greater share of long-term deposits are less likely to participate in TLTRO-II operations. When assessing the differential effect of competition measured by the average number of competitors (Panel A), we find that

³⁸We count for each bank the number of competing branches the bank faces in a NUTS2-area (See Table A3 for descriptive statistics). Since banks can be active in more markets, we use a bank's share of branches in a NUTS2-region as weights to compute a bank's average number of competitors.

³⁹The HHI at the bank-level is constructed as follows: using information on the number of all branches banks operate in an area we compute the HHI at the NUTS2 area by summing the squared share of branches in that area (See Table A3 for descriptive statistics). We then aggregate this at the bank-level using the bank's share of branches in a NUTS2-region as weights.

banks located in areas with less competition are even less likely to participate in TLTRO-II operations. This differential effect for banks located in areas with less competition also remains if we use our IV at the NUTS2-region (column 2) or if we replace the dependent variable with a continuous measure of TLTRO-II participation (columns 3 and 4). In Panel B we capture a bank’s competitive environment based on whether the concentration of branches in a bank’s market (HHI) is above the sample median. Specifically, we consider banks located in more concentrated markets, i.e. banks with a HHI above the sample median, to face less competition. The results in Panel B of Table 5 show that the competitive environment has a significant impact on banks’ decision to obtain long-term funding by the central bank and banks located in less competitive markets are less likely to participate in TLTRO-II operations. Less competition is associated with fewer opportunities for households to deposit funds at other banks, rendering deposits by households in less competitive banking markets even stickier than others. We therefore interpret the findings reported in Table 5 to indicate that banks with a greater share of stable deposits are less willing to apply for long-term financing by the central bank.

6. TLTRO-II and the rebalancing of bank funding

Targeted long-term operations aimed to increase the lending of banks. Several papers document that TLTRO indeed motivated banks to extend their lending and affect the real economy (see among others: Benetton and Fantino (2021); Andrade et al. (2019); Carpinelli and Crosignani (2021); Esposito et al. (2020).) Other work has, however, identified unintended consequences of (unconditional) long-term financing operations: Crosignani et al. (2020) find that Portuguese banks engage in a carry trade in response

to the 3-year unconditional long-term operations and increased their holdings of short-term government bonds. While earlier work examines how banks rebalance their assets in response to (T)LTRO funding, we are curious to see whether the provision of (stable) long-term central bank funding also leads to adjustments in a bank’s funding structure. We therefore extend our analyses and test whether the provision of TLTRO-II funding has an impact on banks’ funding structure and estimate:

$$y_i = \beta \text{TLTRO-II}_i + \gamma X_i + \alpha_c + \alpha_{cq} + \varepsilon_i, \quad (7)$$

where y_i is the change in bank i ’s dependence on different funding sources following TLTRO-II; TLTRO-II_i is the aforementioned participation dummy variable/continuous take-up of TLTRO-II funds ⁴⁰ and X_i are a set of the earlier employed bank specific control variables. To account for the endogeneity in banks’ decision to participate in TLTRO-II we use the share of seniors in a bank’s banking market as an excluded instrumental variable and estimate regression (7) using 2SLS.⁴¹ Since we are interested in how the provision of long-term central bank funding affects a bank’s funding structure we focus on changes in (a) deposit funding, (b) market funding and (c) other funding. When examining changes in deposit funding, we analyze whether TLTRO-II participation changed a bank’s dependence on either long-term deposits or short-term and sight deposits. Regarding market funding, we examine whether TLTRO-II participation changed a bank’s debt issuance or its money market borrowing measured as interbank borrowing and de-

⁴⁰The total take-up of TLTRO-II funds is normalised by a bank’s total assets at the end of March 2017 to account for the effect of differences in bank size.

⁴¹As documented in the reduced form regression of the TLTRO participation and the share of seniors (Panel C of Table 4), we find a statistically strong effect of the share of seniors on the bank’s decision to participate in TLTRO-II.

posits from money market funds.⁴² Finally, we assess whether TLTRO-II participation affected a bank’s other wholesale borrowing⁴³ or ABS funding opportunities. For each of these funding sources we compute the change in these funding variables over the one year period from the end of March 2017 until the end of March 2018, scaled by a bank’s assets at the end of March 2017.

Table 6 reports regression results where we separately report results focusing on each of the three aforementioned broad funding categories: Panel A reports results on deposit financing, Panel B reports results on market financing and Panel C reports results on other borrowing.

When assessing changes in deposits following TLTRO-II, we do not find any significant effect of TLTRO-II participation on a bank’s dependence on long-term deposits (Panel A - columns 1 to 4) or short-term and sight deposits (Panel A - columns 5 to 8). Focusing on changes in banks’ market financing following the participating in TLTRO-II operations, we find that banks reduce their dependence on debt issuances (Panel B - columns 1 to 4) and increase their dependence on money market borrowing (Panel C - columns 5 to 8). The identified reduction in debt financing is consistent with the idea that following the receipt of TLTRO-II funds, participating banks substitute away from bank bonds for funding as this type of funding tends to be more expensive (Altavilla et al., 2020). The finding that banks increase their money market borrowing is, however, at odds with the idea that banks have fewer incentives to rely on market funding following TLTRO-II participation. The results could indicate banks’ increased willingness to accept deposits from money market funds, which do not have access to the ECB’s deposit facility to

⁴²Particularly, interbank and money market funds deposits other than intragroup deposit liabilities.

⁴³Deposit liabilities from other financial institutions and non-euro area entities.

place their liquidity.⁴⁴ Interestingly, the estimated coefficients when focusing on changes in debt issuances and money market borrowing are of similar magnitudes, suggesting that the participation in TLTRO-II motivates banks to not increase their overall dependence on market funding, but rather leads banks to shift financing from issuing (publicly traded) debt to money markets borrowing. Analyzing changes in borrowing from other sources (Panel C), we do not find that central bank funding via targeted operations has a significant effect on banks' dependence on other wholesale funding sources (Panel C - columns 1 to 4) or on ABS funding (Panel C - columns 5 to 8).

7. Conclusion

In this paper, we examine the role of deposit funding on banks' decision to participate in TLTRO-II funding. While earlier research has examined how targeted long-term operations affect bank lending or investment in different assets, we are interested in assessing the role of bank funding structure on TLTRO-II participation. Using a sample of large European banks, we find that a greater share of long-term deposits is associated with a lower likelihood of participating in the TLTRO-II program. To identify the causal effect, we construct an instrumental variable based on the share of seniors in a bank's market (Becker, 2007). We find that a larger share of seniors is associated with a higher share of long-term deposits at the bank. Using this in a 2SLS estimation, we can confirm our OLS regression results and find that a higher share of long-term deposits decreases a bank's likelihood of participating in TLTRO-II operations. This effect is robust to several additional influences and not sensitive to the definition of our IV. Furthermore, we find that

⁴⁴The level of granularity of iBSI balance sheet items does not allow us to further differentiate between changes in interbank deposits and changes in deposits from money market funds.

the negative effect of long-term deposit funding on TLTRO-II participation is stronger for banks located in less competitive environments. This suggests that banks with more stable deposit funding are less willing to participate in TLTRO-II operations. Finally, we examine whether the take-up of long-term targeted funds also impacts a bank's dependence on different funding sources. We find that participating in TLTRO-II reduces a bank's dependence on debt securities (e.g. bonds) issuances and increases in turn its reliance on money markets borrowing, possibly by increasing its willingness to take deposits from money market funds.

References

- Acharya, V. V. and N. Mora (2015). A crisis of banks as liquidity providers. *Journal of Finance* 70(1), 1–43.
- Acharya, V. V. and S. Steffen (2015). The ”greatest” carry trade ever? Understanding eurozone bank risks. *Journal of Financial Economics* 115(2), 215–236.
- Adhikari, B. K., D. C. Cicero, and J. Sulaeman (2021). Does Local Capital Supply Matter for Public Firms’ Capital Structures? *Journal of Financial and Quantitative Analysis* 56(5), 1809 – 1843.
- Altavilla, C., F. Barbiero, M. Boucinha, and L. Burlon (2020). The great lockdown: pandemic response policies and bank lending conditions.
- Andrade, P., C. Cahn, H. Fraisse, and J. S. Mésonnier (2019, aug). Can the provision of long-term liquidity help to avoid a credit crunch? Evidence from the Eurosystem’s LTRO. *Journal of the European Economic Association* 17(4), 1070–1106.
- Andreeva, D. C. and M. García-Posada (2021, jan). The impact of the ECB’s targeted long-term refinancing operations on banks’ lending policies: The role of competition. *Journal of Banking & Finance* 122, 105992.
- Becker, B. (2007, jul). Geographical segmentation of US capital markets. *Journal of Financial Economics* 85(1), 151–178.
- Bednarek, P., V. Dinger, D. M. te Kaat, and N. von Westernhagen (2021, jul). To whom do banks channel central bank funds? *Journal of Banking and Finance* 128.

- Benetton, M. and D. Fantino (2021, oct). Targeted monetary policy and bank lending behavior. *Journal of Financial Economics* 142(1), 404–429.
- Butler, A. W. and J. Cornaggia (2011). Does access to external finance improve productivity? Evidence from a natural experiment. *Journal of Financial Economics* 99(1), 184–203.
- Calomiris, C. W. and C. M. Kahn (1991). The Role of Demandable Debt in Structuring Optimal Banking Arrangements. *American Economic Review* 81(3), 497–513.
- Carletti, E., F. De Marco, V. Ioannidou, and E. Sette (2021, jul). Banks as patient lenders: Evidence from a tax reform. *Journal of Financial Economics* 141(1), 6–26.
- Carpinelli, L. and M. Crosignani (2021, jul). The design and transmission of central bank liquidity provisions. *Journal of Financial Economics* 141(1), 27–47.
- Chen, Q., I. Goldstein, Z. Huang, and R. Vashishtha (2022). Bank transparency and deposit flows. *Journal of Financial Economics* 146(2), 475–501.
- Crosignani, M., M. Faria-e Castro, and L. Fonseca (2020, jun). The (Unintended?) consequences of the largest liquidity injection ever. *Journal of Monetary Economics* 112, 97–112.
- de Haan, L., S. Holton, and J. W. van den End (2021). The impact of central bank liquidity support on banks’ sovereign exposures. *Applied Economics* 53(15), 1788–1806.
- Diamond, D. W. (1991, aug). Debt Maturity Structure and Liquidity Risk. *The Quarterly Journal of Economics* 106(3), 709–737.

- Doerr, S. and G. Kabas (2019). Banking On Demography: Population Aging and Financial Integration.
- Drechsler, I., T. Drechsel, D. Marques-Ibanez, and P. Schnabl (2016, oct). Who Borrows from the Lender of Last Resort? *Journal of Finance* 71(5), 1933–1974.
- Drechsler, I., A. Savov, and P. Schnabl (2017, nov). The deposits channel of monetary policy. *Quarterly Journal of Economics* 132(4), 1819–1876.
- Drechsler, I., A. Savov, and P. Schnabl (2021). Banking on Deposits: Maturity Transformation without Interest Rate Risk. *Journal of Finance* 76(3), 1091–1143.
- Esposito, L., D. Fantino, and Y. Sung (2020). The Impact of TLTRO2 on the Italian Credit Market: Some Econometric Evidence.
- Flanagan, T. (2019, aug). Stealth Recapitalization and Bank Risk Taking: Evidence from TLTROs. *SSRN Electronic Journal*.
- Flannery, M. (1994). Debt maturity and the deadweight cost of leverage: Optimally financing banking firms. *American Economic Review* 84(1), 320–331.
- Gatev, E., T. Schuermann, and P. E. Strahan (2009). Managing bank liquidity risk: How deposit-loan synergies vary with market conditions. *The Review of Financial Studies* 22(3), 995–1020.
- Gatev, E. and P. E. Strahan (2006). Banks’ advantage in hedging liquidity risk: Theory and evidence from the commercial paper market. *The Journal of Finance* 61(2), 867–892.

- Han, J., K. Park, and G. Pennacchi (2015). Corporate Taxes and Securitization. *Journal of Finance* 70(3), 1287–1321.
- Kahn, C., G. Pennacchi, and B. Sopranzetti (1999). Bank deposit rate clustering: Theory and empirical evidence. *The Journal of Finance* 54(6), 2185–2214.
- Kopecky, K. J. and D. D. Van Hoose (2012). Imperfect competition in bank retail markets, deposit and loan rate dynamics, and incomplete pass through. *Journal of Money, Credit and Banking* 44(6), 1185–1205.
- Li, L., E. Loutskina, and P. E. Strahan (2019, aug). Deposit Market Power, Funding Stability and Long-Term Credit.
- Li, W., Y. Ma, and Y. Zhao (2019). The passthrough of treasury supply to bank deposit funding. Columbia Business School Research Paper, USC Marshall School of Business Research Paper.
- Mian, A. and A. Sufi (2022). Credit Supply and Housing Speculation. *The Review of Financial Studies* 35(2), 680–719.
- Stein, J. C. (1998). An Adverse-Selection Model of Bank Asset and Liability Management with Implications for the Transmission of Monetary Policy. *The RAND Journal of Economics* 29(3), 466.
- Vergote, O. and T. Sugo (2020, jul). Who Takes the Ecb’s Targeted Funding?
- Wang, Y., T. M. Whited, Y. Wu, and K. Xiao (2022). Bank market power and monetary policy transmission: Evidence from a structural estimation. *The Journal of Finance* 77(4), 2093–2141.

Tables

Table 1: Summary statistics

This table presents descriptive statistics (Panel A) and correlations (Panel B) of variables at the bank level. 'TLTRO-II' is a dummy variable, taking on the value of one whether the bank participated directly or indirectly in any TLTRO-II operation, 'TLTRO-II take up/Total assets' is a bank's total take up from all TLTRO-II operations, scaled by total assets at the announcement date.

Panel A: Descriptive statistics								
	N	Mean	St.Dev.	Min	p25	Median	p75	Max
TLTRO-II	278	0.579	0.495	0.000	0.000	1.000	1.000	1.000
TLTRO-II take up / Total assets	278	0.027	0.038	0.000	0.000	0.012	0.039	0.228
Long-term deposits / Total assets	278	0.039	0.079	0.000	0.001	0.014	0.047	0.839
Short-term and sight deposits / Total assets	278	0.312	0.245	0.000	0.055	0.319	0.485	0.934
Wholesale funding / Total assets	278	0.454	0.272	0.012	0.236	0.408	0.712	0.979
ABS funding / Total assets	278	0.012	0.034	0.000	0.000	0.000	0.000	0.216
Ln(Total Assets)	278	10.201	1.455	6.310	9.264	10.224	11.010	13.836
Loans / Total Assets	278	0.413	0.239	0.000	0.222	0.441	0.609	0.950
Liquidity ratio	278	0.096	0.100	-0.009	0.027	0.077	0.129	0.833
Capital ratio	278	0.101	0.096	0.001	0.048	0.081	0.127	0.955
SSM significance	278	0.752	0.433	0.000	1.000	1.000	1.000	1.000
GSIB	278	0.248	0.433	0.000	0.000	0.000	0.000	1.000
Borrowing allowance / Total assets	278	0.075	0.055	0.000	0.034	0.067	0.111	0.274
Lending incentives/ objectives	278	-0.004	0.059	-0.372	-0.006	0.025	0.025	0.025
TLTRO outstanding / Total assets	278	0.022	0.047	0.000	0.000	0.004	0.025	0.422
Share of seniors NUTS3	205	0.069	0.068	0.002	0.010	0.031	0.142	0.251
Share of seniors NUTS2	205	0.090	0.068	0.007	0.023	0.074	0.143	0.228
Average number of competitors	205	787.1	974.4	24.0	153.0	290.0	1242.0	3942.0
Average market concentration (HHI)	205	0.207	0.091	0.065	0.134	0.178	0.254	0.483
Δ Long-term deposits / Total assets	203	-0.003	0.013	-0.089	-0.004	-0.001	0.000	0.055
Δ Short-term and sight deposits / Total assets	203	0.025	0.074	-0.215	0.000	0.015	0.037	0.592
Δ Debt issuance / Total assets	203	-0.009	0.031	-0.202	-0.009	0.000	0.000	0.071
Δ Money markets borrowing / Total assets	203	0.000	0.026	-0.173	-0.005	0.000	0.003	0.200
Δ Other wholesale borrowing / Total assets	203	-0.010	0.094	-0.664	-0.025	-0.003	0.007	0.547
Δ ABS funding/ Total assets	203	-0.001	0.020	-0.246	0.000	0.000	0.000	0.085

Panel B: Correlation matrix

Variables	TLTRO-II	TLTRO-II takeup / Total assets	Long-term deposits / Total assets	Short-term and sight deposits / Total assets	Wholesale funding / Total assets	ABS funding / Total assets	Ln(Total Assets)	Loans / Total Assets	Liquidity ratio	Capital ratio	SSM significance	GSIB	Borrowing allowance / Total assets	Lending incentives / objectives	TLTRO outstanding / Total assets	Share of seniors NUTS3	Share of seniors NUTS2
TLTRO-II		0.61***	0.02	0.03	-0.12	0.19**	0.34***	0.1	-0.07	-0.02	0.32***	0.07	0.04	0.16**	0.38***	-0.42***	-0.48***
TLTRO-II takeup / Total assets			0.04	0.15*	-0.2***	0.13*	0.08	0.36***	-0.1	0.08	0.22***	-0.05	0.36***	0.09	0.65***	-0.41***	-0.42***
Long-term deposits / Total assets				0.1	-0.34***	0.07	-0.07	0.18**	0.03	-0.03	0.06	-0.09	-0.07	-0.04	-0.01	0.03	0.04
Short-term and sight deposits / Total assets					-0.84***	0.04	-0.31***	0.52***	0.01	-0.03	-0.19**	-0.18**	0.25***	-0.0	0.03	-0.22**	-0.03
Wholesale funding / Total assets						-0.06	0.24***	-0.49***	0.01	-0.3***	0.1	0.18**	-0.23***	0.01	-0.07	0.31***	0.13
ABS funding / Total assets							0.15*	0.08	-0.07	-0.02	0.17**	0.14*	-0.04	-0.02	0.05	-0.16*	-0.2**
Ln(Total Assets)								-0.34***	-0.12	-0.21***	0.44***	0.11	-0.36***	0.05	0.03	-0.29***	-0.49***
Loans / Total Assets									-0.18**	0.07	-0.09	-0.22***	0.71***	0.08	0.28***	-0.16*	-0.05
Liquidity ratio										-0.02	0.01	-0.06	-0.13*	0.01	-0.03	-0.21**	-0.12
Capital ratio											-0.0	-0.04	0.12*	0.02	0.08	-0.04	0.01
SSM significance												0.02	-0.07	0.01	0.19**	-0.18**	-0.27***
GSIB													-0.12*	0.09	-0.13*	0.16*	0.07
Borrowing allowance / Total assets														0.1	0.35***	-0.05	0.05
Lending incentives/ objectives															0.04	-0.04	-0.06
TLTRO outstanding / Total assets																-0.26***	-0.28***
Share of seniors NUTS3																	0.87***
Share of seniors NUTS2																	

Table 2: TLTRO-II participation and bank funding structure

This table reports results from an OLS regression at the bank level (cross-section) in the month preceeding the TLTRO-II program announcement (February 2016). The dependent variable is a binary variable, taking on the value of one if a bank participated in any of the four TLTRO-II operations (columns 1 to 4). The dependent variable in column (5) is the total TLTRO-II take-up from all operations, scaled by the total assets at the announcement date. For banks participating in groups, the total take-up is distributed at bank level according to their contribution to the group's total borrowing allowance in the TLTRO-II programme. Explanatory variables are measured before the announcement date. All regressions include fixed effects as indicated. Standard errors are clustered at the direct supervision level (e.g. ECB, the relevant National Competent Authorities) and reported in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

	(1)	(2)	(3)	(4)	(5)
Dependent variable:	TLTRO-II participation				TLTRO-II take-up
Long-term deposits / Total assets	-0.935*** (0.265)	-1.030*** (0.352)	-1.038*** (0.334)	-1.009*** (0.295)	-0.033*** (0.009)
Short-term and sight deposits / Total assets	-0.599 (0.413)	-0.638 (0.456)	-0.679 (0.445)	-0.595 (0.417)	-0.018 (0.016)
Wholesale funding / Total assets	-0.856** (0.369)	-0.875** (0.384)	-0.907** (0.374)	-0.860** (0.365)	-0.036*** (0.007)
ABS funding / Total assets	1.390*** (0.429)	1.354*** (0.382)	1.304*** (0.350)	1.204*** (0.347)	0.056*** (0.018)
Ln(Total assets)	0.079** (0.035)	0.074* (0.041)	0.070* (0.038)	0.070* (0.035)	0.001 (0.001)
Loans / Total assets	0.314*** (0.106)	0.407** (0.157)	0.387** (0.156)	0.312** (0.141)	0.023*** (0.008)
Liquidity ratio	0.019 (0.114)	0.021 (0.115)	-0.032 (0.114)	-0.115 (0.122)	-0.013 (0.012)
Capital ratio	-0.867 (0.513)	-0.886 (0.538)	-0.929* (0.535)	-0.871 (0.531)	-0.025* (0.013)
SSM significance	0.158** (0.073)	0.163** (0.075)	0.164** (0.069)	0.115* (0.059)	0.007*** (0.002)
GSIB	0.083* (0.040)	0.085** (0.040)	0.066* (0.037)	0.107*** (0.036)	0.003 (0.003)
Borrowing allowance / Total assets		-0.543 (1.022)	-0.618 (0.960)	-1.065 (0.793)	0.06 (0.067)
Lending incentives/objectives			1.112*** (0.238)	1.041*** (0.229)	0.031** (0.012)
TLTRO outstanding /Total assets (to switch)				3.411*** (0.599)	0.334*** (0.060)
Country fixed effects	x	x	x	x	x
Credit quality fixed effects	x	x	x	x	x
Observations	278	278	278	278	278
R-squared	0.35	0.35	0.37	0.42	0.57

Table 3: Share of seniors and bank branch presence

This table reports descriptive statistics of our instrumental variable and results from a regression at bank-NUTS3 area level. In Panel A, 'Share of seniors NUTS3 (2021/2014)' is the branch-weighted share of seniors in a bank's market based on NUTS3 regions, demographics data at the TLTRO-II announcement (2016) and branch information from 2021 or 2014, respectively. In Panel B 'Share of seniors NUTS3/ Δ Share of seniors NUTS3 (2021 vs 2016)' is the share of seniors (change in share of seniors) in a NUTS3 deposit market in 2016 (2021 vs 2016). All regressions include fixed effects as indicated. Standard errors are clustered at the bank level and reported in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

Panel A: Descriptive statistics (Bank level)				
	N	Mean	St.Dev.	Median
Share of Seniors NUTS3 (2021 subsample) (1)	90	0.050	0.060	0.022
Share of seniors NUTS3 (2014 subsample) (2)	90	0.050	0.060	0.021
Difference (1) - (2) [p-value]		0.00 [0.834]	0.01 [0.910]	
Panel B: Change in bank presence and share of seniors (Bank-NUTS3 area level)				
	(1)	(2)	(3)	(4)
Dependent variable:	Δ Share Branches 2021 vs 2014			
Share of seniors NUTS3	-0.004 (0.008)	-0.004 (0.010)		
Δ Share seniors NUTS3 (2021 vs 2014)			0.013 (0.014)	0.015 (0.016)
Bank fixed effects		x		x
R-squared	0.00	0.00	0.00	0.00
Observations	3288	3272	3288	3272

Table 4: The effect of long-term deposit funding on TLTRO-II participation

This table reports results from a 2SLS regression at the bank level. Panel A reports second stage regression results. Panel B reports associated first stage regression results, Panel C reports reduced form estimates and Panel D reports OLS regression results for the sample of banks with available instrumental variable. The bank level instrumental variables 'Seniors share' represent the weighted (by branches in NUTS3 or NUTS2 regions) average share of seniors in a bank's total market population, i.e. the total population from the NUTS3/NUTS2 areas where a bank is present through depository branches. All regressions include the set of characteristics or fixed effects as indicated. Standard errors are clustered at the direct supervision entity level (e.g. ECB, relevant National Competent Authority) and reported in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

Panel A: Second stage results				
	(1)	(2)	(3)	(4)
Dependent variable:	TLTRO-II participation		TLTRO-II take-up	
Long-term deposits / Total assets	-9.552*** (1.293)	-8.875*** (1.130)	-0.763*** (0.115)	-0.690*** (0.110)
F-test (first stage)	35.2	46.8	35.2	46.8
Panel B: First stage results				
	(1)	(2)	(3)	(4)
Dependent variable:	Long-term deposits / Total assets			
Seniors share NUTS3	0.188*** (0.032)		0.188*** (0.032)	
Seniors share NUTS2		0.202*** (0.029)		0.202*** (0.029)
R-squared	0.64	0.64	0.64	0.64
Panel C: Reduced form result				
	(1)	(2)	(3)	(4)
Dependent variable:	TLTRO-II participation		TLTRO-II take-up	
Seniors share NUTS3	-1.799*** (0.339)		-0.144*** (0.018)	
Seniors share NUTS2		-1.789*** (0.305)		-0.139*** (0.019)
R-squared	0.47	0.47	0.51	0.50
Control variables	x	x	x	x
Country fixed effects	x	x	x	x
Credit quality fixed effects	x	x	x	x
Observations	205	205	205	205

Table 4 (cont.d)

Panel D: OLS results (for comparison with 2SLS results in Panel A)		
	(1)	(2)
Dependent variable:	TLTRO-II participation	TLTRO-II take-up
Long-term deposits / Total assets	-0.419 (0.250)	-0.013 (0.014)
R-squared	0.44	0.46
Control variables	x	x
Country fixed effects	x	x
Credit quality fixed effects	x	x
Observations	205	205

Table 5: The effect of long-term deposit funding on TLTRO-II participation and local markets structure

This table reports results from the second stage of a 2SLS regression at the bank level. The endogenous variable 'Long-term deposits/Total assets' is interacted with the variable 'Few competitors' (Panel A) and 'High market concentration' (Panel B) and instrumented with 'Seniors share' and its interaction with these variables. 'Few competitors' takes on the value 1 if the average number of local competing branches in NUTS2 markets is below the bank level median and 0 otherwise. 'High market concentration' is a dummy variable, taking on the value of one if a bank's average market HHI is above the median and 0 otherwise. All regressions include the set of characteristics or fixed effects as indicated. Standard errors are clustered at the direct supervision entity level (e.g. ECB or relevant National Competent Authority) and reported in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

Panel A: Average number of competitors				
	(1)	(2)	(3)	(4)
Dependent variable:	TLTRO-II participation		TLTRO-II take-up	
Long-term deposits / Total assets	-6.291*** (1.003)	-6.135*** (0.863)	-0.579*** (0.087)	-0.505*** (0.115)
Long-term deposits / Total assets x Few competitors	-6.939*** (1.699)	-7.434*** (1.756)	-0.392* (0.209)	-0.501* (0.248)
Panel B: Average market concentration				
	(1)	(2)	(3)	(4)
Dependent variable:	TLTRO-II participation		TLTRO-II take-up	
Long-term deposits / Total assets	-14.005** (5.612)	-9.670*** (1.872)	-1.021*** (0.347)	-0.737*** (0.149)
Long-term deposits / Total assets x High market concentration	-23.498* (12.911)	-9.158** (3.320)	-1.361 (0.795)	-0.542** (0.218)
Control variables	x	x	x	x
Country fixed effects	x	x	x	x
Credit quality fixed effects	x	x	x	x
Excluded instrumental variables Panel A (Panel B)				
Seniors share NUTS3, Seniors share NUTS3 x Few competitors (High market concentration)	x		x	
Seniors share NUTS2, Seniors share NUTS2 x Few competitors (High market concentration)		x		x
Observations	205	205	205	205

Table 6: The effect of TLTRO-II participation on liability rebalancing

This table reports second stage results from 2SLS regression. The dependent variable is i) the change in long-term deposits from March 2017 until March 2018, scaled by total assets in March 2017 (columns 1 to 4, Panel A), ii) the change in sight and short-term deposits from March 2017 until March 2018, scaled by total assets in March 2017 (columns 5 to 8, Panel A), iii) the change in debt issued from March 2017 until March 2018, scaled by total assets in March 2017 (columns 1 to 4, Panel B), iv) the change in money markets borrowing from March 2017 until March 2018, scaled by total assets in March 2017 (columns 5 to 8, Panel B), v) the change in other wholesale borrowing from March 2017 until March 2018, normalised by total assets in March 2017 (columns 1 to 4, Panel C) or the change in the ABS funding over the same period, normalised by total assets in March 2017 (columns 5 to 8, Panel C). The endogenous variable is either a dummy variable, taking on the value of one whether the bank participated in any TLTRO-II auction (columns 1,2 and 5,6) or the total take-up of funds over all TLTRO-II operations, scaled by total assets in March 2017 (columns 3,4 and 7,8). The excluded instrumental variable is the weighted (by branches in NUTS3 or NUTS2 regions) average share of seniors in a bank's total market population. All regressions include the set of control variables and fixed effects as indicated. Standard errors are clustered at the direct supervision entity level (e.g. ECB or relevant National Competent Authority) and reported in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Deposit financing								
Dependent variable:	Δ Long-term deposits / Total assets				Δ Short-term and sight deposits/ Total assets			
TLTRO-II participation	0.000 (0.004)	0.005 (0.005)			0.005 (0.020)	-0.006 (0.022)		
TLTRO-II take-up			0.002 (0.054)	0.064 (0.071)			0.061 (0.267)	-0.078 (0.311)
Panel B: Market financing								
Dependent variable:	Δ Debt issued / Total assets				Δ Money markets borrowing / Total assets			
TLTRO-II participation	-0.031*** (0.006)	-0.032*** (0.010)			0.026** (0.011)	0.026** (0.012)		
TLTRO-II take-up			-0.415*** (0.069)	-0.440*** (0.129)			0.349** (0.139)	0.358** (0.153)
Panel C: Other financing								
Dependent variable:	Δ Other wholesale borrowing/ Total assets				Δ ABS funding/ Total assets			
TLTRO-II participation	-0.007 (0.034)	-0.009 (0.051)			0.002 (0.002)	-0.003 (0.003)		
TLTRO-II take-up			-0.094 (0.449)	-0.123 (0.706)			0.029 (0.026)	-0.036 (0.044)
Excluded IV:								
Seniors share NUTS3	x		x		x		x	
Seniors share NUTS2		x		x		x		x
Control variables	x	x	x	x	x	x	x	x
Country fixed effects	x	x	x	x	x	x	x	x
Credit quality fixed effects	x	x	x	x	x	x	x	x
F-test (first stage)	28.1	34.3	68.8	65.8	28.1	34.3	68.8	65.8
Observations	203	203	203	203	203	203	203	203

Figures

Figure 1: Geographical distribution of bank branches for a sub-sample of euro area banks

This figure illustrates the locations of 62,335 depositary domestic branches of the 205 euro area banks used in the instrumental variable strategy analysis based on their latitude and longitude information.

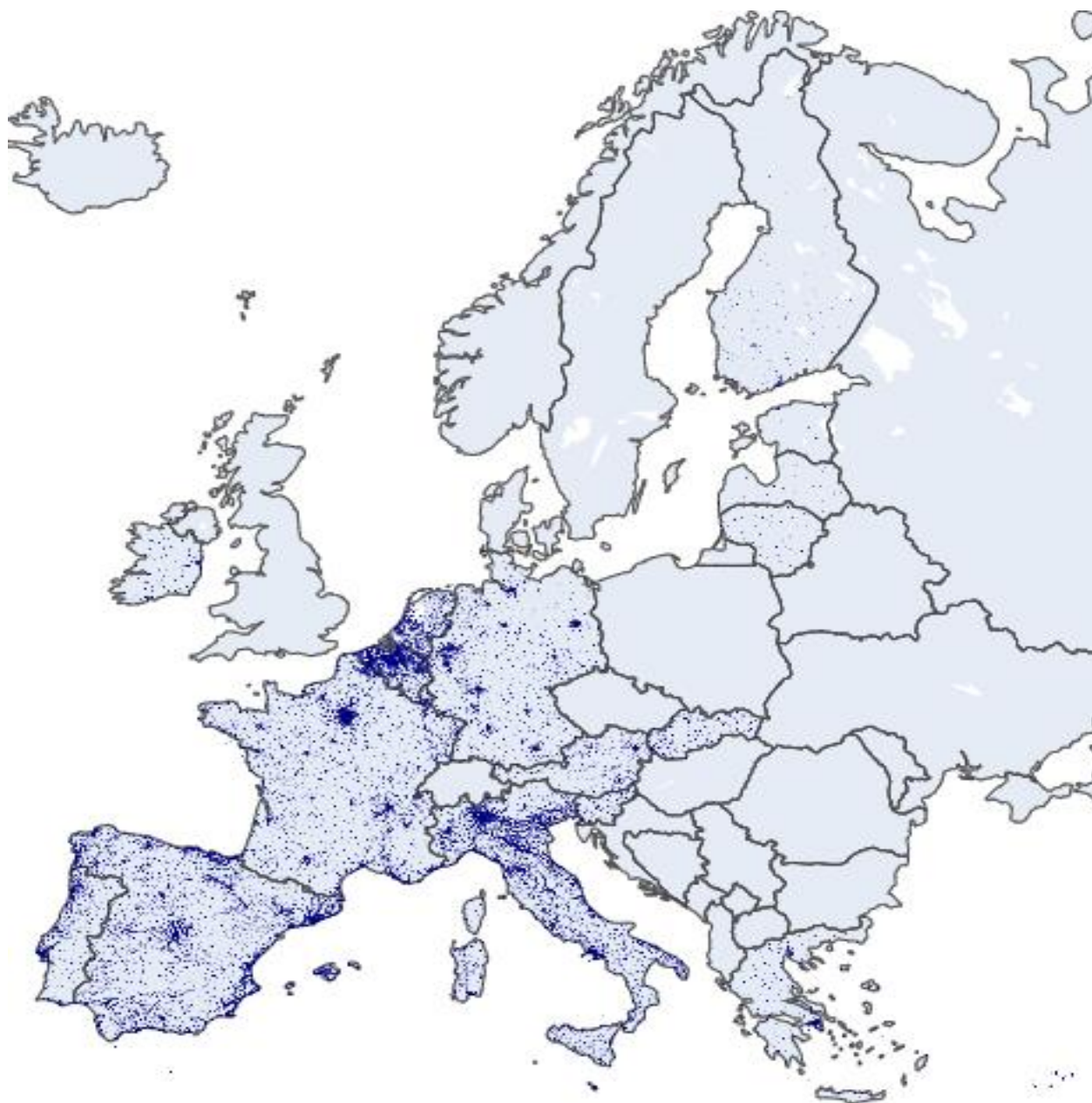


Figure 2: Share of seniors based on branch information from 2021 vs. branch information from 2014

This figure represents the relationship between our excluded instrumental variable using information on the distribution of branches from 2021 (y-axis) against the construction of the excluded instrumental variable using information on the distribution of branches from 2014 (x-axis). Each dot represents the share of seniors based on information from 2021 and the share of seniors based on information from 2014 for a bank. The lines represent the linear fit.

$$Shareofseniors_i = \sum_m ShareBranches_{i,m} \frac{Seniors_m}{\sum_m 1(i \in m) Totalpopulation_m}$$

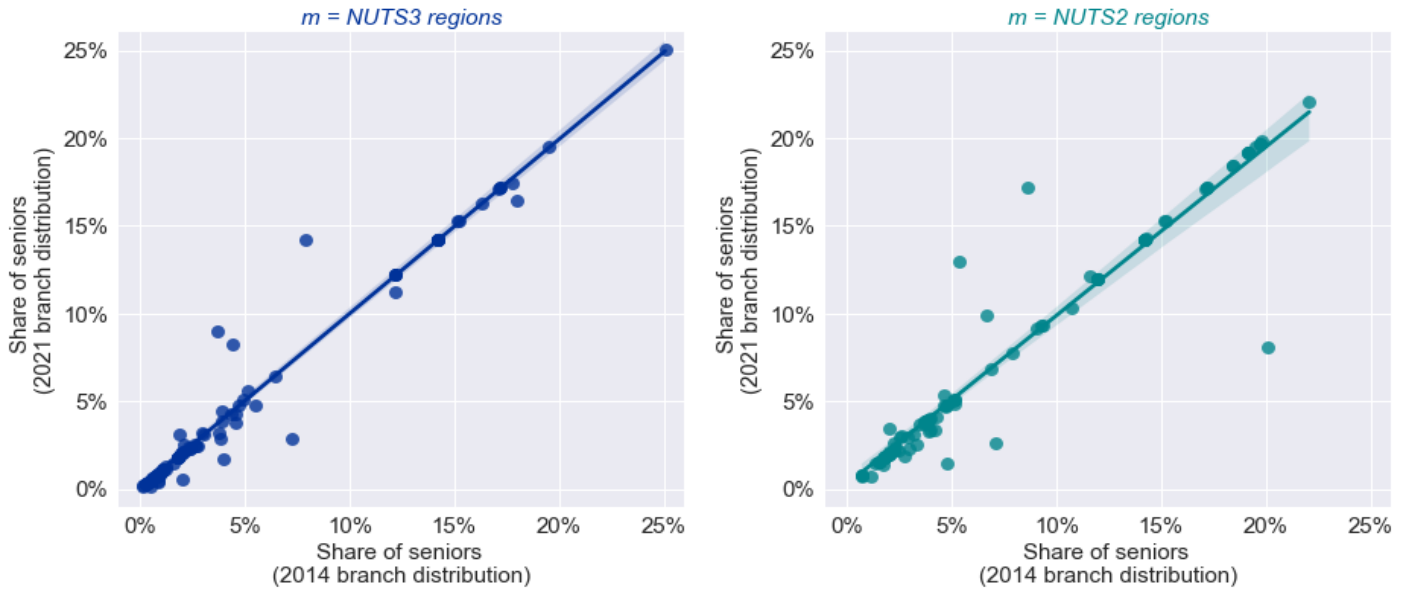
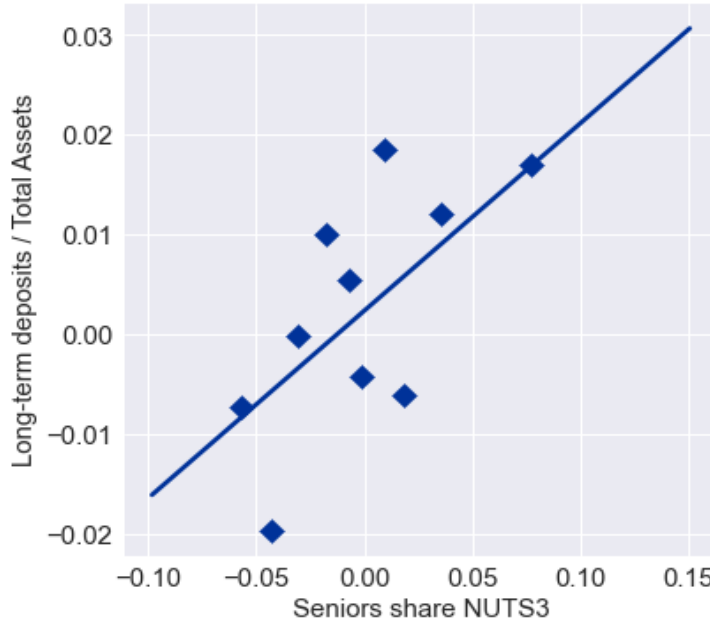


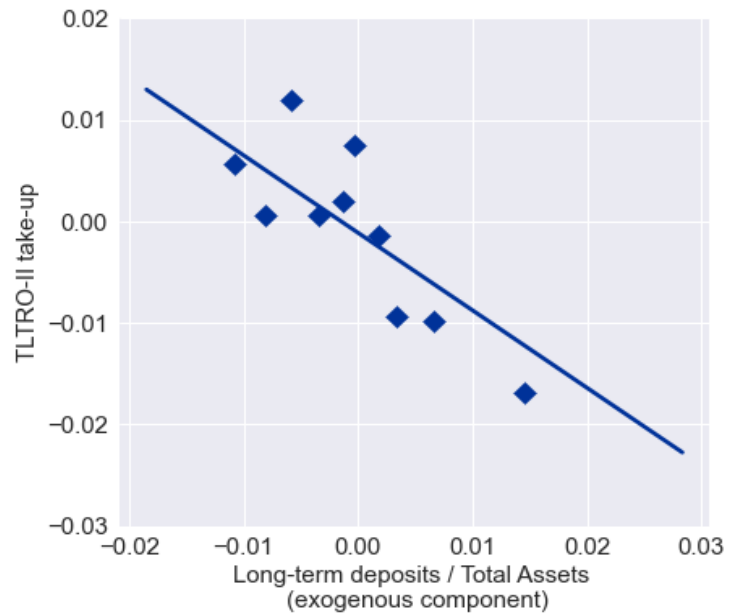
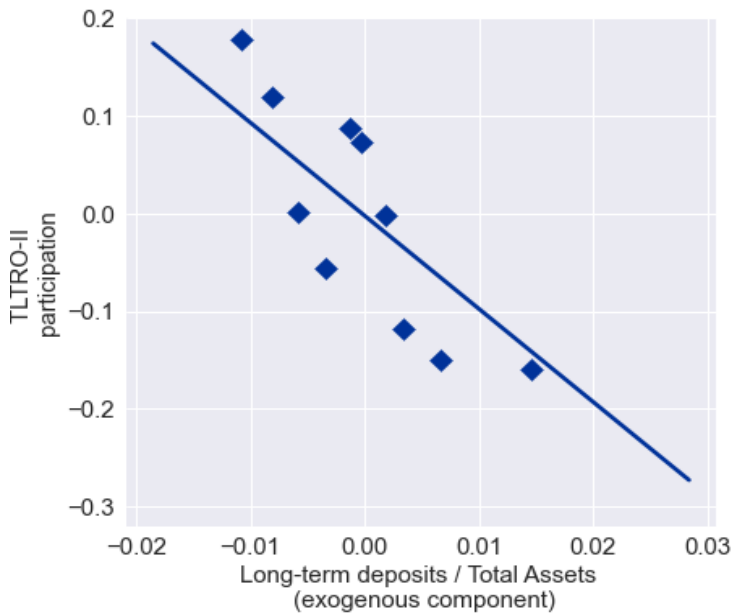
Figure 3: Share of seniors, long-term deposit financing and TLTRO-II participation

This figure represents the first stage (Panel A) and second stage regression (Panel B) graphically. We group banks into ten decile bins based on the banks share of seniors (Panel A) or the exogenous component of Long-term deposits / Total assets (Panel B) and compute the average share of long-term deposits (Panel A) or the dummy variable taking on the value of one whether the bank participating in any TLTRO-II auction (left hand figure of Panel B) or the average TLTRO-II take-up (right hand figure of Panel B). Dots represent the average for banks in each bin. The lines represent the linear fit.

Panel A: First stage



Panel B: Second stage



Appendix

Table A.1: TLTRO-II participation and bank funding structure (Logit)

This table reports results from a logit regression in the month preceeding the TLTRO-II programme announcement (end February 2016). The dependent variable is a binary variable, taking on the value of one if a bank participated, directly - individually or as the lead institution of a group, or indirectly - as part of a group, in the any of the four TLTRO-II operations. All explanatory variables are also measured before the announcement date. All regressions include fixed effects as indicated. Standard errors are clustered at the direct supervision level (e.g. ECB, the relevant National Competent Authorities, other) and reported in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

	(1)	(2)	(3)	(4)
Long-term deposits / Total assets	-6.319*** (2.388)	-7.155** (2.869)	-7.166** (3.380)	-7.901*** (2.552)
Short-term and sight deposit / Total assets	-4.213 (3.043)	-4.59 (3.333)	-4.832 (3.877)	-4.832* (2.822)
Wholesale funding / Total assets	-5.815** (2.795)	-6.103** (2.990)	-6.382* (3.608)	-6.182** (2.633)
ABS funding / Total assets	7.864** (3.161)	7.534*** (2.750)	7.097** (2.766)	12.333*** (2.941)
Ln(Total Assets)	0.489* (0.257)	0.453 (0.283)	0.461* (0.272)	0.797** (0.360)
Loans / Total Assets	1.808*** (0.517)	2.390*** (0.854)	2.268*** (0.878)	2.132*** (0.786)
Liquidity ratio	0.113 (0.764)	0.097 (0.732)	-0.281 (0.780)	-0.525 (0.641)
Capital ratio	-5.797* (3.285)	-6.084* (3.562)	-6.14 (4.106)	-4.505 (3.328)
SSM significance	0.807** (0.395)	0.853** (0.414)	0.840** (0.408)	0.569 (0.629)
GSIB	0.607** (0.293)	0.641** (0.297)	0.509* (0.290)	1.092*** (0.403)
Borrowing allowance / Total Assets		-3.729 (5.300)	-4.264 (5.166)	-18.214*** (6.194)
Lending incentives/objectives			7.185*** (1.489)	17.107*** (2.565)
TLTRO outstanding /Total Assets (to switch)				285.871*** (38.350)
Country fixed effects	x	x	x	x
Credit quality fixed effects	x	x	x	x
Observations	278	278	278	278

Table A.2: TLTRO-II participation and bank funding structure (Panel analysis)

This table reports results from OLS regressions at the bank-quarter level. The dependent variable in columns (1) to (3) is a indicator variable, taking on the value of one if a bank participated, directly - individually or as the lead institution of a group, or indirectly - as part of a group but not as a lead, in each of the four quarterly TLTRO-II operations. The dependent variable in column (4) is the TLTRO-II takeup in each operation, scaled by the total assets at the participation decision (application) time. For banks participating in groups, the take-up is distributed at bank level according to the bank's contribution to the group's total borrowing allowance in the TLTRO-II programme. The participation decision times are two months before the allotment of each operation and correspond to April 2016, July 2016, October 2016 and January 2017 respectively (Figure A1). The control variables are also measured at the participation decision time. The sample period ranges from Q2 2016 to Q1 2017. All regressions include control variables and fixed effects as indicated. Standard errors are clustered at the direct supervision entity level (e.g. ECB, relevant National Competent Authority, other) and reported in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

	(1)	(2)	(3)	(4)
Dependent variable:	TLTRO-II participation (quarterly)		TLTRO-II take-up (quarterly)	
Long-term deposits / Total assets	-2.068** (0.983)	-1.968* (0.955)	-1.965* (0.954)	-0.122*** (0.041)
Short-term and deposits / Total assets	0.594 (0.947)	0.373 (0.639)	0.34 (0.590)	0.016 (0.030)
Wholesale funding / Total assets	0.312 (0.333)	-0.007 (0.278)	-0.03 (0.272)	-0.002 (0.013)
ABS funding / Total assets	-0.587** (0.220)	-0.741*** (0.232)	-0.934* (0.448)	-0.133** (0.051)
Ln(Total Assets)	0.150* (0.084)	0.440*** (0.113)	0.447*** (0.123)	0.025** (0.010)
Loans / Total Assets	1.462*** (0.369)	0.841** (0.328)	0.820** (0.338)	0.023 (0.024)
Liquidity ratio	-0.433 (0.597)	-0.379 (0.472)	-0.368 (0.448)	-0.012 (0.021)
Capital ratio	0.717 (0.443)	0.756 (0.677)	0.742 (0.659)	0.028 (0.045)
Bid limit/Total Assets		7.054*** (0.810)	7.225*** (0.624)	0.676*** (0.120)
(Remaining) TLTRO outstanding / Total Assets (to switch)			-0.277 (0.514)	0.034 (0.038)
Bank fixed-effect	x	x	x	x
Country fixed effects	x	x	x	x
Credit quality fixed effects	x	x	x	x
Observations	1107	1102	1102	1102
R-squared	0.68	0.705	0.705	0.811

Table A3: Additional summary statistics

This table presents additional descriptive statistics of variables at the NUTS3/NUTS2 local market level and bank-NUTS3/NUTS2 level, namely variables used in the construction of the 'Seniors share' instrumental variables and of the 'Average number of local competitors' variables. Further details are provided in the text.

Panel A: Descriptive statistics at local market (NUTS3/NUTS2 area) level								
	N	Mean	St.Dev.	Min	p25	Median	p75	Max
NUTS3 local markets								
Number of banks	933	5.558	3.416	1.000	3.000	5.000	7.000	24.000
Number of branches	933	77.059	172.695	1.000	8.000	23.000	76.000	2909.000
Seniors	933	72,410	90,664	2,421	26,380	46,922	85,134	1,102,214
Population	933	363,447	488,447	10,731	127,062	217,574	410,054	6,424,275
Market concentration (HHI)	933	0.235	0.142	0.051	0.160	0.204	0.271	1.000
NUTS2 local markets								
Number of banks	178	8.169	4.487	2.000	5.000	7.000	11.000	26.000
Number of branches	178	403.921	631.596	4.000	82.000	183.500	411.750	3943.000
Seniors	178	379,418	346,370	6,079	129,960	276,363	476,557	2,201,233
Population	178	1,908,921	1,809,090	28,983	669,066	1,416,532	2,297,775	12,117,132
Market concentration (HHI)	178	0.212	0.105	0.065	0.143	0.181	0.259	0.693
Panel B: Descriptive statistics at bank - local market (NUTS3/NUTS2 area) level								
	N	Mean	St.Dev.	Min	p25	Median	p75	Max
NUTS3 local markets								
Number of branches	5,186	12.0	27.8	1.0	1.0	3.0	11.0	637.0
Number of competing branches	5,186	133.1	265.5	0.0	13.0	52.0	148.0	2908.0
NUTS2 local markets								
Number of branches	1,454	42.9	84.2	1.0	2.0	12.0	45.0	998.0
Number of competing branches	1,454	569.2	798.7	2.0	106.0	281.5	585.8	3942.0

Table A4: The effect of long-term deposit funding on TLTRO-II participation (Robustness)

This table reports results from a 2SLS regression at the bank level. The bank level instrumental variables 'Seniors share' represent the weighted (by branches in NUTS3 or NUTS2 regions) average share of seniors in a bank's total market population, i.e. the total population from the NUTS3/NUTS2 areas where a bank is present through depository branches. The endogenous variable in Panel A uses information on long-term deposits from retail investors (households), scaled by total assets; the sample in Panel B consists only of banks that are direct participants in any TLTRO-II operations, i.e. individual participants or lead banks of the group participants and non-participant banks, while the indirect participants are excluded; the endogenous variable in Panel C includes all time and savings deposits when considering long-term deposits; the endogenous variable in Panel D includes all time and savings deposits with an original maturity greater than 2 years and 3 months respectively when considering long-term deposits, namely all customer deposits not included in M3; the instrumental variables employed in regressions reported in Panel E use branch location from 2014; the instrumental variables employed in regressions reported in Panel F use the definition of 'Seniors' as the population above 60 years; the sample in Panel G excludes non-investment grade rated banks. All regressions include the set of characteristics or fixed effects as indicated. Standard errors are clustered at the direct supervision entity level (e.g. ECB, relevant National Competent Authority, other) and reported in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

Panel A: Long-term retail deposits				
	(1)	(2)	(3)	(4)
Dependent variable:	TLTRO-II participation (any)		TLTRO-II take-up	
Long-term retail deposits / Total Assets	-9.006*** (1.131)	-9.714*** (1.308)	-0.725*** (0.111)	-0.747*** (0.132)
Long-term deposits from NFC / Total Assets	5.623* (2.715)	5.643* (2.846)	0.303 (0.203)	0.303 (0.206)
F-test	26.7	31.0	26.7	31.0
Observations	205	205	205	205
Panel B: Direct participants only (with direct take-up, borrowing allowance and outstanding TLTRO)				
	(1)	(2)	(3)	(4)
Dependent variable:	TLTRO-II direct participation (any)		TLTRO-II direct take-up	
Long-term deposits / Total Assets	-17.405** (7.018)	-15.659** (6.618)	-0.955** (0.374)	-0.816* (0.401)
F-test	18.2	19.5	18.2	19.5
Observations	174	174	174	174
Panel C: Alternative (broader) definition of Long-term deposits (all time deposits instead of time deposits >1Y)				
	(1)	(2)	(3)	(4)
Dependent variable:	TLTRO-II participation (any)		TLTRO-II take-up	
Long-term deposits (broader) / Total Assets	-11.043*** (2.604)	-9.592*** (2.049)	-0.878*** (0.194)	-0.743*** (0.162)
F-test	36.3	59.2	36.3	59.2
Observations	205	205	205	205

Panel D: Alternative (narrower) definition of Long-term deposits (Only non-M3 deposits)				
	(1)	(2)	(3)	(4)
Dependent variable:	TLTRO-II participation (any)		TLTRO-II take-up	
Long-term deposits (narrower) / Total Assets	-8.808*** (1.099)	-8.110*** (0.955)	-0.706*** (0.095)	-0.632*** (0.090)
F-test	36.4	43.9	36.4	43.9
Observations	205	205	205	205
Panel E: IV construction based on 2014 branch dataset				
	(1)	(2)	(3)	(4)
Dependent variable:	TLTRO-II participation (any)		TLTRO-II take-up	
Long-term deposits / Total Assets	-13.149* (5.894)	-11.478** (4.236)	-0.843** (0.299)	-0.898** (0.237)
F-test	6.3	14.0	6.3	14.0
Observations	112	112	112	112
Panel F: IV construction based on alternative definition of Seniors (>60 years)				
	(1)	(2)	(3)	(4)
Dependent variable:	TLTRO-II participation (any)		TLTRO-II take-up	
Long-term deposits / Total Assets	-9.883*** (1.534)	-9.110*** (1.229)	-0.749*** (0.118)	-0.677*** (0.110)
F-test	43.2	53.1	43.2	53.1
Observations	205	205	205	205
Panel G: Drop risky (non-investment grade) banks - rated below CQS3/BBB-				
	(1)	(2)	(3)	(4)
Dependent variable:	TLTRO-II participation (any)		TLTRO-II take-up	
Long-term deposits / Total Assets	-8.232*** (0.996)	-7.973*** (0.923)	-0.653*** (0.098)	-0.594*** (0.097)
F-test	39.0	51.2	39.0	51.2
Observations	186	186	186	186
Control variables	x	x	x	x
Country fixed effects	x	x	x	x
Credit quality fixed effects	x	x	x	x
Excluded instrumental variable				
Seniors share NUTS3	x		x	
Seniors share NUTS2		x		x

Table A5: The effect of long-term deposit funding on TLTRO-II participation and local markets structure - Total effects

This table reports results from the second stage of a 2SLS regression at the bank level. The endogenous variable 'Long-term deposits/Total assets' is interacted with the binary variables 'Many competitors' and 'Few competitors' (Panel A) and 'Low market concentration' and 'High market concentration' (Panel B) and instrumented with the variables 'Seniors share' interacted with the binary variables 'Many competitors' and 'Few competitors' (Panel A) and 'Low market concentration' and 'High market concentration' (Panel B). The variables 'Many competitors' and 'Few competitors' are constructed based on the the average number of local branch competitors in each broader (NUTS2) area a bank is present in, using a bank's share of branches in the respective area as weights. More specifically, 'Many competitors' takes on the value 1 if the average number of local competing branches in NUTS2 local markets is above the bank level median and 0 otherwise while 'Few competitors' takes on the value 1 if the average number of local competing branches is below the median and 0 otherwise. Similarly, the variables 'Low market concentration' and 'High market concentration' are constructed based on the bank's average HHI in each broader (NUTS2) area a bank is present in, using a bank's share of branches in the respective area as weights. The HHI at local market level is calculated by summing up the squared market shares of all banks that operate branches in a given area, with the market share being equal to the share of branches of a bank in that market. The variable 'Low market concentration' takes on the value 1 if a bank's average HHI is below the bank level median and 0 otherwise while the variable 'High market concentration' takes on the value 1 if the average HHI is above the median and 0 otherwise. Standard errors are clustered at the direct supervision entity level (e.g. ECB, relevant National Competent Authority, other) and reported in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

Panel A: Average number of competitors				
	(1)	(2)	(3)	(4)
Dependent variable:	TLTRO-II participation		TLTRO-II take-up	
Long-term deposits / Total assets x Many competitors	-6.291*** (1.003)	-6.135*** (0.863)	-0.579*** (0.087)	-0.505*** (0.115)
Long-term deposits / Total assets x Few competitors	-13.230*** (2.295)	-13.569*** (2.434)	-0.971*** (0.215)	-1.006*** (0.232)
Panel B: Average market concentration				
	(1)	(2)	(3)	(4)
Dependent variable:	TLTRO-II participation		TLTRO-II take-up	
Long-term deposits / Total assets x Low market concentration	-14.005** (5.612)	-9.670*** (1.872)	-1.021*** (0.347)	-0.737*** (0.149)
Long-term deposits / Total assets x High market concentration	-37.504* (18.343)	-18.829*** (4.967)	-2.383** (1.119)	-1.279*** (0.354)
Control variables	x	x	x	x
Country fixed effects	x	x	x	x
Credit quality fixed effects	x	x	x	x
Excluded instrumental variables Panel A (Panel B)				
Seniors share NUTS3 x Many competitors (Low market concentration)	x		x	
Seniors share NUTS3 x Few competitors (High market concentration)	x		x	
Seniors share NUTS2 x Many competitors (Low market concentration)		x		x
Seniors share NUTS2 x Few competitors (High market concentration)		x		x
Observations	205	205	205	205

Figure A1: TLTRO-II timeline and program design

This figure illustrates the timeline and the programme design of TLTRO-II. It describes how the borrowing allowance (BA) and the interest rate (r) applicable to the amount borrowed are set. In the first lending period, for the computation of the benchmark eligible loans (BEL), BNL refers to benchmark net lending, ENL to eligible net lending while EL refers to outstanding eligible loans. In the second lending period, FEL denotes the final amount of eligible loans used in determining the lending performance (LP) vis-à-vis the benchmark. Finally, $r(LP)$ is the interest rate applicable to the amounts borrowed under the programme, conditional on the lending performance (LP), and bounded by the two key policy rates: the rate on main refinancing operations (MRO) and the rate on the deposit facility (DFR). Below, the timeline shows the announcement date of the programme, the settlement dates of the four operations and the dates spanning the two lending periods of the programme. Source: Guideline ECB/2016/10, as amended and authors' representation.

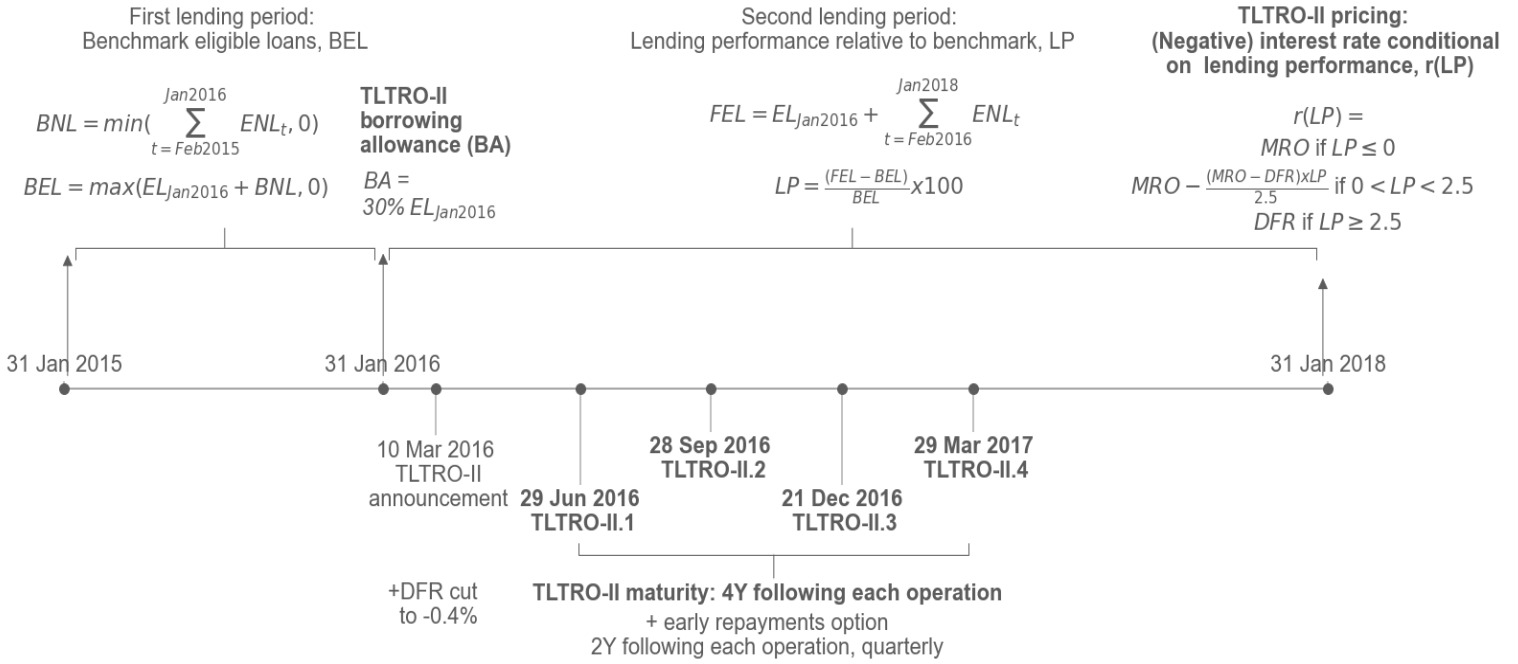


Figure A2: TLTRO-II timeline and analysis time

This figure illustrates the timeline of the TLTRO-II programme and the time of analysis used in the previous tables.

