



Outlook for the German residential property market 2022 and beyond

Base case: Rising overvaluations, end of the cycle in the near future, subdued price corrections

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We changed our view at the beginning of 2021 and began to believe that the end of the cycle was approaching. In fact, many developments identified in last year's report have intensified. We expect that the cycle will come to an end during the current decade. A combination of our different approaches suggests that, despite the uncertainties, the cycle will probably end in 2024.

Prices will not necessarily undergo a massive correction from their peak. In the past, prices regularly collapsed after a systemic crisis. While it is impossible to rule out such a crisis against the background of technological disruption, the climate crisis and geopolitical upheaval, our baseline scenario foresees an isolated ending of the cycle.

During the cycle as a whole, macro indicators, above all loose monetary policies, were the key drivers. But as market prices rise and the end of the zero-rate policy seems imminent, traditional analysis methods for the property sector are regaining importance. Our valuation model implies that, in many cities, properties are undervalued only if risk premiums remain low and prices rise strongly.

As migration inflows were low and new construction activity has been dynamic during the pandemic, fundamental supply shortages are a thing of the past for many cities. The current refugee wave will not weigh on the market for long.

According to our analysis, rising house prices are the most important factor in providing protection against inflation. This applies in the current environment, too. However, higher interest rates may offset the inflation hedge. In fact, investors may prefer bonds over real estate after a major rate shock. This increases the risk of an abrupt revaluation of residential properties.

Our calculations show that energy refurbishment raises valuations. However, the traffic-light coalition will probably reduce financial incentives for refurbishment and may replace them by obligatory refurbishment requirements. Investors will probably need to spend more on fighting climate change. The additional expenses will weigh on valuations and may contribute to the end of the cycle.

There are major differences between the eleven metropolitan regions. Our projections suggest that the fundamental supply shortage is nearly over in Bremen, Dusseldorf, Hamburg and Nuremberg. As a result, rate sensitivity is probably quite high in these cities. In contrast, housing will probably remain in short supply in Berlin, Hanover, Cologne, Leipzig and Stuttgart for some years to come. The cycles in Berlin and Leipzig may be particularly long. While Munich continues to suffer from shortages, the high valuations will probably cause the cycle to end. In Heidelberg, the surplus may soon be replaced by another shortage. Despite these differences, it may send a signal if the cycle ends in one metropolitan area.



Outlook for the German residential property market 2022 and beyond

Table of contents

1. Overview of our analyses	3
2. Comparison of historical and national, absolute and relative prices	3
2.1 House and apartment prices continued to rise in 2021	3
2.2 International comparison of absolute and relative apartment prices suggests that valuations are normal	4
2.3 Affordability indices suggest overvaluation.....	6
2.4 Historical comparison: The current cycle is one of the 30 longest house-price cycles of the past 60 years	6
3. Fundamental supply shortage easing both in Germany as a whole and in our 126 cities	8
3.1 Review: Nationwide shortage eases again in 2021	8
3.2 Supply and demand developments nationwide and in our 126 cities	9
3.3 Supply shortages over in most C and D cities.....	12
4. House prices are approaching fair valuations	13
4.1 A uniform model for 126 cities	13
4.2 Over- and undervaluations in case of changes to price and rent growth	15
4.3 Changes to the assumptions for A, B, C and D cities	16
5. Residential properties offer less inflation protection today than in the past	19
5.1 A review of the 1970s, which provided high inflation protection to investors via both rent and price growth.....	19
5.2 What can we learn from the 1970s for today?	21
5.3 Valuation: Complicated interaction between inflation and interest rates	24
6. The impact of climate policy on the German residential market	26
7. Summary and outlook for German metropolises and metropolitan regions	30
7.1 Market prices tend to be overvalued	30
7.2 Residential real estate provides only limited protection against inflation	31
7.3 Highly different fundamental market situations and valuations in the different metropolises and metropolitan areas	33
8. Price path after the end of the cycle: Subdued correction more likely than slide	33
Appendix: All formulas for the present value model	38
Appendix: Correction of the supply shortage in our 126 cities	39

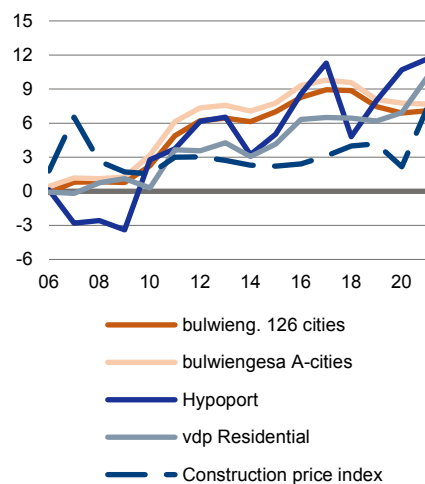


Outlook for the German residential property market 2022 and beyond

Residential and construction prices

1

% year-over-year



Sources: bulwiengesa, Deutsche Bank Research, Hypoport, National statistical office, vdp

1. Overview of our analyses

This year, our annual report focuses on the question of just when the current house-price cycle is going to end. We will first take a look at historical price developments and compare absolute and relative as well as national and international house prices. Afterwards, we will analyse the fundamental supply shortage. We will then use a present-value model to determine the theoretical fair price level. This will form the basis for a look at potential changes to valuations caused by high inflation and rising interest rates on the one hand and tighter climate policies on the other. Finally, we will summarise and assess the different aspects and discuss potential price paths during the remainder of the decade.

2. Comparison of historical and national, absolute and relative prices

2.1 House and apartment prices continued to rise in 2021

The uptrend in house and apartment prices continued in 2021. According to bulwiengesa, the aggregate house and apartment price indices for the 126 cities we observe were up by about 6 to 7% compared to 2020, i.e. roughly in line with the pace of the preceding years. All four subgroups, namely condominium units and terraced houses, both existing and new, moved roughly in line with the average. Rents continued to rise as well, even though they did so at a more subdued pace, just like in the preceding years. Rents for re-let and new apartments were up by about 3% and roughly 4%, respectively. As a result, initial gross rental returns dropped to 3.7% for existing and 3.1% for new properties.

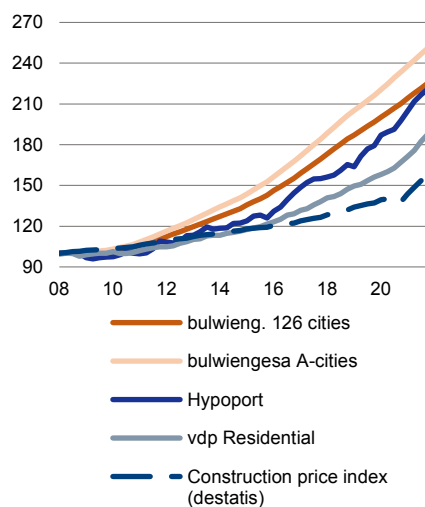
Remarkably, the bulwiengesa data diverge considerably from other price indices. According to vdp, house and apartment prices rose by about 10%, and Hypoport even registered price increases of almost 12%. This is particularly remarkable because the bulwiengesa data tended to leave the other indices behind in the past. One possible reason is that the pandemic drove up demand for properties outside the 126 bulwiengesa cities. At the same time, the divergence may suggest that the end of the cycle is approaching. Ultimately, the bulwiengesa data are not based on either transaction or supply figures, but on expert assessments for each of the 126 cities. The series may therefore reflect information not yet captured by the other indices.

The fact that rents and prices have decoupled may be an indication that the end of the cycle is approaching. A regression of price growth for existing condominiums and rent growth for re-let apartments for the 126 cities and each year gives a bivariate estimation coefficient of about 0.3 for both 2019 and 2020. The average for the whole cycle since 2009 is about 0.4. This means that an increase in rents by 1% was usually accompanied by a price rise by 0.4%. The coefficient for 2021 is only 0.031. And the picture is similar for the correlation coefficient for price and rent growth. From a statistical vantage point, the two time series decoupled in 2021. This is probably due to restrictive rent regulation on the one hand and very loose monetary policy, possibly due to the pandemic, and a flight to safer havens on the other.

Residential property prices

2

1st quarter 2008=100

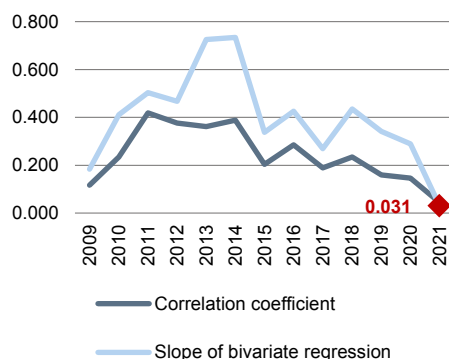


Sources: bulwiengesa, Deutsche Bank Research, Hypoport, National statistical office, vdp

126 cities: Ratio of re-letting rents to apartment prices in each year

3

dimensionless



Sources: bulwiengesa, Deutsche Bank Research

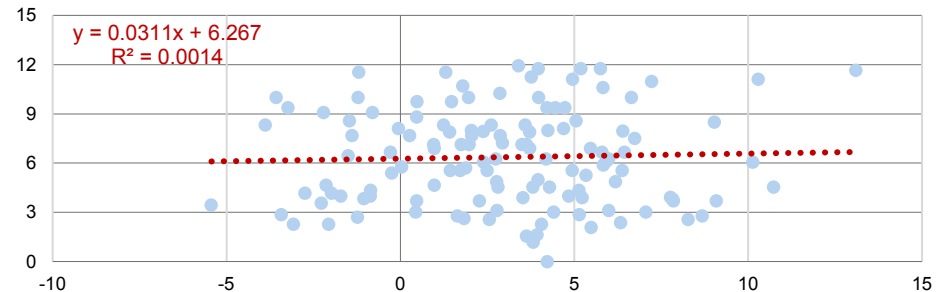


Outlook for the German residential property market 2022 and beyond

2021: Residential property prices and re-letting rents in 126 cities

4

y axis: prices, % yoy
x axis: rents, % yoy



Sources: bulwiengesa, Deutsche Bank Research

2.2 International comparison of absolute and relative apartment prices suggests that valuations are normal

German apartment prices have risen strongly during the last few years. However, a comparison of prices per square metre (sqm) in European and global cities shows that, despite these price increases, valuations in German cities appear normal at first sight. Germany's most expensive city, Munich, is the fourth most expensive city in Europe, with prices of about EUR 9,700/sqm outside the city centre, and ranks seventh worldwide, after Hong Kong, Seoul, Paris, Geneva, Tel Aviv-Jaffa and Zurich. Frankfurt am Main, the second most expensive German city, ranks ninth in Europe and 25th in the world. Dusseldorf, Stuttgart, Hamburg, Augsburg, Berlin and Cologne ranks 16 to 30 in Europe and 41 to 64 globally. Erlangen, Hanover, Heidelberg and Karlsruhe are around rank 40 in Europe and around rank 80 in the world. Nuremberg and Mannheim are ranked near 50 in Europe and among the top 100 cities worldwide. Dresden, Aachen and Leipzig follow, ranking in the 90s in Europe and the 150s globally. All in all, German prices have risen to international levels and made up for the undervaluation at the beginning of the cycle.

Price-to-income ratios do not point to clear overvaluation for either German or European cities

We combine two sources of data for our relative comparison of apartment prices. First, we compare the Numbeo prices for a 75 sqm apartment outside the city centre with the per-capita income in the region where the city is located. Eurostat provides per-capita income at NUTS2 level. This categorisation divides Germany into 38 regions, which roughly correspond to administrative districts (*Regierungsbezirke*). Measured by income in the Upper Bavarian region, Munich remains Germany's most expensive city in this ranking. In Munich, the price for a 75 sqm apartment is roughly equivalent to 25 disposable annual incomes. Only in Paris and Dubrovnik are the price-to-income ratios higher. Frankfurt belongs to the administrative district of Darmstadt and ranks seventh in Europe, with a ratio of more than 20. Berlin follows on rank 26, with a ratio of about 16, and Hamburg, Stuttgart and Cologne are close behind. Augsburg and Hanover rank 38th and 46th, respectively, with ratios around 14. Nuremberg, Heidelberg, Karlsruhe and Mannheim follow on ranks 62 – 72, with a price-income ratio of about 12. Dresden, Leipzig and Aachen hover around rank 80, at a price-income ratio of about 10.

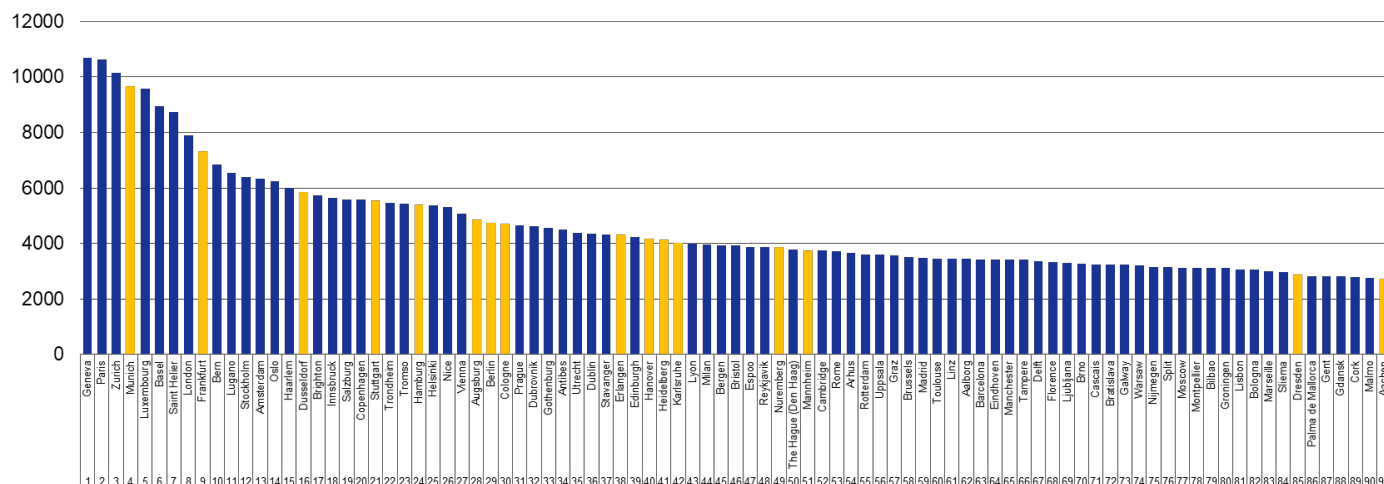


Outlook for the German residential property market 2022 and beyond

Top 91 in Europe: Prices for apartments outside city centres

5

EUR/sqm



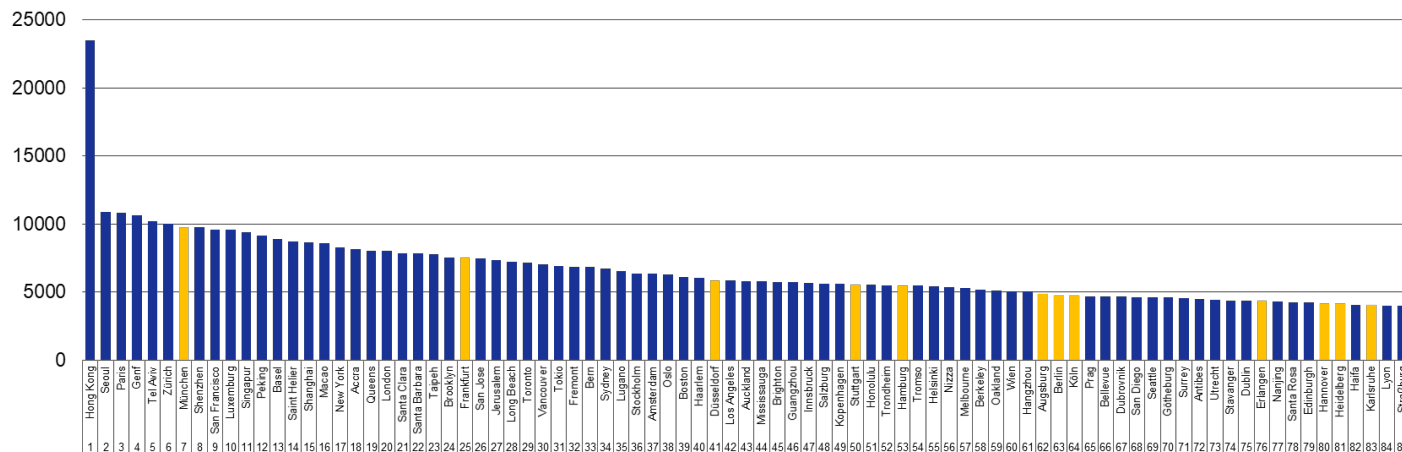
Download from numbeo.com as of December 21, 2021

Sources: Numbeo Doo, Deutsche Bank Research

Top 85 worldwide: Prices for apartments outside city centres

6

USD/sqm



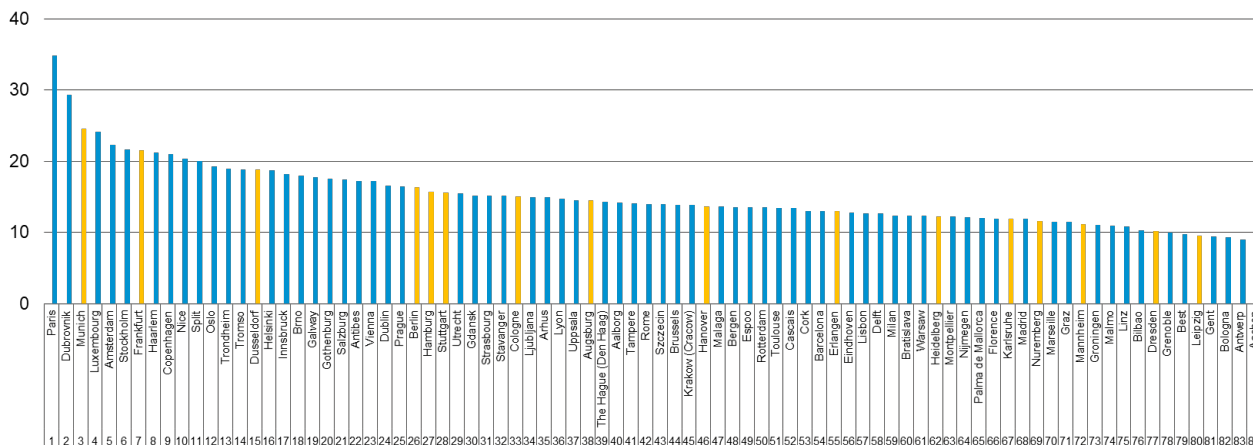
Download from numbeo.com as of December 16, 2021

Sources: Numbeo Doo, Deutsche Bank Research

Europe: Price-income ratios for 84 cities

7

Multiple of regional annual income, dimensionless, price = 75-qm-apartment outside of the city center, income = disposable income per inhabitant in NUTS2 region



Sources: Deutsche Bank Research, Eurostat, Numbeo Doo

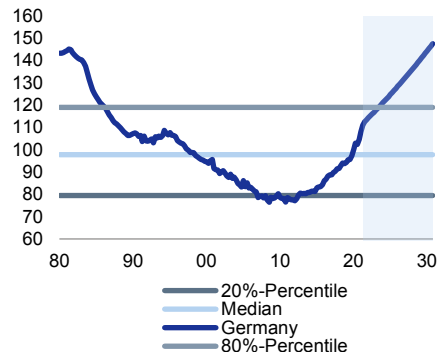


Outlook for the German residential property market 2022 and beyond

1980-2030 Price-to-income percentiles based on OECD countries

8

dimensionless

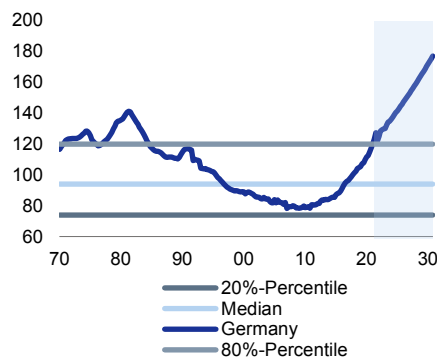


Sources: Deutsche Bank Research, OECD

1980-2030 Price-to-rent percentiles based on OECD countries

9

dimensionless



Sources: Deutsche Bank Research, OECD

The ranking clearly shows that, compared to regional incomes, German cities are about as expensive as many of their European counterparts. Moreover, the rankings for absolute and relative prices are largely similar. Thus, the price-income ratio does not point to major overvaluations or a housing price bubble either.

2.3 Affordability indices suggest overvaluation

We will now compare the German price-income ratios for the period from 1980 to 2021 with those for 21 other OECD countries. This affordability indicator currently stands at 113 index points for Germany, with the long-term average being standardised to 100. This level appears relatively low at first sight. However, it is largely due to high relative valuations at the beginning of the 1980s. One important question is whether the cycle is more likely to end soon if the index values rise. With this question in mind, we discussed in last year's outlook which index levels tend to imply a decline on a three-year horizon on the basis of the historical data from our 21 OECD countries. It seems that the threshold is roughly near the 80% percentile or an index value of about 119. We will use this value as a point of reference to estimate the length of the German cycle. During the current cycle, the index value for Germany has risen by 3.0 points per year. This is equivalent to average house price growth of 5.3% and disposable income growth of 2.3%. At this rate, Germany will reach the 80% percentile threshold by Q3 2023. If we apply the same method to the price-rent ratio, the German index stands currently at 127.0, i.e. clearly above the long-term average of 100 and also above the international 80% percentile of almost 120 points. Our rule of thumb thus implies that house prices are likely to decline in the coming years.

2.4 Historical comparison: The current cycle is one of the 30 longest house-price cycles of the past 60 years

Based on the OECD house price data, we have calculated the usual length of house-price cycles. The database contains quarterly data for 41 countries for the years from 1960 to 2021. However, many time series do not start until 1970 or even later. We define the length of a cycle as follows: the upswing continues if the new quarterly figure is above its predecessor or above the average of the past five quarters. The latter part of the definition ensures that short-term fluctuations do not end the cycle prematurely. Moreover, it makes sure that two subsequent upswings are aggregated into one. The same definitions apply to downswings (*mutatis mutandis*). We determine the length of the cycles on the basis of inflation-adjusted price indices. According to this definition, the current cycle has been going on for 49 quarters by now. German house prices have risen by 58% in inflation-adjusted terms and by 84% in nominal terms. The German cycle is now the eleventh-longest in our sample (2021: 15). If it continued until the end of the decade, it would be the second-longest in the OECD database. And if prices continued to rise until the end of 2023, it would already be the fourth-longest. While this is only a historical categorisation, which does not contain any analytical value, we believe that it shows just how exceptional a continuation of the cycle during the entire decade would be. In fact, history suggests that the cycle will end sooner rather than later.



Outlook for the German residential property market 2022 and beyond

OECD history of exceptionally long house price cycles based on inflation-adjusted price indices

10

Rank	Start	End	Country	#Quarters	Price increase		Constant average growth rate p.a.		Price deflator p.a.
					Nominal	Real	Nominal	Real	
1	1985	2012	Belgium	106	377%	184%	6.1%	4.0%	2.0%
2	2003	2021	Colombia	69	353%	119%	9.2%	4.7%	4.5%
3	1991	2008	Netherlands	67	288%	165%	8.4%	6.0%	2.4%
4	1993	2007	Norway	58	272%	186%	9.5%	7.5%	2.0%
5	1960	1974	Japan	55	972%	358%	18.8%	11.7%	7.1%
6	1993	2007	Denmark	55	257%	189%	9.7%	8.0%	1.7%
7	1993	2007	Ireland	55	403%	229%	12.5%	9.0%	3.4%
8	1993	2007	USA	54	111%	61%	5.7%	3.6%	2.1%
9	1978	1991	Japan	52	148%	80%	7.2%	4.6%	2.6%
10	2008	2021	Austria	50	117%	71%	6.4%	4.4%	2.0%
11	2009	2021	Germany	49	84%	58%	5.1%	3.8%	1.3%
12	1996	2007	Spain	47	232%	131%	10.8%	7.4%	3.3%
13	1996	2008	Sweden	47	168%	127%	8.7%	7.2%	1.5%
14	2008	2021	Canada	46	108%	82%	6.6%	5.3%	1.2%
15	2009	2021	Luxembourg	46	119%	85%	7.1%	5.5%	1.6%
16	1996	2007	UK	45	225%	173%	11.0%	9.3%	1.7%
17	2010	2021	Switzerland	45	49%	-13%	3.6%	-1.3%	4.9%
18	2010	2021	Estonia	44	136%	84%	8.1%	5.7%	2.4%
19	2010	2021	Latvia	42	100%	63%	6.8%	4.8%	2.1%
20	2009	2019	India	39	213%	84%	12.4%	6.4%	6.0%
21	1998	2008	France	39	150%	111%	9.9%	8.0%	1.9%
22	1970	1979	USA	38	138%	28%	9.6%	2.7%	6.9%
23	2009	2019	Japan	38	15%	13%	1.5%	1.3%	0.2%
24	1998	2008	Italy	38	103%	53%	7.7%	4.6%	3.1%
25	2008	2017	Israel	38	114%	90%	8.3%	7.0%	1.3%
26	1999	2008	Canada	38	100%	69%	7.6%	5.7%	1.9%
27	2012	2021	USA	37	92%	65%	7.3%	5.5%	1.7%
28	1996	2005	Australia	34	117%	83%	9.5%	7.3%	2.2%
29	2012	2021	Denmark	34	56%	47%	5.4%	4.7%	0.7%
30	1999	2007	South Africa	32	310%	149%	19.3%	12.1%	7.2%

Note: The ranking has changed relative to the 2021 outlook. 1st due to a data update, 2nd due to the correction of minor errors and 3rd mainly due to a change in methodology. What did change? The previous definition of a cycle meant that an upswing could be followed by another upswing. New rules define upswings that follow upswings as a common upswing. As a result, some cycles are significantly longer, especially the first two (Belgium and Colombia). Also, now the 30 longest cycles are shown, not the 20 longest cycles as last year.

Source: OECD, Deutsche Bank Research

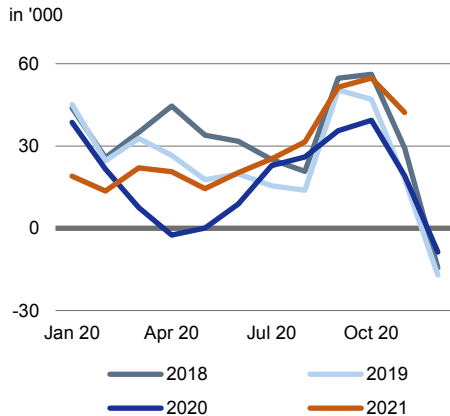


Outlook for the German residential property market 2022 and beyond

3. Fundamental supply shortage easing both in Germany as a whole and in our 126 cities

Net immigration per month

11

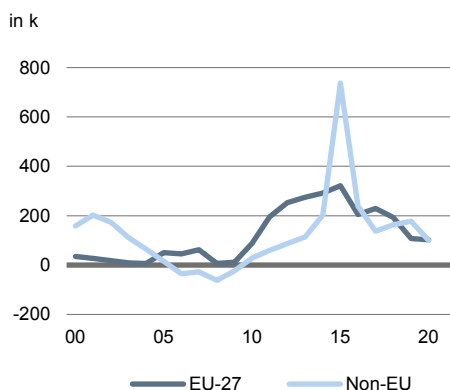


3.1 Review: Nationwide shortage eases again in 2021

Despite the first waves of the COVID-19 pandemic, the number of completed residential units rose by almost 5% in 2020, to about 306,400. Staff and materials shortages characterised 2021. An unusually high number of companies had to deal with both. Nevertheless, order intake, construction output and construction investments rose, as did employment and turnover. In spring, i.e. before the staff and materials shortages began to dampen business massively, we expected about 320,000 completions. In fact, at least 300,000 new units are likely to have been completed in 2021. For the first time ever, more than 43.1 million residential units are available in Germany. The average household consists of 1.9 persons. This means that accommodation for about 570,000 people was newly created in 2021. At the same time, population growth looks set to have been small. With natural population growth negative, just above 200,000 people need to migrate to Germany each year just to keep the population figures unchanged. During the lockdown months, immigration regularly declined. Nevertheless, net immigration probably amounted to about 300,000 people in 2021, largely due to strong immigration during the second half of the year. Immigration from Afghanistan after the shift in power probably played a major role. Immigration figures have normalised from their low of 220,000 in 2020. Overall, the German population seems to have grown only slightly during the pandemic years, to currently c. 83.3 million. In view of slightly higher housing demand and strong supply growth, the supply shortage looks set to have eased considerably.

2000-2020: Net migration

12

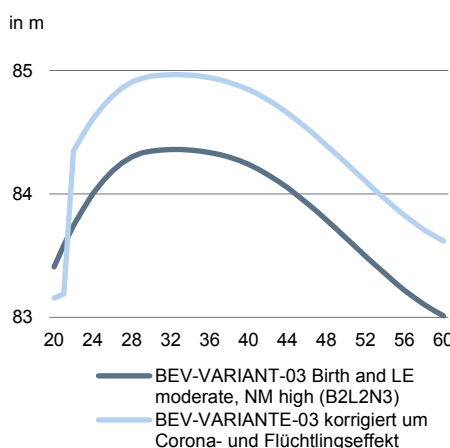


Until 2030: Immigration from outside the EU to increase and support nationwide demand for housing

We expected high net immigration even before the war in Ukraine triggered a refugee wave. From our vantage point, net immigration of more than 300,000 people per year during the remainder of the decade still appears plausible. In many sectors, the lack of qualified labour has been intensified by the pandemic. The new government therefore plans to make it easier for qualified workers to come to Germany. The special rules for western Balkan nationals are to be prolonged, and it would not be a surprise if the current upper limit of 25,000 immigrants per year was abolished. Moreover, the coalition agreement foresees a credit point system for immigrants from outside the EU, an extension of the Blue Card rules to non-academics and an easier procedure for the recognition of foreign degrees. The war in Ukraine has triggered a major refugee wave. We expect about one million refugees to come to Germany.

Official population projections plus adjustment for COVID and 'Ukraine'

13



Geopolitical conflicts around the world and the significant gap between living conditions in Germany and many countries of origin may repeatedly cause immigration waves. This points to considerably stronger immigration from countries outside Europe. During the last few years, migration from non-European countries was already about as important as migration within the EU. Excluding EU enlargements, it will probably exceed internal migration with the EU during the decade. We base our calculation on the 2019 population projection of the Federal Statistical Office, which expects high net immigration to continue (311,000 persons per year). However, we have adjusted this figure to the downside for 2020, as the pandemic dampened immigration in that year, and to the upside for 2021 due to the refugee wave caused by the war in Ukraine. We arrive at a total population of almost 85 million at the beginning of



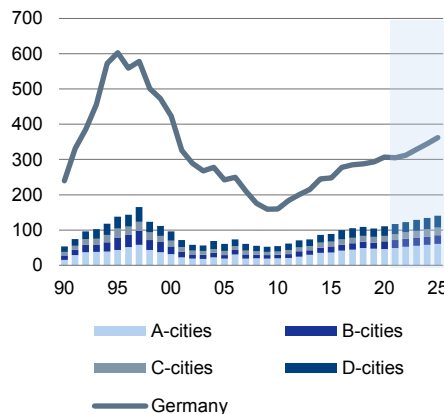
Outlook for the German residential property market 2022 and beyond

the 2030s (84.3 million excluding the adjustments). With c. 1.7 million people more living in Germany, demand for housing looks set to grow strongly.

Housing market: Completions

14

No. of dwellings in '000

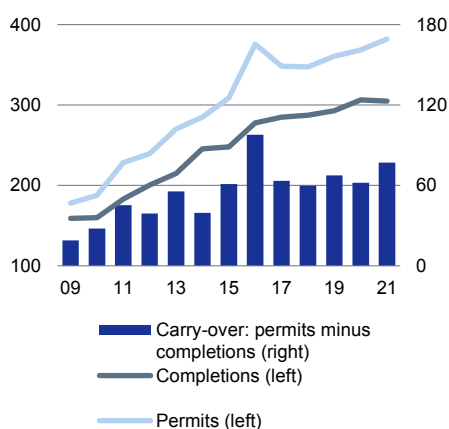


Sources: bulwiengesa, Deutsche Bank Research, Federal Statistical Office

2009-2021 Completions vs. permits

15

in k

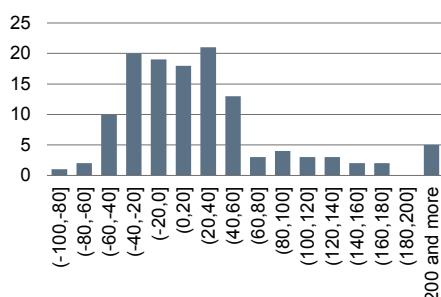


Sources: Deutsche Bank Research, Federal Statistical

2020 Completions: Deviation in percent: Projections vs. realisations

16

y-axis: No. of cities, x-axis: Deviation in percent, Realisation minus projection



Sources: bulwiengesa, Deutsche Bank Research

2022: Number of completions to rise further

Against the background of buoyant demand, construction companies are likely to expand their business further, employ more workers and build more residential units. Subsidies to families and special write-off options ran out in 2021. This development should dampen construction in 2022. In addition, KfW subsidies for new, energy-efficient homes were abruptly stopped and not resumed until after several weeks had passed. This uncertainty will slow activity as well. While materials shortages will probably dampen activity as well, this factor is unlikely to play a major role in 2023. All in all, we expect growth rates of 2.5% for 2022 and 5% later on. Thus, the number of newly completed residential units will probably exceed 350,000 for the first time ever in 2025, making it the first year in the current cycle in which annual supply exceeds new demand. This forecast is in line with the increase in the number of building permits, which has risen steadily from less than 350,000 in 2018 to c. 380,000 in 2021. A relatively high number of permits is for buildings with three and more residential units, which is another hint for a rising number of completions. We believe that the accumulated overhang of residential units approved, but not yet completed since the beginning of the cycle in 2009 probably amounts to 715,000 for 2021. This figure includes our estimates. Based on our forecasts, the construction overhang will be even higher in 2024 and not decline until later on. The construction sector can look forward to years of buoyant business.

3.2 Supply and demand developments nationwide and in our 126 cities

Our March 2021 outlook for the residential property market contained our projections for the number of completions for 2020. The official figure was released in May 2021. Chart 16 depicts the difference between our projections and actual figures. It is considerable in some cases. Nevertheless, our aggregate projections are roughly right. We expected 101,800 completions in aggregate for all 126 cities; the actual number came to 110,600. We therefore shifted our new projections to the upside and forecast now 643,000 new residential units for our 126 cities in the period from 2021 to 2025. In 2021, we expected 606,000 in aggregate. This assumes that the ratio between completions in our 126 cities and completions in Germany as a whole will probably remain constant, at just about one-third.

Demand looks set to increase further in the coming years, too. Since 2011, Germany's population has increased by about 3 million. Almost two-thirds of these three million people lived in our 126 cities. Large cities and metropolitan areas will continue to take up most of the additional population in the future. The current refugee wave is probably an exception to this rule. As accommodation is in short supply in large cities and metropolitan areas, only some of the immigrants are likely to move there. That is why we believe that the number of inhabitants of our 126 cities increased only by 250,000 in 2021. Instead, many refugees will probably go to rural areas with weak infrastructure. With about 2 million residential units vacant in these regions, additional housing demand will probably have only a minor impact on prices and rents. On the basis of these considerations and our nationwide estimates, we expect the population in our 126 cities to increase from currently c. 30 million to about 30.8 million in 2030.



Outlook for the German residential property market 2022 and beyond

A simple method to answer the question: When is the current cycle going to end? A fundamental analysis for 126 cities where more than 30 million people live

17

Aim: Calculate supply shortages

Assumption: Supply and demand are balanced in 2011. Why 2011? We believe that the current cycle began at the end of the financial crisis in 2009. However, as the census in 2011 led to a major correction of population figures, 2011 is the first year for which a comparison makes sense.

Operationalisation: Annual comparison of cumulative supply and cumulative demand per capita from 2011 to 2030.

Calculation of cumulative demand for each of the 126 cities

- Demand baseline for annual population growth = average annual population growth in absolute terms in 2018 and 2019.
- From 2021, steady, population growth in absolute terms declines steadily by 6.1% of the demand baseline for each city in each year. As a result, population growth in 2030 will amount only to about one-third of that in 2021. Why 6.1%? Adjusted for the impact of the pandemic and the current refugee wave (see above), the G2L2W3 population forecast for Germany implies that the aggregate number of inhabitants of our 126 cities rises from 30.0 million in 2019 to 30.8 million in 2030. A proportionate distribution to the 126 cities implies a decline in absolute growth by 6.1% per year.
- The higher population figures are added up for each year from 2011 to the current year.

Calculation of cumulative supply for each of the 126 cities

- Supply baseline = average annual increase in completed residential units between 2016 and 2019 (if the figure is negative, which is the case in a small number of instances, we put it at zero).
- Projection for the years until 2030 on the basis of the released number of completions in 2020. Method: Supply baseline for each city scaled with 0.93. From 2021, the number of completed residential units in each city is forecast to grow by the figure for 2020 plus the scaled baseline. Why 0.93? This factor captures the ratio between nationwide completions and completions in our 126 cities. The ratio between completions in our 126 cities and in Germany as a whole remains roughly constant at about slightly more than one-third for each year until 2030.
- The average annual decline of the number of persons per household in the period from 2011 to 2019 is extrapolated for the period from 2021 to 2030.
- For each year, the number of completions is multiplied with the average number of persons per household in each city.
- The number of people who can move into a new apartment is added up for the years from 2011 up the relevant year.

Cumulative supply minus cumulative demand = annual housing need/surplus in number of persons.

Negative result = supply shortage, **positive result** = supply surplus.

Source: Deutsche Bank Research

Correction of supply shortage calculations in year-on-year terms

18

Year of publication	Supply shortage	
	2016	2019
2021	250.000	200.000
2022	270.000	180.000

Notes*: Data errors and miscalculations in the residential outlook 2021

Changes in 2016 plus dataupdate.

*details see appendix

Source: Deutsche Bank Research

2021: Despite the refugee wave, supply shortages are likely to be eliminated in our 126 cities in the coming years

Before explaining our new projections in detail, we would like to draw attention to several revisions in comparison to the previous year. First, we have corrected minor mistakes in last year's assumptions, and second, we have revised the numbers of inhabitants and households for several the cities. Chart 18 gives an overview of those results which have a major impact on supply shortage figures for the past (for more details see the appendix). These adjustments have not led to major changes to our general assessment. Nevertheless, corrections and revisions are a regular result of a thorough data analysis. The census in 2022 may have an impact. Its predecessor in 2011 reduced population figures considerably.

Census 2011: Revision of inhabitants

19

in m relative to 2010



Sources: bulwiengesa, Deutsche Bank Research

In addition to the number of completions and population growth, the calculations of fundamental supply shortages take into account the trend towards single-person households and the decline in the average household size and extrapolate both trends until the end of the decade for each city. Our aim is to calculate the lack of residential units in aggregate terms. We do not take into account the living space per capita. Our simple method only compares the number of completions and population growth during the cycle while taking into account the average household size (for more details see chart 17). This approach does not consider additional demand due to the wear-and-tear-related decline in quality or due to ESG and climate-friendly construction requirements. Additional demand triggered by the availability of higher technical standards, such as smart-home solutions, is not taken into account either. In fact, many households in our 126 cities cannot really afford such extras against the background of the significant increase in prices and rents. Most households will probably continue to focus on their new home's location, public transport opportunities and its size. That is why we believe that a comparison of the number of inhabitants with the number of available residential units is probably a



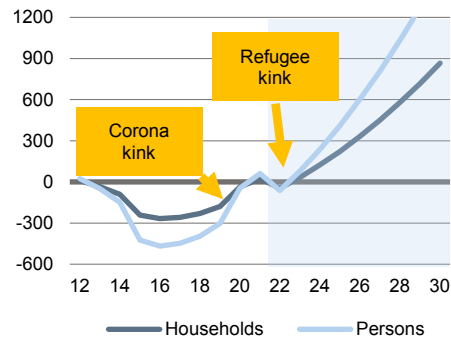
Outlook for the German residential property market 2022 and beyond

126 cities: Comparison of supply and demand

20

y-axis: in '000

+ = excess supply, - = supply shortage

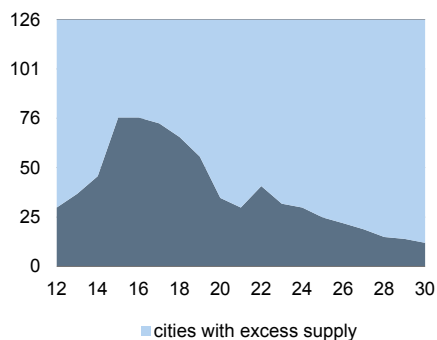


Sources: bulwiengesa, Deutsche Bank Research

2012-2030: Comparison of supply and demand

21

No. of cities



Legend: cities with excess supply (light blue), cities with supply shortage (dark blue)

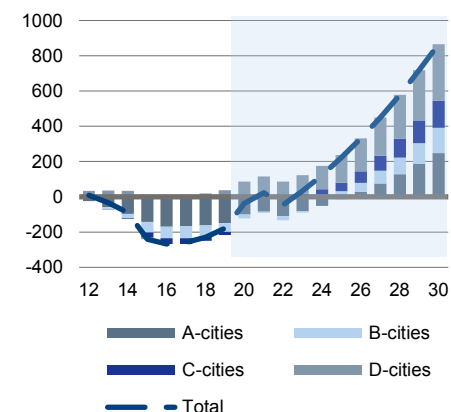
Sources: bulwiengesa, Deutsche Bank Research

2012-2030: Comparison of supply and demand

22

y-axis: No. of dwellings in '000

+ = excess supply, - = supply shortage



Sources: bulwiengesa, Deutsche Bank Research

good proxy for most of our 126 cities, in particular the metropolitan areas. Our method does not differentiate between different asset classes either. While the overall residential market may be in equilibrium, there may be considerable shortages or surpluses in individual sectors.

Apart from population growth, household size and completions, we would like to include other factors such as vacancy and demolition rates. However, the relevant time series are not available for all cities. Demolitions will probably play a minor role in most cities. Vacancy rates make it easier to define market equilibrium. As a proxy, we assume that the market was in equilibrium in 2011. This assumption probably makes sense for most cities, with the exception of several large metropolitan areas, in particular Munich, where vacancy rates were very low at the beginning of the cycle already. From a purely analytical vantage point, it would make more sense to expect market equilibrium in 2009, the year in which the cycle began. We have chosen 2011, however, because the census in 2011 led to considerable adjustments to the population figures. Based on average household size, residential unit completions exceeded population growth in 2012. This means that, according to our calculations, there was a supply surplus in the first year of our sample period. Supply did not decline until later. It is therefore not implausible to assume market equilibrium for 2011.

The supply shortage was most pronounced in 2016, at almost 270,000 residential units for almost 470,000 persons. It has been declining since. In 2019, the lack amounted to just below 180,000 residential units. For the reasons described above, the trend continued in the years of the pandemic (2020 and 2021). Since completion figures for 2021 will not be released until May 2022, this is the first year of our projections. We extrapolate past trends for our three variables. This suggests that, across our 126 cities, the supply shortage was eliminated in aggregate in 2021. A surplus appears possible for the first time since 2012. The war in Ukraine and our forecast that 250,000 out of a total of one million refugees will go to our 126 cities suggest that the supply shortage is likely to return in 2022, only to be over again by 2023.

If, as we assume, the number of completions increases in the future, the number of vacancies will rise despite population growth. In 2025, the aggregate surplus will rise to about 200,000 residential units. This will lift the average vacancy rate in our 126 cities by about 1.2 pp. By the end of the decade, housing shortages will persist in only 12 out of our 126 cities. In contrast, 114 cities will register a surplus. Remember that these figures are not forecasts, but projections. New construction activity will certainly slow down if vacancy rates rise in specific regions and cities. This means that our projections exaggerate the supply surplus in the coming years, particularly for 2030, when we project an aggregate surplus of about 780,000 residential units.

We believe that our projections are particularly helpful for finding out just when the housing price cycle is due to end. As our analysis shows, shortages on the housing market persist in the aggregate. However, supply is likely to grow more quickly than demand. This suggests that people will have more choice and that the market will become less tense. As a result, investors will become less willing to pay even higher prices. As we have already explained last year, the fundamental supply situation suggests that the price cycle is approaching its peak.



Outlook for the German residential property market 2022 and beyond

3.3 Supply shortages over in most C and D cities

According to our projection, the aggregate fundamental supply shortage for our 126 cities will end in 2021 or 2023. However, there are major regional differences, particularly between large and small cities. The A cities will register a cumulative supply surplus from 2026, the B cities from 2024, and the C and D cities already from 2020 and 2016, respectively.

There are also major differences between the metropolitan regions. In Berlin, Cologne, Hanover, Leipzig and Stuttgart, the supply shortage will persist until after 2025. In contrast, conditions in Bremen, Dusseldorf, Hamburg, Heidelberg, Munich and Nuremberg are roughly similar to 2011. In the case of cities like Munich, where the vacancy rate was very low back in 2011, supply has increased marginally at best. In contrast, cities such as Bremen, Dusseldorf, Hamburg or Nuremberg registered much higher vacancy rates back then. This suggests that they are quite near to the end of cycle.

A look at the situation in Heidelberg may help to put our projections into perspective. According to our approach, the cycle in Heidelberg already reached its end in 2020. In our outlook for 2021, we did not expect that development until 2028. This is the biggest change in our projections for the eleven metropolitan areas. It stems from a decline in the number of inhabitants by about 1.8%, from 161,500 to only 158,700 in 2020. Heidelberg is a university town, so the drop in the population figures was probably caused by virtual teaching during the first year of the pandemic. At the same time, the number of completions remained roughly unchanged from the previous years. It is relatively low, at 0.6% of the total number of residential units. If the national pandemic ends and students return to Heidelberg, living space may soon be in short supply once again and the cycle may become considerably longer than our current projections suggest.

Another striking feature is that there may be considerable heterogeneity between cities in one metropolitan area. There is no connection between the end of the cycle in the metropolises themselves and the metropolitan areas around them. In fact, in some cases the cycle in the metropolis itself may be considerably longer than in the region around it. We believe that, while housing demand is largely interconnected in neighbouring cities, housing and construction policies may differ considerably. This may depend on several factors, such as geography, political decisions and many others.

2022: Comparison of housing supply and demand in eleven metropolitan regions

23

Metropolis	End of cycle in year	Metropolitan Region including Metropolis	End of cycle in year	Metropolitan Region excluding Metropolis	End of cycle in year
Berlin	2028	Berlin/Brandenburg	2028	Berlin/Brandenburg	2011
Bremen	2019	Northwest	2018	Northwest	2011
Dusseldorf/Cologne	2026	Rhine-Ruhr	2020	Rhine-Ruhr	2018
Frankfurt	2028	Rhine-Main	2027	Rhine-Main	2025
Hamburg	2021	Hamburg	2020	Hamburg	2019
Hanover	2028	HBGW	2020	HBGW	2019
Heidelberg	2020	Rhine-Neckar	2028	Rhine-Neckar	2029
Leipzig	2030	Central Germany	2027	Central Germany	2016
Munich	2020	Munich	2020	Munich	2020
Nuremberg	2020	Nuremberg	2019	Nuremberg	2019
Stuttgart	2028	Stuttgart	2024	Stuttgart	2020

Note Dusseldorf and Cologne have very different supply-demand balances. Based on our approach, Cologne exhibits a very large supply shortage whereas in Dusseldorf there is already excess supply. HBGW = Hanover-Brunswick-Göttingen-Wolfsburg. "2030" implies the fundamental supply shortage still exists in 2030.

Source: Deutsche Bank Research



4. House prices are approaching fair valuations

Just like in our residential market outlook for 2021, we will now use a present value model to calculate theoretical price levels. However, we will expand our initial model to include 17 parameters. This more complex approach is more similar to methods used in the real-estate industry. It enables us to use nominal figures to estimate excess valuations (a persistent issue) and to calculate returns on equity. We will also calculate the financial impact of a potential pick-up in inflation and differentiate between nominal and real figures. And finally, we can use this model to analyse the value of energy refurbishment.

4.1 A uniform model for 126 cities

It is a truth universally acknowledged among economists that each formula included in a text reduces the number of readers by half. That is why we give only the two most important formulae to determine fair theoretical valuations here and will explain our reasoning in writing. All formulae are available in the appendix.

The present value model and our assumptions

24

$$\text{Fair value} = \sum_{t=1}^{50} \frac{\text{cash flow}_t}{(1 + \text{Bund yield} + \text{risk premium})^t} - \frac{\text{net selling price}_{t=51}}{\text{discounted to today}}$$

with cash flow being defined as

$$\text{cash flow}_t = \text{net rental income}_t - \text{interest rate}_t - \text{repayment}_t - \text{tax}_t$$

Initial assumptions: investment period = 50 years, subsequent sale at residual value, depreciation of 2% p.a., assumptions for 50 years: rent growth 2% p.a., Bund yields steadily at 0.50%, risk premium (= rent yield minus Bund yield) = 367 bp.

Source: Deutsche Bank Research

Investment project and basic parameters: Purchase and financing of a flat in a condominium building

For our model calculations, we assume the purchase of a flat in a condominium building with a total floor space of 675 sqm and 9 flats with 75 sqm each. The building plot has a size of 600 sqm. The purchase is made at the market price/sqm for each of the 126 cities in the year of the calculation. Ancillary expenses shall amount to 10% of the net purchase price. We assume a holding period of 50 years and a subsequent sale at the market price, with the market price rising in line with annual price developments. 20% of the gross purchase price are to be paid for from savings, and the current ECB benchmark rate for 5-10-year mortgage loans shall apply for the borrowed capital. In January 2022 (latest available figure), this interest rate was 1.19% p.a. In addition, we assume that 2% of the loan are repaid each year so that the loan is fully repaid after 50 years.

Rents shall be equivalent to re-letting rents in 2021 and rise steadily each year. Operative and administrative expenses, maintenance and rent losses shall reduce gross annual rent income by an aggregate 14%. Net rents shall cover interest and redemption payments and taxes. The remainder – i.e. annual cash flow – goes to the owner. We calculate the present value both on a cash flow basis and on an equity basis, with redemptions increasing the cash flow.

Loan interest and tax depreciation shall reduce the tax burden. We use the capital gains tax rate of 25% for our calculation, which is above the corporate tax rate for funds (15%), but in many cases below income tax rates. Tax depreciations shall be equivalent to the book value of the flat without the plot; we use a degressive depreciation rate of 2% p.a.



Outlook for the German residential property market 2022 and beyond

Investment project and baseline parameters: Bund yields and risk premium

The discount factors in the formula's denominator, i.e. the Bund yield and the risk premium, have a significant impact on the result. Discounting is used to put a present value on payments due in the coming years. The risk premium ensures that the discount factor is always slightly above 1. That means that, from today's vantage point, future payments are worth less than current payments. Payments farther out are worth considerably less than payments in the next year. The risk premium describes the additional return which real-estate investors expect over a relatively secure investment in Bunds.

In mid-March, the Bund yield was 0.50%, i.e. considerably above the level of -0.57% used for our calculations in the market outlook for 2021. Back then, we also assumed a risk premium of 440 bp. Due to the interest-rate increase and the decline in rent yields, the risk premium currently comes to 367 bp. This is the figure we use in this year's issue. There are good reasons to assume either a higher or a lower risk premium.¹ One reason which would justify a higher risk premium is the shift from overall capital cost in 2021 to equity capital cost in our current, more complex model. As a rule, returns on equity need to be higher than returns on overall capital. One reason which would justify a lower risk premium is that our current, more complex model explicitly includes rent losses in net rent income and does not cover them via the risk premium, as in 2021. Moreover, interest rates have declined – a development which tended to reduce the risk premium over the last few years. From our vantage point, the most important argument is that residential property is increasingly used as a substitute for bonds. That means that 367 bp are probably near the average additional return expected by institutional investors.

Investment project and baseline parameters: Price and rent growth

In a final step we also determine rent and price growth. Major rent hikes will probably remain difficult to implement in the future. The new "traffic-light" coalition intends to extend the period used as a basis to calculate regular local rents and reduce the cap. Moreover, the "rent brake" is likely to be prolonged. Beyond this regulatory tightening, sentiment in society as a whole makes it difficult to ask for higher rents in many places. We therefore assume steady growth at 2% p.a. in our baseline model. This rate is below the increase in re-letting rents in the last few years, but above the nationwide increase in rents under existing tenancy contracts.

We have now determined all parameters apart from price growth. In 2021, the average square metre price, adjusted per capita, amounted to about EUR 3,600 for our 126 cities. This is also the value which our model gives under the baseline assumptions and assuming price growth of 4.2% p.a. So this is the growth rate where the market and the model price converge. In other words: rational market participants expect price growth of 4.2% p.a. for the coming 50

Basic assumptions for our present value model

25

Base assumptions

in % p.a. exceptions are marked

Prices and rents

Price growth	4.2%
Rental growth	2.0%
Auxiliary costs in %*	10%

Asset management variables

Administrative costs	2%
Maintenance costs	10%
Rent losses	2%

Apartment

Plot in sqm	600
Living area in sqm	75
No. of units in MFH	9
Total area in sqm	675

Mortgage

Equity in %**	20%
Mortgage rate	1.19%
Repayment	2.00%

Tax and depreciation

Tax write-offs	2%
Tax rate	25%

Discounting factor

Bund yields	0.50%
Risk premium in basis points	367 Bp

*of net purchase price

**of gross purchase price

MFH=condominium building

Source: Deutsche Bank Research

¹ While our data are relatively thin on the ground, risk premiums have tended to decline in the past. Schilling (2003) puts survey-based risk premiums for US commercial properties at 600 – 675 bp. McDonald and McMillen (2008) report a survey-based US real-estate market premium of 400 – 600 bp. Current calculations by Aswath Damoradan suggest that, due to interest-rate developments, risk premiums for equity capital have declined considerably for European real-estate equities. They have halved from about 700 bp in 2014 to c. 350 bp in 2021. If we use Bunds instead of US Treasuries as a proxy for the risk-free interest rate, the risk premium is probably even lower. Total capital risk premiums have also tended to decline. A comparison of Bund yields and initial gross rent yields also points to a clear decline over the last few decades. This comparison also illustrates just how difficult it is to calculate risk premiums: In the 1990s, the risk premium according to this approach was negative, and the sign did not change until the current cycle. Oberst and Voigtländer (2020) use a more macroeconomic model and assume a premium of 270 bp for Germany, which corresponds to the difference between initial gross yield and the mortgage interest rate.



Outlook for the German residential property market 2022 and beyond

years. We have now determined our 17 parameters. They form the basis for our subsequent analyses.

4.2 Over- and undervaluations in case of changes to price and rent growth

Annual rent growth of 4.2% is not unusual. In fact, numerous OECD countries have registered considerably higher growth rates during the past decades. The average is above 5%, so a rate of 4.2% appears quite conservative. However, we should remember the unusual decline in interest rates over the past 40 years, which has driven up asset prices around the world. This constellation is unlikely to be repeated. From that vantage point, 4.2% may be quite a high value. However, this will depend largely on economic framework conditions, in particular inflation and interest rates.

Changes to price growth enable us to calculate over- and undervaluations. Across the entire cycle since 2009, prices for existing condominium apartments have risen by 7.4% p.a. on average. This assumption gives a model price of more than EUR 10,000/sqm, which would make the German residential market grossly undervalued. If, in contrast, we use average price growth for the period from 1970 to 2008, i.e. 2.5% p.a., the model gives a price of EUR 2,140/sqm. This would make the residential market considerably overvalued.

In addition to the univariate analysis, we will now examine which combinations of price and rent growth result in over- and undervaluations. Chart 26 shows valuations on the y axis and price growth on the x axis. The curves represent valuations for constant rent growth of 1% and 4% p.a., respectively. 1% is a historically low rate, which, however, cannot be fully excluded in view of the steady tightening of the regulations. In contrast, rent growth of 4% is probably the maximum because the caps have been reduced. The intersections with the x axis give the fair valuations. If rents grow at a rate of 1%, prices will need to rise by about 4% to arrive at a fair valuation. If rents grow at a rate of 4%, price growth should be roughly 2½%. The negative area points to current undervaluations, the positive to overvaluations.

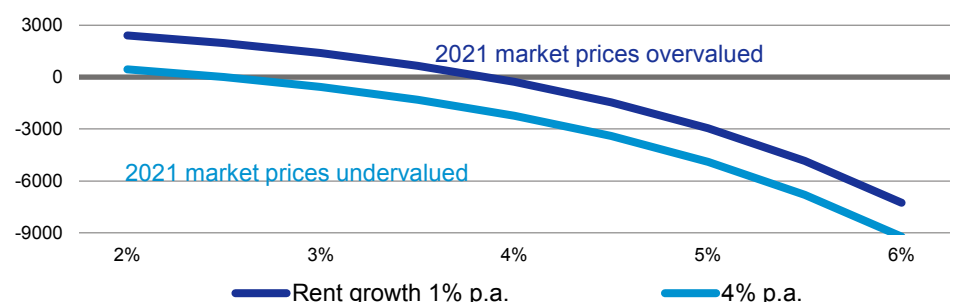
Sales price is an important factor to determine overall cash flow

We use our model to calculate other figures, such as the importance of the discounted net sales price at the end of the 50-year investment period compared to the overall discounted cash flow, i.e. rent income plus the net sales price. Under our baseline assumptions and across our 126 cities, the net sales prices is, on average, equivalent to about 88% of total cash flow. This remarkable ratio reflects the steady decline in rent yields over the past 13 years. In 22 cities, mainly metropolitan areas and large cities in southern Germany, the ratio is even above 100%. This means that, according to our valuation model,

126 cities: Modeled price and rent growth 2022-2072 vs. market price in 2021

26

y-axis: overvaluation in EUR pro sqm
x-axis: price growth in % p.a.



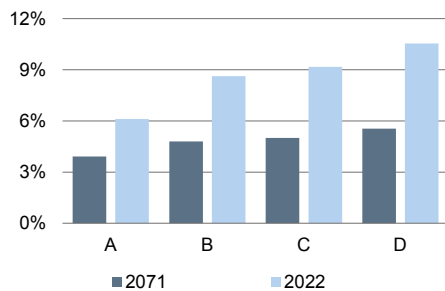
Sources: bulwiengesa, Deutsche Bank Research



Outlook for the German residential property market 2022 and beyond

Return on equity

27

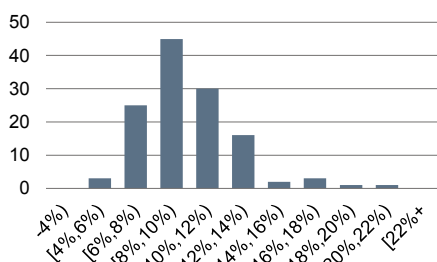


Source: Deutsche Bank Research

126 cities: Initial equity yields in 2022

28

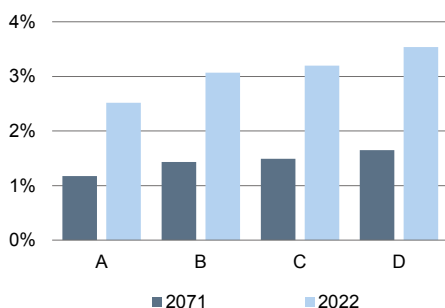
No. of cities



Sources: bulwiengesa, Deutsche Bank Research

Net rental yields

29



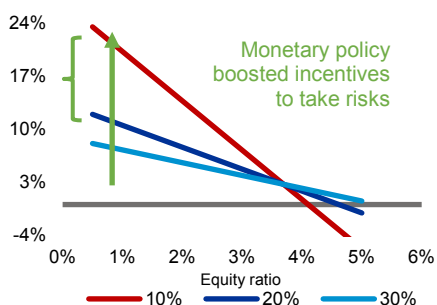
Source: Deutsche Bank Research

Return on equity depends on 5-10-year mortgage rate and equity ratio

30

y-axis: return on equity

x-axis: 5-10-year mortgage rate



Source: Deutsche Bank Research

residential properties provide investors with negative cash flows during the holding period and do not offer a gain unless they can be sold at a high price. This is in line with the traditional definition of a house price bubble.² For this reason, financing variables, taxes and depreciation tend to play a minor role for valuations, as we will explain below.

High returns on equity will call get attention from the regulators

Under our baseline assumptions, initial returns on equity amount to c. 10% and initial rent yields to c. 3% in the B, C, and D cities. In A cities, returns on equity are about 6% and initial net rent yields are about 2 ½%. Even if valuations are fair, there are still massive incentives to invest in the German residential market. Higher interest rates can reduce returns on equity. However, even if 5-10-year mortgage rates amounted to 2.5%, the average return on equity across all 126 cities would still be above 6%. As many global investments will become considerably less profitable when interest rates rise, the German residential market may still be quite attractive for investors.

Assuming the low interest rates seen in January, both return on equity and net rent yields will steadily decline during the 50-year holding period. By the end, they will be about half as high as at the beginning. The fact that yields are so low suggests once again that current valuations may indeed be excessive. They make sense only in a “Japanese-style” future, where interest rates are structurally low. Our model also shows that the very low interest rates provide high incentives to enter into risky financings. Low equity ratios offer particularly high yields if interest rates are very low (chart 30). The loose monetary policy of the past decade has not only made loans cheaper but has also given massive incentives to take risks. Under our baseline assumptions, halving equity to only 10% will lift the return on equity to more than 19% in 2022. At the same time, the model price rises only moderately if the equity share is reduced to 10%, from EUR 3,600 to nearly EUR 3,800. These considerations imply that macroprudential countermeasures will be taken. If investors are still willing to enter into risky financings, they should consider the potential consequences of significantly tighter regulation on subsequent financings.

4.3 Changes to the assumptions for A, B, C and D cities

Most of our baseline assumptions are probably useful approximations for all 126 cities. This applies to the property itself, ancillary costs, maintenance and administrative expenses, taxes and depreciation, loan conditions, the interest-rate environment and rent growth. Other variables may differ considerably between the regions, however. In many A cities, rent losses will probably clearly below 2% p.a., whereas they are likely to be higher in D cities. Vacancies have only a minor impact on valuations and change them only by a few euros. Due to a lack of data, we have used constant vacancy rates of 1% p.a. for A cities, 2% for B and C cities and 4% for D cities in the following analysis.

Price paths may differ considerably from one city to another

Using our base assumptions, we will now calculate the end of the cycle for our metropolitan areas and metropolises in terms of valuations. The base assumptions were chosen so that, on average, current prices are in line with valuations. This means that cycles for some cities and regions have already ended, whereas others are about to end or the end is not yet in sight. If current

² Stiglitz, Joseph E. (1990). Symposium on Bubbles. Journal of Economic Perspectives 4(2), Spring, pp. 13-18.



Outlook for the German residential property market 2022 and beyond

valuations are below the market price, we extrapolate average price growth for each city between 2009 and 2022 in order to determine the end of the cycle. The calculations point to particularly long cycles in central Germany and in the Rhine-Ruhr area. Economic momentum in these areas tends to be lower than in many other metropolitan regions. Thus, the late cycle ends reflect both relatively low market prices compared to valuations and comparatively low price growth. This calculation also shows where uniform, nationwide assumptions meet their limits. It might make sense to use individual parameters for some cities. We will now continue this discussion for prices and finally the risk premium. Prices in metropolitan areas might be expected to rise much more strongly than in D cities. Cities have always been economic powerhouses in human history. As a rule, their importance increased with their size. This means that prices in large cities might rise more strongly than at a rate of 4.2% p.a. However, the working-from-home boom of the past two years and digitisation will put this historical rule to the test. In the very long run and if digital services play an ever more important role in our lives, extrapolating past trends may turn out to be a mistake. This means that we may see considerably lower growth.

Investors may vary risk premiums for an individual assessment of the 126 cities

Another important valuation variable, the risk premium, may differ considerably, too. Investors will probably have very different expectations for their investments in a dynamic metropolis or in a small city in a region with poor infrastructure. Discount factors, i.e. risk premiums, may be considerably lower in metropolises, as investors will regard investments in the residential market almost as risk-free. In contrast, investors may use higher risk premiums for smaller D cities. Chart 32 shows how average valuations change across A, B, C and D cities if we assume different risk premiums and price growth paths. We calculate fair theoretical values for all four city categories, assuming price growth of 2-6% and risk premiums between 250 and 500 bp. Fair valuations are on the x axis. If price growth increases, the risk premium needs to rise as well in order to get market prices to correspond to valuations. In the negative area of the y axis, valuations are above market prices, and in the positive area, they are below. Once again, it becomes clear just that changes to the assumptions will result in major changes to valuations. Under our base assumptions, A cities already appear somewhat overvalued. If we put the risk premium at only 300 bp, however, they are, on average, undervalued by more than EUR 1,000. In contrast, B, C and D cities are undervalued by several hundreds of euros under the base assumptions. If we put the risk premium at 434 bp, however, they are overvalued by about EUR 500 on average. The chart allows investors to use their own assessments of fair parameters and thus arrive at fair valuations.

Cycle ends according to valuations under baseline assumptions

31

Metropolis	End of cycle in year	Metropolitan Region including Metropolis	End of cycle in year	Metropolitan Region excluding Metropolis	End of cycle in year
Berlin	2020	Berlin/Brandenburg	2021	Berlin/Brandenburg	2023
Bremen	2023	Northwest	2023	Northwest	2023
Dusseldorf/Cologne	2020	Rhine-Ruhr	2024	Rhine-Ruhr	2025
Frankfurt	2020	Rhine-Main	2021	Rhine-Main	2022
Hamburg	2020	Hamburg	2021	Hamburg	2022
Hanover	2021	HBGW	2023	HBGW	2023
Heidelberg	2020	Rhine-Neckar	2021	Rhine-Neckar	2022
Leipzig	2021	Central Germany	2026	Central Germany	2027
Munich	2020	Munich	2020	Munich	2020
Nuremberg	2020	Nuremberg	2021	Nuremberg	2021
Stuttgart	2021	Stuttgart	2021	Stuttgart	2021

HBGW = Hanover-Brunswick-Göttingen-Wolfsburg. "2020" implies an overvaluation in 2020 or earlier.

Source: Deutsche Bank Research



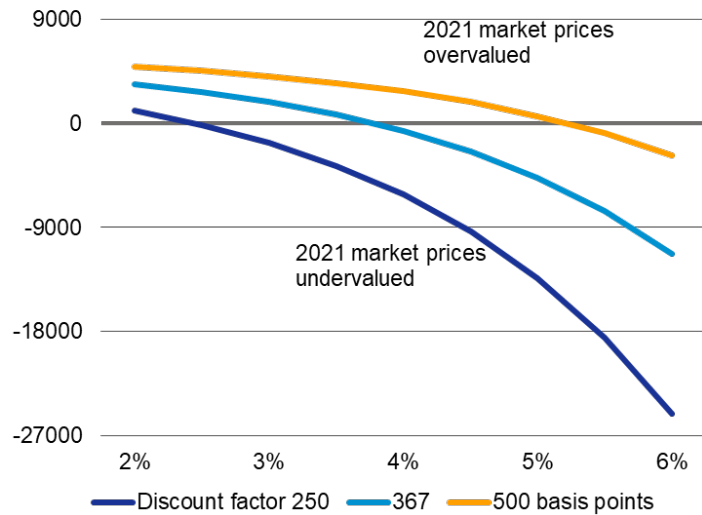
Outlook for the German residential property market 2022 and beyond

Models of fair prices for A, B, C and D cities: Price growth of 2022 – 2072 vs risk premium in the discount factor

32

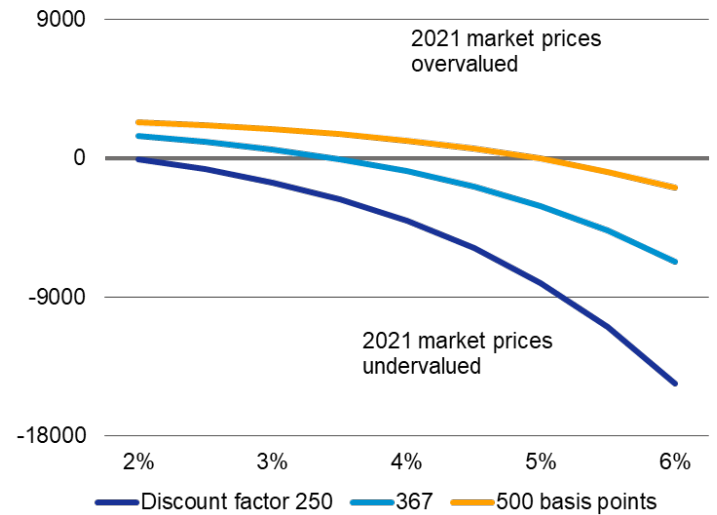
A-cities

y-axis: overvaluation in EUR per sqm
x-axis: price growth in % p.a.



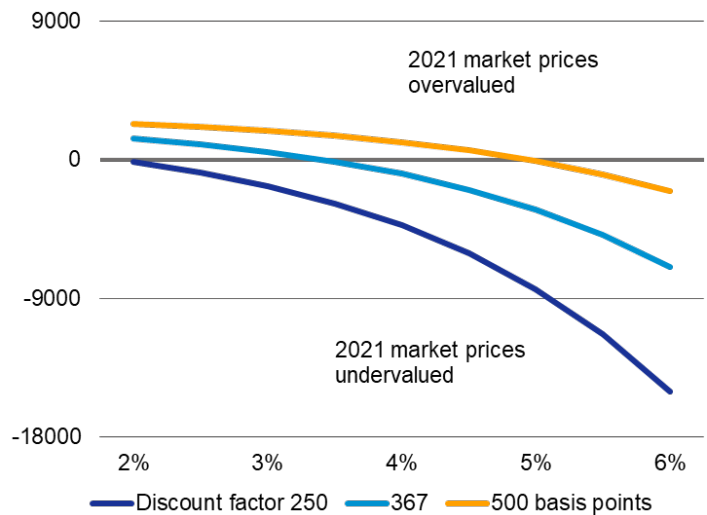
B-cities

y-axis: overvaluation in EUR per sqm
x-axis: price growth in % p.a.



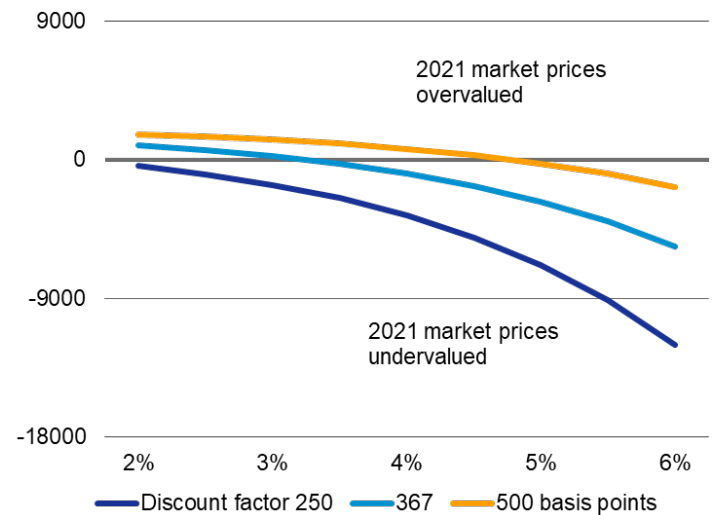
C-cities

y-axis: overvaluation in EUR per sqm
x-axis: price growth in % p.a.



D-cities

y-axis: overvaluation in EUR per sqm
x-axis: price growth in % p.a.



Source: Deutsche Bank Research

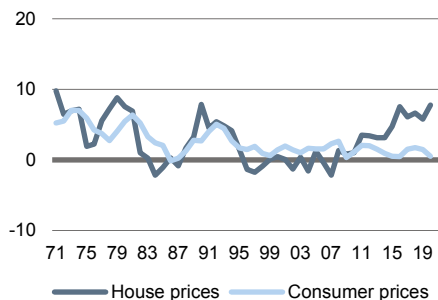


Outlook for the German residential property market 2022 and beyond

1971-2021: Inflation vs. house prices in Germany

33

in % year-over-year

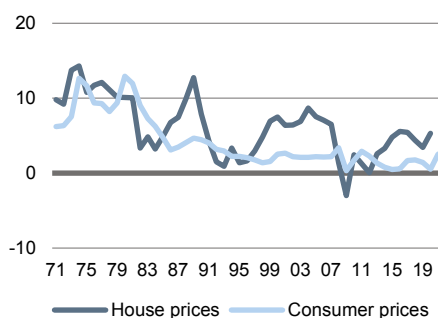


Sources: Deutsche Bank Research, OECD

1971-2021: Inflation vs. house prices in 23 industrialised countries

34

Medians of annual growth rates in % yoy

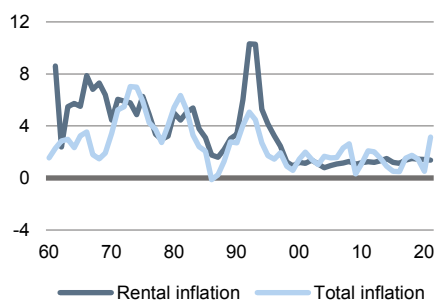


Sources: Deutsche Bank Research, OECD

1960-2021: Total vs. rental inflation in Germany

35

in % p.a.

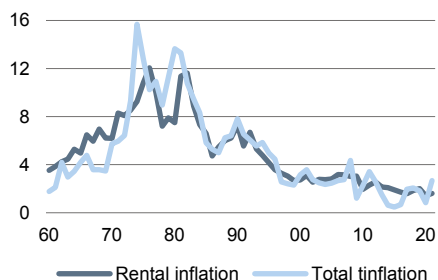


Sources: Deutsche Bank Research, OECD

1960-2021: Total vs. Rental inflation in 23 industrialised countries

36

in % p.a.



Sources: Deutsche Bank Research, OECD

5. Residential properties offer less inflation protection today than in the past

Investors can protect their purchasing power if higher inflation translates into higher house prices and/or rents. Expanding the loan volume (i.e. financing a large share of the purchase price with the help of borrowed capital) can also provide protection against inflation. At the same time, financing becomes usually more expensive as inflation accelerates. We will first examine the complicated interplay of contradictory effects for the past, using the 1970s as an example. We will then explain our forecasts for long-term mortgage rates. And finally, we will use our present-value model to demonstrate the potential impact of high inflation rates and rising interest rates on valuations.

5.1 A review of the 1970s, which provided high inflation protection to investors via both rent and price growth

During the 1970s, consumer and house prices moved largely in step, both in Germany and worldwide. In Germany, inflation averaged c. 5% p.a., and house prices rose by c. 6%. Both consumer and house price inflation were even stronger in many other countries. This high-inflation period ended due to the rate shock at the beginning of the 1980s. Since then, rates have been trending downwards, financing costs have declined and house prices have risen. This is probably the reason why many countries have seen house and consumer-price inflation decouple from each other since the 1980s. Strong legal protection for tenants is probably the reason why the German residential market has been unattractive for many investors for decades. Moreover, comparatively high interest rates in Germany, both in real and in nominal terms, probably prevented a boom. After the German unification, high subsidies drove house prices and inflation upwards. In response, the Bundesbank hiked its key rates aggressively. From the mid-1990s, the subsidies led to high vacancy rates. The subsequent market correction was not overcome until after the financial crisis. Inflation remained low as well. During the current cycle, house and consumer-price inflation decoupled in Germany, too.

Up until 2021 at least, rent inflation, which is largely determined by existing tenancy contracts, and headline inflation have not decoupled. They have been moving in step at the international level, too. During the 1970s, high inflation regularly drove up rents, both in Germany and worldwide. Rent inflation averaged almost 5% p.a. in Germany and about 10% p.a. in many other industrialised countries. In Germany, rent increases were probably driven not only by price pressures in the economy as a whole, but also by a supply shortage. Millions of residential units had been destroyed in the war, and millions of refugees were looking for shelter. As a result, residential space was in extremely short supply. Due to the structural supply shortage after the war, rents rose by more than 6% p.a. on average during the 1960s, i.e. more strongly than in the 1970s. It was not until the mid-1990s that rent growth slowed palpably. Since then, it averaged about 1.4% p.a., about half the rate registered in other OECD countries. Usually low headline inflation in Germany is probably one of the reasons, as is the particularly restrictive rent law in comparison to other countries.

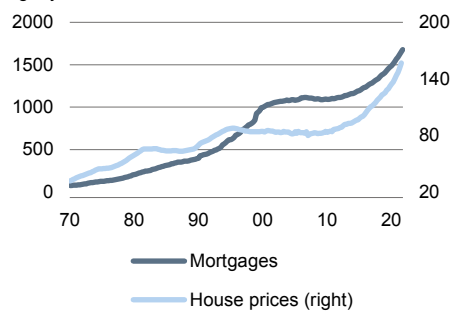


Outlook for the German residential property market 2022 and beyond

1970-2021 Germany: Mortgages vs. house prices

37

left y-axis: EUR bn
right y-axis: 2015=100

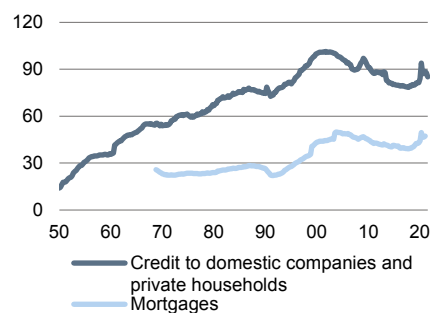


Sources: Bundesbank, Deutsche Bank Research, Haver

Germany: Credit volume

38

in % of GDP

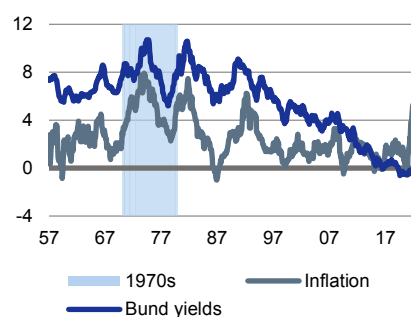


Sources: Bundesbank, Deutsche Bank Research

1957-2021: Inflation vs. Bund yields

39

in % p.a. and in % year-over-year

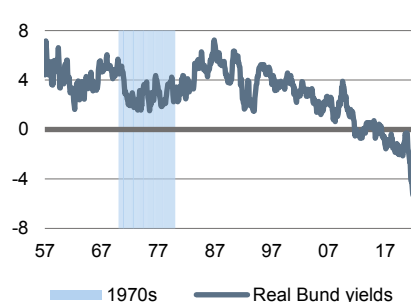


Sources: Deutsche Bank Research, IWF

1957-2021: Inflation-adjusted Bund yields

40

in % p.a.



Sources: Deutsche Bank Research, IMF

Financing options and interest rates in the 1970s

Investors can also protect themselves against inflation by taking out high loans. During the 1970s, the sum total of extended mortgage loans almost tripled, from just below EUR 75 bn to almost EUR 200 bn. This is an increase of 170%. During the same time, house prices rose only by 85%. The significant increase in the loan volume was probably a consequence not only of high inflation, but also of very low indebtedness. Mortgage loans as a percentage of GDP remained relatively stable, at only just above 20%.

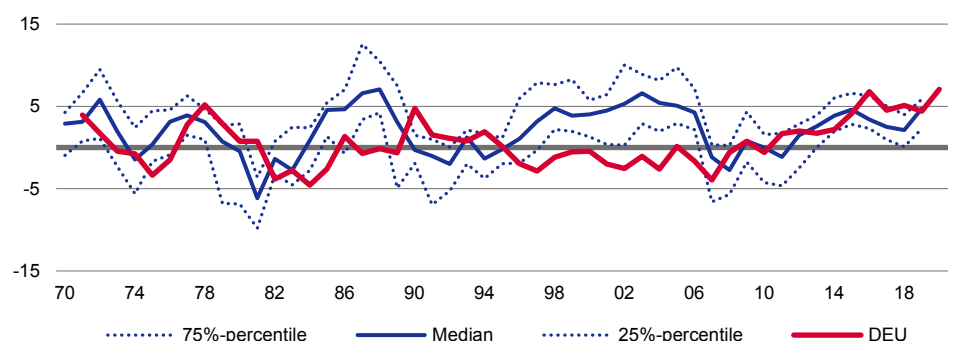
For our interest rate analysis, we focus on 10-year Bund yields because the time series for mortgage rates does not start until 2000. Remember that the spread of 5-10-year mortgage rates has been about 120 bp over Bunds since 2000. Between 1957 and 2000, Bund yields averaged 7.1%. During the 1970s, they averaged 7.95%. In 1974, they even rose above 10% for a short time and money-market rates were even higher. However, this was just a nominal rate shock. Real Bund yields remained relatively steady during the decade, at around 3%.

The 1970s are often described as a stagflation phase. In fact, the first oil crisis in 1973 triggered a jump in inflation and an economic slump. Monetary policy was not very restrictive, obviously. This may be one reason why real house prices rose much more strongly in the 1970s, by almost 1.2% p.a. on average, than in subsequent decades. It was not until after the second oil price crisis in 1979 that the central bank tightened the monetary reins. Nominal Bund yields returned to almost 11% and money-market rates were back in the two-digit area, too. At the same time, the central banks made clear that they were going to keep inflation in check. They were successful, and there were no further oil crises. Later on, nominal money and capital-market rates rose and real house prices declined. This trend was visible not only in Germany, but in almost all industrialised countries (chart 41). In Germany, real Bund yields rose to about 4.5% on average during the 1980s and peaked at above 7%. At the same time, real house prices declined by about 1.2% p.a. Consequently, by the end of the 1980s, the real gains of the 1970s had been eradicated. Following nominal price increases by 85% during the 1970s, prices rose only 18% during the 1980s.

1970-2020 Real house prices: Germany and 22 OECD industrialised countries

41

in % ggü. Vorjahr



Sources: Deutsche Bank Research, OECD



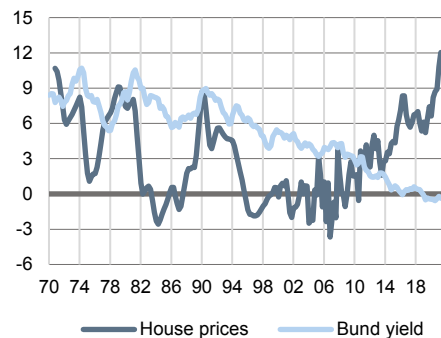
Outlook for the German residential property market 2022 and beyond

5.2 What can we learn from the 1970s for today?

1970-2021 Nominal data:
Rates vs. house prices

42

in % p.a. and % year-over-year

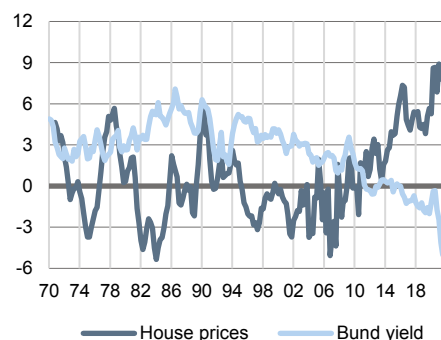


Sources: Deutsche Bank Research, OECD

1970-2021 Real data:
Rates vs. house prices

43

in % p.a. and % year-over-year



Sources: Deutsche Bank Research, OECD

Our look at the past has shown that strong house price and rent growth used to provide relatively high protection against inflation. So did large nominal loans, as debtors had to repay less in terms of purchasing power than they had borrowed when inflation was high. At the same time, real interest rates were positive and remained largely steady. Creditors therefore included higher inflation rates in their interest calculations. Thus, investors probably did not benefit from lower and, in particular, negative real financing costs. We will now discuss potential inflation protection from today's vantage point. In particular, we will take into account the changes to the regulatory and monetary environment.

Outlook: House prices are likely to move in step with consumer-price inflation, at least in the short run. However, rent hikes will probably not provide protection against inflation

Despite numerous market interventions, there is currently no regulation for residential property prices, apart from legislation on ancillary costs. Buyers and sellers can negotiate freely. As long as the supply shortage continues, sellers will expect some compensation for inflation and be able to get it. In 2021, some price indices already rose markedly, possibly due to high inflation. This means that house prices continue to offer relatively reliable protection against inflation. This will apply until vacancy rates are significant and buyers and tenants can choose between different offers.

Rents, in contrast, will rise only marginally in the coming years because the traffic-light coalition plans to pursue a tighter housing policy (see above). This will not change in the face of higher inflation. The lower cap limits average annual rent hikes under existing tenancy contracts to 3.66% p.a. in tight markets. And in many cases, the obligatory comparison with rents for similar apartments in the relevant city will keep rent hikes even lower. Moreover, policymakers will probably welcome declines in real rents and regard them as a setoff to the highly investor-friendly trend in house prices during the last few years. Indexed and staggered rents may be a solution. However, they are quite unusual in Germany, and many tenants may refuse them. Overall, rents are therefore unlikely to offer protection against inflation.

Outlook: Borrowing may protect against inflation, provided that the money is used wisely

At about 60% of GDP, household debt is relatively low in Germany. The average ratio for other industrial countries comes to 80%. Moreover, mortgage debt in Germany amounts to about 47% of GDP, i.e. the same level as in 2009. In fact, the ratio temporarily dropped below 40%. Higher borrowing may protect many investors effectively against inflation. However, this presupposes that the money is used effectively. Property refurbishments, for example in order to comply with future sustainability and climate-protection requirements, may make sense. Moreover, refurbishment may become obligatory sooner rather than later.

Alternatively, the loans can be used for investments in other assets. Indexed rents and short-term tenancy contracts are quite common in the commercial property segment. Commercial real estate may therefore provide good inflation protection. Buying corporate shares may be helpful, too. However, a look at the 1970s shows that not all investments in this asset class necessarily benefit from high inflation. The average DAX return, which consists of both price gains and dividends, amounted only to slightly more than 2% per year in the 1970s. It seems probable that companies with relatively high leverage and low-risk financing structures, a well-established business model and, in particular,



Outlook for the German residential property market 2022 and beyond

Returns of different asset classes in Germany

44

annualized total returns in %

Nominal	Financial		Residential		
	Equity	Bonds	Prices	Rents	Total
1970-1980	2.2	8.1	6.3	4.9	11.5
1980-1990	15.9	8.2	1.7	4.2	5.9
1990-2000	12.1	8.5	1.7	5.2	7.0
2000-2010	-0.9	5.8	-0.1	4.4	4.4
2010-2020	9.2	4.3	5.2	6.1	11.6

Real					
1970-1980	-2.6	3.0	1.1	-0.2	0.9
1980-1990	12.8	5.3	-0.9	1.6	0.7
1990-2000	9.6	6.1	-0.2	2.7	2.6
2000-2010	-2.5	4.1	-1.4	2.8	1.4
2010-2020	7.7	2.8	4.0	4.8	9.0

Note: The implicit inflation rates differ slightly due to several different sources.

Sources: OECD, Bloomberg Finance LP, Reid, Jim (2021) Long-term Asset Return Study. Deutsche Bank Research

Macprudential regulation of the residential property market leads to target conflict for new construction

45

Against the background of current valuations and risks, tighter regulation does make sense. However, already planned and potential further regulatory requirements will not only reduce risks but may also dampen new construction. Thus, they may counteract the original goal of preventing boom-bust-cycles and their negative impact on the financial sector and the real economy, at least to some extent.

Macprudential regulation has been influenced by the financial and euro crisis, and academic literature regularly identifies credit growth and generous lending standards as two of the reasons for misallocations in the financial sector and for house-price bubbles. However, to our knowledge it does not differentiate between lending for existing properties, which tends to drive prices up, and lending for new construction, which tends to dampen prices.

In Germany and in many other countries, only aggregate lending data are collected. This may be the biggest gap in macprudential regulation. The fact that no differentiated data is available prevents targeted market intervention with minor side effects.

Source: Deutsche Bank Research

The pandemic and ultra-loose monetary and fiscal policies triggered a flight to safe havens

46

High uncertainty and the prolonged low-rate policy have triggered a flight into real assets. Across 40 OECD countries, housing prices rose by more than 10% between the beginning of 2020 and the end of 2021.

Source: Deutsche Bank Research

customers who accept price hikes did better and achieved higher returns. Commodities, whose prices are driven by global geopolitical tensions, digitisation and climate-policy-induced demand for new sources of energy, may be another source of higher returns. In addition, corporate shares and commodities can be attractive additions to a property portfolio because they are usually very loosely correlated with residential returns. All in all, investors in prudently financed residential properties may therefore benefit from higher debt.

Riskier projects and financings in particular may have to cope with regulatory headwinds

However, this statement probably does not apply to riskier financings and projects. Bold investors have regularly benefited from higher returns during the past 13 years. Now, however, the end of the house-price cycle is approaching and the macroprudential environment is likely to become tighter. The Bundesbank believes that German house prices are up to 40% above the equilibrium level. The European Systemic Risk Board (ESRB) at the ECB also sees major overvaluations. In addition, the regulators are probably concerned about the recent, strong acceleration in lending growth. By the end of 2021, mortgage loans grew at a rate of more than 7% yoy, a 20-year high. This was probably why Bafin introduced a countercyclical capital buffer of 0.75% of risk-weighted assets and a sectoral systemic risk buffer of 2.0% of risk-weighted assets for loans secured by residential properties. All major banks have sufficient equity to comply with the new rules, which are to enter into effect on 1 February 2023. However, the significant increase from the current level of 0% clearly signals that further tightening steps are planned.

Additional macprudential regulation may follow, for example in the form of income-related instruments. Income-related caps on interest-service payments and lending may reduce default risks and thus protect reckless borrowers and lenders. Moreover, debtor-based instruments for lending caps for residential properties may be introduced. This would allow Bafin to set a cap on the loan-to-value ratio and introduce an amortisation requirement, which would oblige debtors to repay a certain percentage of the loan within a given period of time. The main goal of these instruments would be to protect the banking system against defaults. Before dealing with the consequences for interest rates and risk premiums, let us take a look at inflation.

Numerous factors are potential drivers of inflation: The pandemic, the war, geopolitical tensions, climate policy, demographics and a loose fiscal policy

At the beginning of 2020, the pandemic sent shockwaves through the money and bond markets. The central banks responded with massive monetary impulses, and market rates declined accordingly. At the same time, the European governments launched major fiscal packages and stimulated demand. Combine with the supply-chain bottlenecks, these measures caused inflation to accelerate. Only a few observers warned early on of the pandemic-related and structural inflation risks. In fact, many analysts believed that the price increases would be temporary. Now, however, this perception seems to be changing. The new consensus among economists is that inflation will remain higher for longer, not least due to the war in Ukraine. The ECB has recently started to communicate a turnaround in rate policy, too. This shift was probably caused by a number of factors. Import and producer-price inflation currently amounts to c. 20% yoy. Companies can respond to this development by increasing productivity, accepting lower margins or passing on the price pressure to their customers. With their order books full, many companies will probably try and raise their prices. Structural factors such as the upcoming



Outlook for the German residential property market 2022 and beyond

retirement wave and potentially higher wage pressures, higher expenses stemming from tighter climate-policy regulation, the replacement of global with continental value chains and geopolitical tensions also suggest that inflation will remain higher in the long run. In short, there are many factors which may keep inflation (which is currently near 5%) above the 2% target.

High inflation will push interest rates up, macroprudential regulation will probably lead to higher risk premiums

High inflation implies monetary tightening. We expect net bond purchases to end during the third quarter of 2022 and forecast the first rate hike by 0.25% for September. We anticipate quarterly rate steps afterwards, which should lift the deposit rate to +0.50% by mid-2023. Capital market rates look set to rise further, too. Before the war, Bund yields rose and climbed from -0.39% in December to currently about 0.50%. The war in Ukraine dampened them only for a short time. We expect yields to rise further to 0.80% during the remainder of the year. 10y swap rates have risen even more strongly, to more than 1.00% right now. We expect them to climb above 1.20% during the remainder of the year. By end-2022, 5-10y mortgage interest rates will probably come in at 2.45%. The ECB may be forced to tighten monetary policy further up until the end of 2023. This may drive mortgage rates up to 2.95%. This means that the low-rate environment will be a thing of the past at least in the foreseeable future, and rate hedges may turn out to be a reliable method to protect financing and wealth.

Despite the expected rate increases, real interest rates should remain very low so that credit demand should remain high. There is therefore a risk that credit and house-price growth remain strong. As a result, macroprudential tightening (see above) will be used to counteract the development in order to limit lending to bolder investors in particular. Regulators will mainly target riskier financings. If regulatory rules are tightened, there will be fewer incentives for banks to finance risky projects – or else they will demand significant risk premiums. Riskier projects may turn out not to provide inflation protection after all when higher risk premiums are demanded for refinancings. In contrast, prudently financed projects may benefit from higher borrowing. Banks may find it considerably more attractive to offer loans for such projects.



Outlook for the German residential property market 2022 and beyond

5.3 Valuation: Complicated interaction between inflation and interest rates

We will now use our valuation model to calculate the impact of inflation on theoretical prices. Starting with our baseline assumptions, we differentiate between the real and the price components of house prices and rents. Moreover, we determine a factor from the [0,1] interval for each variable. 0 means that higher inflation has no influence at all on the variable, whereas 1 means that the impact is felt in full. We assume a factor of 1 for house prices. This means that house prices move in step with consumer-price inflation. The pick-up in inflation was probably one reason behind strong house-price growth during the pandemic, and we believe that inflation will continue to be fully reflected in house prices and thus influence the re-selling value at the end of the investment period. In contrast, we put the factor for rents only at 0.2. Moreover, we assume an inflation rate of 1%, which is roughly in line with the average for the past decade. Chart 47 summarises our extended baseline assumptions.

According to our valuation model, higher inflation pushes rents and in particular house prices up. In turn, the theoretical fair prices rise strongly. Price and rent growth shall remain constant in real terms so that any and all changes in valuation are inflation-induced. If inflation accelerates from 1% to 2% and mortgage rates remain unchanged at 1.19%, the fair price per sqm jumps from EUR 3,600 to more than EUR 6,000. Since higher inflation will drive up interest rates as well, this result probably exaggerates the actual development. Assuming a mortgage rate of 2.5%, the fair price drops to EUR 5,800, and assuming a rate of 3.5%, to EUR 5,500. This means that higher mortgage rates tend to dampen fair prices slightly, at least compared to the significant effect of house-price developments. Chart 48 shows how prices, rents and mortgage rates interact. Higher borrowing also increases theoretical fair prices, if only slightly, similar to rate hikes. As a rule of thumb, reducing the equity share by 1 pp will increase fair sqm prices by about EUR 10. However, as explained above, this does not apply to the return on equity, which is very sensitive to a lower equity share. Our interim conclusion is: under our assumptions, residential properties provide inflation protection mainly via price growth.

Extended baseline assumptions for our present value model to gauge the impact of inflation on valuations

47

in % p.a. exceptions are marked

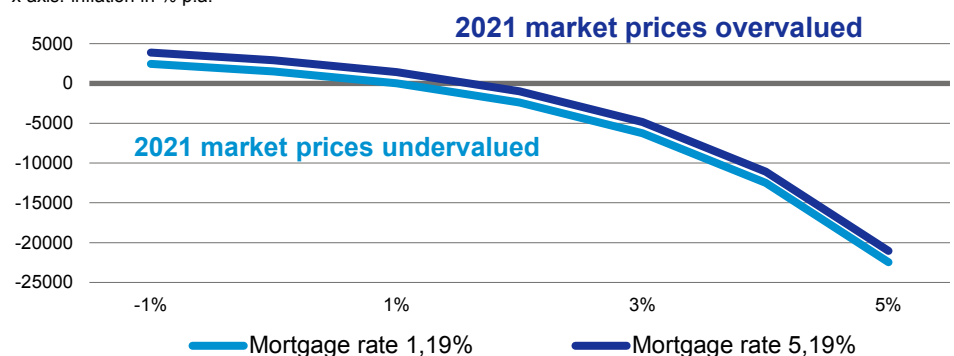
Inflation	
CPI	1.0%
[0,1]-Intervall	
Price growth	1.00
Rental growth	0.20
Real variables	
Price growth	3.2%
Rental growth	1.8%
Nominal variables	
Price growth	4.2%
Rental growth	2.0%

Source: Deutsche Bank Research

126 cities: Inflation-based valuation vs. market prices

48

y-axis: overvaluation in EUR pro sqm
x-axis: inflation in % p.a.

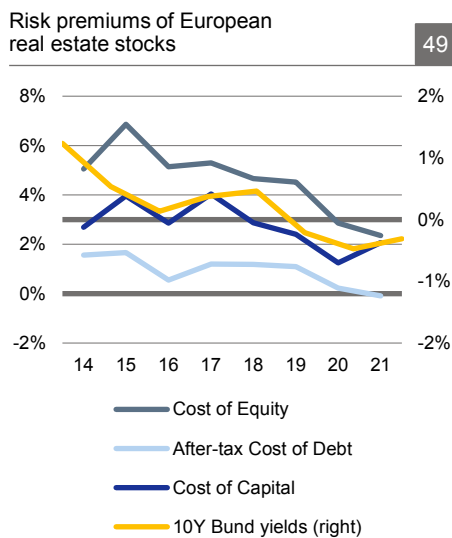


Sources: bulwiengesa, Deutsche Bank Research



Outlook for the German residential property market 2022 and beyond

Abrupt increase in risk premiums may trigger a revaluation



Sources: Aswath Damodaran, Deutsche Bank Research

However, the low interest-rate sensitivity of our valuation model only applies under our assumptions. We will now extend the assumptions and vary the discounting factors. Calculations by Aswath Damodaran and our own calculations show that risk premiums for European real-estate equities dropped in line with government bond yields during the last few years. It seems likely that the German residential market developed in a similar way. This means that higher interest rates will drive up not only Bund yields, but also risk premiums. We assume that these general valuation parameters change abruptly. As long as institutional investors in particular plan to hike the share of real-estate investments in their portfolios further (which means that they are the marginal investor in the German residential market), small rate changes have only a minor effect (see above), not least because bonds are very unattractive when interest rates rise. During a period of inflation-induced interest-rate increases, bonds will certainly lead to losses up to the time when the uptrend in interest rates stops. This general rule becomes particularly important if interest rates start to rise from zero or even a negative level, as is the case today. Moreover, a massive revaluation on the bond market may make investors demand ever higher risk premiums. They may delay their market entry and thus push bond prices down even further until private-sector investors regard the yields as attractive again.

Up until then, the German residential market will remain an attractive bond substitute. However, once interest rates reach a certain level, we may see an abrupt revaluation if interest rates rise further. As soon as bond yields appear attractive again, demand for residential properties may collapse overnight. It is difficult to identify this turning point. Based on our experience, the insufficient coverage of many pension funds and the steady decline of residential rent yields, it is probably reached when Bund yields amount to between 2% and 4%. Our analysis of the valuations in A, B, C and D cities has shown that this level may trigger significant reactions in valuations. Increasing the discount factor from 367 bp (our baseline assumption) to 467 bp already reduces the fair model price from EUR 6,000 to c. EUR 2,000. Macroprudential regulation and monetary policy will try to prevent such a massive revaluation or at least smooth it out. However, they will succeed only if they do not have an inflationary impact themselves.

The inflationary spiral of the 1970s did not end until the beginning of the 1980s. The “Volcker shock”, named after the then Fed chairman, brought inflation back under control, but also contributed significantly to the crisis in Latin America. This historical experience shows that global macroprudential risks are quite high at the moment. A rate shock is unlikely to remain limited to Germany or the euro area; in fact, interest rates in the UK and the US are currently rising more quickly than in the euro area. In the past, global economic and financial crises have increased demand for residential properties in Germany. However, this argument is losing weight as prices rise. A renewed flight to safety might involve significantly lower demand impulses for the German residential market than during former rate shocks.



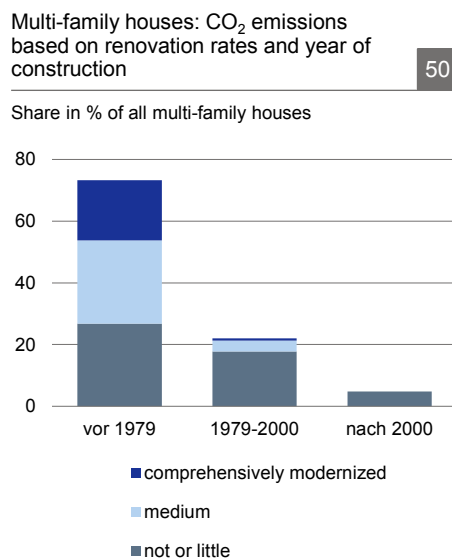
Outlook for the German residential property market 2022 and beyond

6. The impact of climate policy on the German residential market

Pursuant to ARGE³ calculations, the residential sector emitted 132 million tons of carbon equivalents in 2020.⁴ Total emissions roughly remained at the level of the preceding years. According to our calculations, emissions will need to be reduced to c. 74 m tons by 2030.⁵ The different types of buildings have different shares in total emissions. In Germany, there are about 16 million one- and two-family homes and 3.2 million condominiums.⁶ Overall, condominiums provide 40% of total residential space, and they also have a share of c. 40% in total residential emissions.

Refurbishments of residential properties built before 1979 play a particularly important role in the efforts to reduce emissions. After the second world war, residential space was urgently needed and quality considerations took second place. It was not until the oil crises of the 1970s that energy saving became an issue. The first Thermal Insulation Ordinance of 1977 was the first legal text that imposed minimum requirements to reduce the loss of heating energy from windows and heating transition. Buildings constructed before that year are often not very energy-efficient. About 73% of all condominiums were built before 1979; in fact, many of them date from shortly after the war. According to the ARGE, about one-third of them are fully refurbished, with another third being to a significant extent refurbished and the last third not or only marginally refurbished. Another 22% of the condominiums were built between 1980 and 2000 and less than 5% after 2000.

Cooling, lighting and power needed for electronic devices play only a small role for total household emissions. About 90% of the total emissions stem from energy consumption for heating and hot water. That is why the focus is on the energy-efficient refurbishment of buildings, in particular on installing low-emission heating systems and insulation systems. It will probably be necessary to replace oil and gas-fired heating systems to reach the carbon targets for the construction sector. The Fraunhofer Institute estimates that by 2045, about 90% of all homes will be heated by district heating and heat pumps.⁷ While district heating requires municipal investment, heat pumps are building-specific investments.



Sources: ARGE, Deutsche Bank Research

Energy refurbishment raises valuations

Based on our valuation model, we estimate the financial impact of energy refurbishment for our sample condominium described above (675 sqm of living space and 9 flats). We assume that the building is refurbished directly after the purchase in line with the requirements of the Building Energy Act. We combine our valuation model with parameters and calculations by INATECH and Fraunhofer Institute.⁸ We assume that putting in a bivalent heat pump with a gas boiler as a second source of heat costs EUR 25,700. The refurbishment of the building shell shall cost EUR 153,500.⁹ Chart 51 gives an overview of the

³ Walberg, Dietmar, Timo Gniechwitz, Klaus Paare and Thorsten Schulze (2022). Die Zukunft des Bestandes. Bauforschungsbericht Nr. 82. Kiel, February, Wohnungsbau.

⁴ For comparison: According to estimates by the Federal Statistical Office, direct household carbon emissions amounted to 125.8 million tons in 2019.

⁵ According to official calculations, the real-estate sector emitted c. 119 m tons of carbon in 2020. The official target for 2030 is 67 million tons. Based on this ratio between official and unofficial figures, 74 m tons in 2030 seem a likely target.

⁶ About 52% of all apartments are situated in condominiums. Their average size is 70 sqm.

⁷ See Brandes et al. (2021). Wege zu einem energieneutralen Energiesystem, Fraunhofer-Institut für Solare Energiesysteme ISE, Freiburg, November 2021.

⁸ Stefan Hess et al. (2021). Techno-ökonomische und ökologische Perspektiven für Wärmepumpen im Mehrfamilienhaus-Bestand. DKV-Tagung 2021.

⁹ Our sample condominium has 9 apartments and 675 sqm of living space. The Fraunhofer Institute uses a sample condominium with 12 apartments and a total living space of 908 sqm. The



Outlook for the German residential property market 2022 and beyond

Investment expenses for a bivalent heat pump and a gas boiler

51

Envelope components	EUR k
window	16.8
facade	57.4
roof	57.1
lower floor	18.1
scaffold	4.2
Total	153.5
Heating components	
gas boiler	5.3
Storage space heat	1.5
Storage drinking hot water	1.7
Heat pump air/water	17.3
Total	25.7
Costs ex subsidies	
Funding rate	25%
Building envelope	115.1
Heating system	19.3
Total	134.4
per residential unit	14.9

Original data: Stefan Hess et al. (2021): Costs see table 7 and 8. Area of the multi-family house 908 sqm. Costs broken down by rule of three to our multi-family house with 675 sqm.

Source: Deutsche Bank Research

Rent increases due to investments

52

Modernization costs	EUR
per sqm in euro	199.18
8% allocation per annum	15.93
8% allocation per month	1.33
2021 pre modernization	
Monthly rent per sqm	10.18
Annual rent per sqm	122.13
2022 post modernization	
New annual rent	138.06
New monthly rent	11.51

Source: Deutsche Bank Research

expenses for the individual components. Once the state subsidies are subtracted, the investment amounts to EUR 134,400 overall or EUR 14,900 per apartment. Landlords are permitted to increase rents by 8% of the investment sum after refurbishment works. This results in a rent increase by EUR 1.30/sqm, which is below the legal limit for rent hikes after refurbishment.¹⁰ For our 126 cities, this would lift average rents (weighted per capita) from EUR 10.20 to c. EUR 11.50.¹¹ For investors, energy refurbishment is attractive because it enables them to raise rents above the local average for comparable apartments. According to our baseline assumptions, the valuation will increase from EUR 3,600/sqm to EUR 4,000/sqm. This raises the value of each apartment by about EUR 30,000, which is more than double the invested sum. In addition, the initial annual return on equity will rise from 10.0% to 10.8%. The calculations of the Fraunhofer Institute for Solar Energy Systems¹² imply that carbon emissions drop by c. 75%. Accordingly, a high refurbishment rate may help to reach the carbon emission targets for 2030.

Carbon emissions target for 2030 is highly ambitious

However, there are many hurdles on the way towards making real estate fully climate-neutral. Installing a new gas boiler is much cheaper and putting in a modern heating system today may actually prevent owners from benefiting from even better technical solution in the coming decades. These are incentives to wait. Moreover, there may be technical hurdles such as a lack of space for downhole heat exchangers and heat pumps. Many landlords may be reluctant to undertake energy refurbishments because tenants may move out if their rent is increased. The Fraunhofer Institute data suggest an investor-tenant dilemma, which is borne out not only by our sample, but also by many other studies. Running expenses for a 75 sqm apartment may decline considerably thanks to energy refurbishment. However, the total savings will depend on oil and gas prices. According to the heating survey ("Heizspiegel") for 2020, a year with very low energy prices, heat pumps were more expensive than oil and gas heating systems. In contrast, heat pumps probably caused lower costs in 2021 and probably also in 2022. Nevertheless, any savings are below the additional money spent on rents after refurbishment-related increases. Calculated rents increase by almost EUR 1,200. While landlords will be able to find new tenants quickly in metropolitan areas, where living space is in short supply, this dilemma probably reduces incentives for energy refurbishment outside metropolitan areas and in regions with weak infrastructure. In addition, the construction industry has been working at almost full capacity for years now, and the widespread lack of qualified workers hampers refurbishment. The refurbishment rate would probably need to at least double in order to meet the carbon targets for 2030. It currently amounts to c. 1% of all existing residential buildings. ARGE also points out that many non-refurbished buildings may be due for replacement. Tearing them down and building them from scratch may be cheaper and produce fewer emissions than refurbishment. Moreover, the refurbished space tends to decline while costs increase (chart 55). The lack of building materials has probably driven up expenses considerably. And finally, there is a micro-macro dilemma. Our examples confirm that energy

heat pump costs EUR 25,966 and the renovation of the building shell c. EUR 206,515. We have taken into account the difference in living space to calculate the figures for our condominium.

¹⁰ At least if rent were not hiked at any other time during the past six years.

¹¹ This figure may exaggerate the increase in rents. Since most of the energy refurbishment has taken place in metropolitan areas and large cities so far, the retrofitting efforts will have raised rents strongly in these areas. It may therefore make sense not to include these buildings to calculate additional rent increases from energy refurbishments. However, we cannot quantify the effect. Still, the increase in monthly rents by EUR 1.30/sqm and the general effect on valuation will remain unaffected.

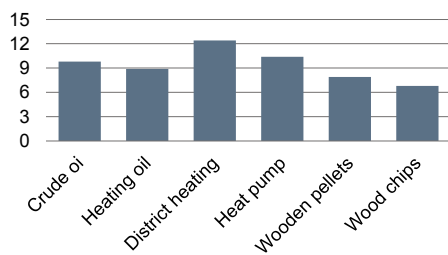
¹² Stefan Hess et al. (2020). Einsparung von CO₂-Emissionen und Betriebskosten durch Wärmepumpen in Mehrfamilienhäusern. System-Analysen im Projekt LowEx-Bestand.



Outlook for the German residential property market 2022 and beyond

2020 Average heating costs 53

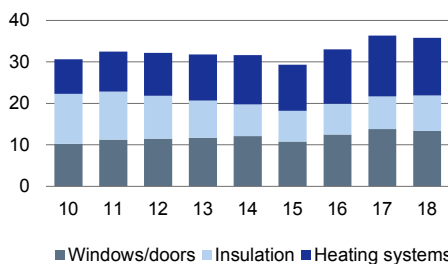
Euro per sqm living area



Sources: heizspiegel.de, Deutsche Bank Research

2010-2018 Investments in energetic residential renovation ex PV 54

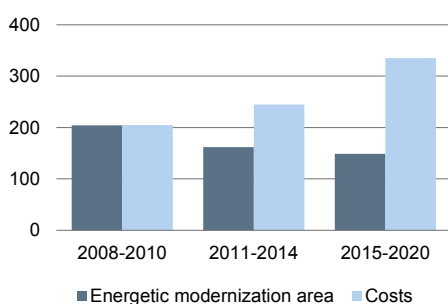
EUR bn



Sources: Deutsche Bank Research, DIW

2008-2020 Energetic modernisation: Costs and area 55

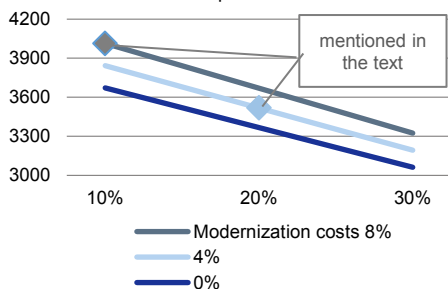
m sqm or EUR per square metre



Source: ARGE

126 cities: Valuation dependent on maintenance and modernisation cost allocation 56

y-axis: valuation in Euro per sqm
x-axis: maintenance in % p.a.



Source: Deutsche Bank Research

refurbishment pays off and reduces carbon emissions. According to the German Institute for Economic Research (DIW), investments in the energy refurbishment of residential buildings totalled c. EUR 360 bn between 2010 and 2018. However, carbon emissions from buildings declined slightly at best during this period.¹³ Several factors may play a role here (see chart 58).

Valuation implications of tighter regulations

Regardless of the reasons, all these hurdles show that policymakers will probably adopt even more restrictive climate-policy regulation in order to have at least a chance to reach the carbon goals for 2030. The traffic-light coalition has already tightened the climate-policy rules in its coalition agreement. From 2025, renewable sources are to provide at least 65% of the energy needed for newly installed heating systems. From 2024, any extension and conversion projects of existing buildings will need to comply with the energy-efficiency standard 70. In order to resolve the investor-tenant dilemma, policymakers are considering including part of the heating costs in the net rent. This would divvy up heating costs among landlords and tenants. Rent hikes due to refurbishment costs will then be included in the rent. From investors' vantage point, energy refurbishments will probably become less attractive. It would not come as a surprise if refurbishment were to be made obligatory under certain conditions. Higher energy costs due to rising carbon prices will probably be shared by landlords and tenants in the coming months. It would not come as a surprise if the traffic light coalition adopted further measures at the expense of landlords.

Refurbishment expenses may therefore feed through to rents to a lesser extent than so far. At the same time, maintenance costs may rise considerably due to climate policy and increasing damage to the environment. Chart 56 shows the consequences for our valuation model. If maintenance costs doubled to 20% per year and rent hikes due to refurbishments were reduced to 4%, the theoretical fair value would drop from EUR 4,000 to EUR 3,500/sqm. Starting from our baseline assumption of EUR 3,600, energy refurbishments would then imply a valuation loss. The initial return on equity would drop from 10.8% to 8.6%. This means that new regulation may have a significant impact on residential-property valuations and contribute to the end of the cycle.

¹³ Stede, Jan, Franziska Schütze and Johanna Wietschel (2019). Wärmemonitor 2019: Klimaziele bei Wohngebäuden trotz sinkender CO₂-Emissionen derzeit außer Reichweite. DIW-Wochenbericht.

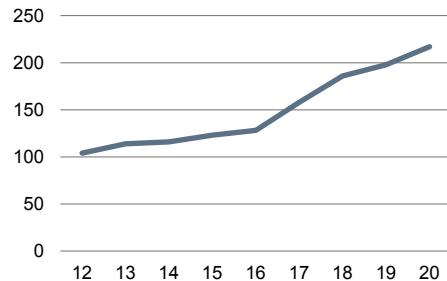


Outlook for the German residential property market 2022 and beyond

Lack of qualified workers: Plumber, sanitary, heating, air conditioning

57

Cast time for job vacancies in days



Professional group 342 in accordance with the classification of occupations in 2010

Source: Arbeitsagentur

Micro-macro dilemma: Despite comprehensive energy refurbishments worth c. EUR 360 bn between 2010 and 2018, carbon emissions did not decline much during this period. Potential reasons:

58

- More inhabitants
- More space per capita
- Declining insulation effect of energy refurbishments over time
- Shoddy craftsmanship
- Inadequate or counterproductive user behaviour

Source: Deutsche Bank Research

How is the market likely to be segmented?

The owner ratio has hardly changed during the boom years and still amounts to c. 47%. On average, German households move about ten times during their lives. Due to high ancillary costs linked to the purchase of a home or condominium, many people live in rented apartments. In addition, many households do not have the necessary capital. The average apartment size is 70 sqm. Assuming a purchase price of EUR 3,600/sqm for our 126 cities, this translates into a net purchase price of EUR 252,000 and a gross purchase price (including ancillary expenses) of c. EUR 277,000. If 20% of that total are to be financed by own capital, households need at least EUR 55,000 to buy their home. That means that, based on standard financing assumptions, about half of the households do not have sufficient money to buy a home.¹⁴ This segmentation already existed in the past and probably became more pronounced during the boom of the past 13 years. Energy refurbishments are likely to play a role in this trend, too. In our example, they will raise the gross purchase price to c. EUR 294,000 and the necessary own capital to almost EUR 59,000.

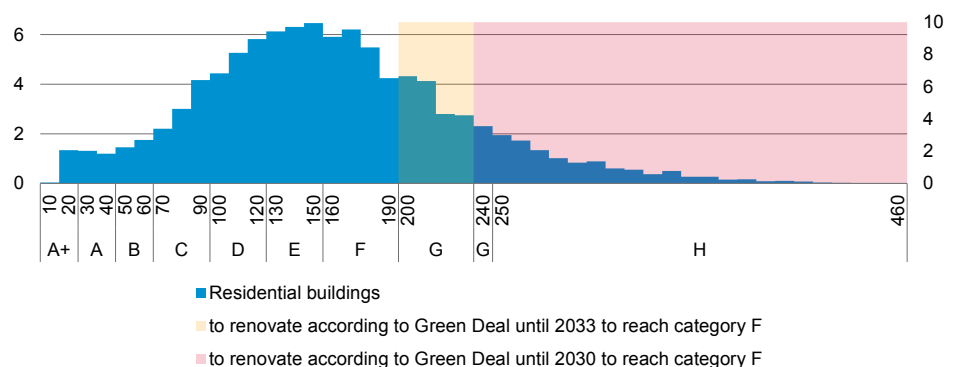
Moreover, energy refurbishment will create two sub-markets for residential buildings, one for refurbished and one for non-refurbished buildings. As described above, refurbishment works will increase valuations and, in turn, market prices and rents. While across all income and wealth strata, people are probably quite willing to help to make Germany's buildings climate-neutral, the additional expense involved will weigh on consumption. Low-income and low-wealth households in particular may therefore prefer non-refurbished apartments. The current refugee wave may increase demand for cheap living space further, seeing that Ukraine's per-capita GDP amounted to c. EUR 3,500 in 2021. Due to potentially high demand for less expensive living space, the share of "stranded assets" (i.e. properties which can be neither sold nor let) is likely to be very small. Most of these properties are probably situated outside metropolitan areas.

At the same time the supply of non-refurbished apartments looks set to decline. Apart from the national climate-policy targets, the EU Green Deal is to be implemented. It sets concrete goals for building refurbishment. Existing buildings are categorised by energy efficiency. The 15% in the lowest category need to be refurbished by 2030, the 15% in the second-lowest by 2033. Thus, buildings which belong to the categories H and, to some extent, G on the national scales need to meet the category F requirements by 2030, with the remainder of the G

Residential buildings: Distribution of heating energy consumption

59

y-axis: share in % of total residential buildings
x-axis: kWh per sqm and German energy efficiency classes



Sources: wohngebaeude.info, Deutsche Bank Research

¹⁴ Grabka and Halbmeier (2019). Vermögensungleichheit in Deutschland bleibt trotz deutlich steigender Nettovermögen anhaltend hoch. DIW-Wochenbericht.



Outlook for the German residential property market 2022 and beyond

category to follow by 2033. While these figures refer to the complete range of existing residential buildings, the percentages for condominiums are likely to be similar. ARGE points out that implementing the Green Deal implies raising the refurbishment ratio from currently 1% to up to 3%. This seems unrealistic in view of the numerous problems described above.

Some investors, for example senior small landlords, may be willing to sell simply because they do not want to make the effort. That means that prices for non-refurbished or difficult-to-refurbish properties may rise less or come under pressure earlier than prices for refurbished properties. Opportunistic investors may regard this as an opportunity, buy buildings at relatively cheap prices and hope that the refurbishment obligation envisaged by policymakers turns out to be impossible to be enforced at least for some years to come due to the numerous hurdles described above.

7. Summary and outlook for German metropolises and metropolitan regions

7.1 Market prices tend to be overvalued

All analytical approaches presented in our residential property outlook 2021 implied an end of the cycle during the current decade. The median was for 2024. We have repeated and extended these analyses here. In absolute terms, the prices for residential space in European and global cities show that, just as in the last few years, German cities have moved up in the rankings of the most expensive cities. If this trend continues, market prices will be considerably overvalued at least in the longer run. To some extent, however, the development is simply a function of high incomes in Germany. Only 16 out of the 84 cities with the highest price-to-income ratios in Europe are situated in Germany. At the same time, the analysis of the OECD affordability indices points to significant overvaluations in Germany, both compared to national and international history. The price-to-income and price-to-rent indices are both clearly above the long-term national averages. International comparisons which span several decades show that the price-to-income index will reach the threshold that suggests an end of the cycle in 2023; the price-to-rent index has already passed this level.

Valuations according to the present value model reflect expectations of persistently strong price growth and persistently low interest rates

Our present value model also points towards overvaluations. It shows which expectations are currently being priced in. Current market prices appear justified if we expect persistent price growth of 4.2% p.a. This rate appears low compared to strong growth of almost 7% on average during the past 13 years; however, during the 40 preceding years, house prices were up on average only 2.5% p.a. Moreover, interest rates have steadily declined during the past decades, driving prices up. This combination is unlikely to be repeated. Quite the contrary; in fact, high inflation points to interest hikes. Higher interest rates will not only make borrowing more expensive but may also lead to a revaluation of discount factors in the long run. During the last few years, lower interest rates have probably led to lower risk premiums and therefore lower discount factors for future payments. If investors reconsider, the theoretical fair prices may decline considerably. As we have shown, the revaluation may take place abruptly if interest rates rise strongly.



Outlook for the German residential property market 2022 and beyond

Our present value model sends clear alarm signals. In many cities, the reselling price is quite important, particularly compared to cash flow from rents. In some cities, our assumptions even imply negative regular cash flows, which means that valuations are based only on the future reselling value. Investors buy properties only to resell them at a higher price in the future. This is a typical feature of a bubble. The observation applies mostly to metropolitan areas and some cities in southern Germany, where initial returns on equity are significantly below 3% p.a.¹⁵ In these cities, marginal investors clearly treat properties like bonds with a negative coupon.

On average, initial equity returns on equity are at about 10% p.a. This relatively high percentage shows why the residential market is still attractive for many investors. Even if we change the valuation parameters, the observation is still valid in principle. This provides investors with an incentive to earn the high initial returns on equity. There is, in turn, a risk that investors, in particular those who have been successful so far, buy more properties. This may drive prices up even more. Macroprudential countermeasures are therefore on the cards.

Comparison of the results of the present value model with past absolute and relative, national and international prices

There are numerous different approaches for determining the fair price, which raises the question of which measure is best suited for our purpose. The OECD affordability indices and the present value model point to overvaluations. However, a comparison with international prices (both in absolute and in relative terms) suggests that house prices in Germany are not excessive. This discrepancy probably reflects the fact that monetary policy has been very loose around the world since the financial crisis. Monetary policy aimed to prop up inflation and has led to considerably higher prices for bonds and, in turn, real estate. Between the second world war and 2000, 10-year Bund yields averaged c. 7% p.a. The slide down into the negative area is probably why present value models have tended to lose importance during the last few years and international comparisons have been more helpful for assessing the market situation. If, according to the present value model, the German residential market is overvalued and is beginning to show signs of a bubble in some areas, the same applies to much of the global residential markets and possibly to all capital markets, at least to some extent. Ultimately, investors can only choose between markets that are overvalued to different extents.

As higher inflation should raise interest rates, real-estate models such as the present-value model may gain importance once again. However, the extremely high indebtedness of many governments and companies indicates that a return to former rate levels is improbable. First, the ECB has already announced that it will keep its balance-sheet bond holdings unchanged until the end of 2024 at least and replace maturing bonds. Second, it will continue its asymmetrical purchases of government bonds in order to prevent excessive rate increases and market-adequate risk premiums. This suggests that a mix of international comparisons and valuations under a present-value model may be the best way to value properties.

7.2 Residential real estate provides only limited protection against inflation

Residential investments are a particularly good protection against inflation if house prices and rents rise in step with inflation. In the current market

¹⁵ Note: Why are initial returns on equity positive? Annual repayments increase equity but reduce cash flows.



Outlook for the German residential property market 2022 and beyond

environment, with still limited supply of housing space, higher inflation will drive up house prices. As rent increases are limited by law, however, rents offer almost no protection against inflation. Higher borrowing and low real interest rates may also provide protection against inflation. In fact, real interest rates will remain negative for some time to come. Thus, investors who have borrowed money to invest in residential real estate will continue to benefit from paying back less (in terms of purchasing power) than they have borrowed. In principle, this effect magnifies with the size of the loan. High inflation may therefore be one of the reasons behind the recent, strong pick-up in credit growth. However, from our vantage point the near end of the cycle and the macroprudential environment should make investors cautious about high loan-to-value ratios. The recently announced increase in the Bafin's capital and systemic risk buffers may be just the first step in a tightening cycle. Financing for riskier projects in particular looks set to become considerably more expensive. Thus, higher borrowing as a protection against inflation may be interesting mostly for conservatively financed projects with relatively low loan-to-value ratios. We have included these considerations in our present value model and distinguished between real and price effects. Our model implies significant nominal valuation gains thanks to strong price growth as inflation accelerates. However, a look back at the 1970s, the last decade with high inflation, puts the risks into the limelight. At the beginning of the 1980s, a rate shock helped to get inflation back under control. As a consequence, real valuation gains during the 1970s were offset during the 1980s. If inflation remains high, we are in for a similar scenario. And if higher interest rates lead to a revaluation of expected returns, the discount factors in our model may rise considerably. In that case, theoretical fair prices as calculated by our model would decline considerably and the market would be massively overvalued.

Pandemic and refugee wave have contradictory effects on fundamental supply shortage

The pandemic has reduced immigration. At the same time, new construction boomed during the pandemic so that fundamental supply shortages were reduced. In fact, our calculations imply a surplus for 2021. We assume that the refugee wave will temporarily lead to bottlenecks in 2022, which will, however, soon be resolved. Our projections are based on relatively strong net immigration of more than 300,000 people per year. This means that the fundamental supply shortage may be resolved permanently, despite high immigration in the coming years.

Envisaged climate policy measures to weigh on valuations and returns on equity

According to our calculations, energy refurbishment has increased valuations. However, the new climate-policy measures will reduce incentives to refurbish. If rent hikes after refurbishment are capped at a lower percentage, such measures may become unattractive for investors. In addition, landlords will probably have to make a contribution to climate protection. Theoretical fair valuations, as calculated by our present value model, may decline by several hundred euros. Moreover, these expenses reduce initial returns on equity. All in all, climate policy may make the German residential market less attractive and provide another factor for the end of the price cycle.

Conclusion: Our main message is again that the cycle will probably end during the current decade. 2024 still seems a plausible option



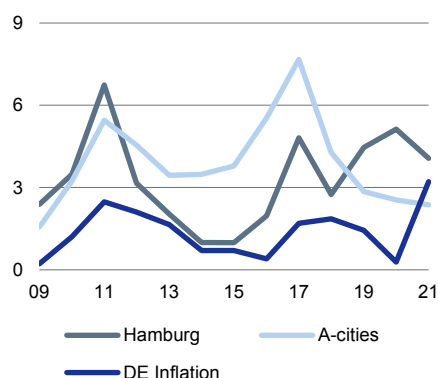
Outlook for the German residential property market 2022 and beyond

Our different price models suggest that the end of the cycle is near. The refugee wave and potentially higher inflation in the coming years may delay the end of the cycle. In contrast, tighter climate-policy measures and lower financial incentives for energy refurbishment may bring it forward. Overall, the situation does not seem to have changed much compared to our outlook for 2021. Moreover, our subjective impression is that “2024” has taken on a life of its own as the end-year of the cycle. Many market participants seem to be relying on our 2021 analysis. Based on all relevant factors, we come to the cautious conclusion that the cycle may end in 2024. In any case, we think it is very probable that the cycle ends during the current decade. That is why we continue to recommend caution when it comes to risky financings.

7.3 Highly different fundamental market situations and valuations in the different metropolises and metropolitan areas

Inflation vs. re-letting rents
in Hamburg and A-cities

% year-over-year



Sources: bulwiengesa, Deutsche Bank Research, Federal Statistical Office

The fundamental supply shortage is already over in many cities, and it will be over in many others in the coming years. We believe that the refugee crisis will lead to temporary bottlenecks at most. Rate sensitivity will be high in areas where there is already surplus supply. Prices in these areas may decline sooner if interest rates rise. According to our projections, this will apply in particular to cities such as Bremen, Dusseldorf, Hamburg or Nuremberg. Rents in Hamburg have risen strongly during the past two years, and we expect rent growth to slow down again. In metropolitan areas excluding the metropolises itself this applies to the cities in the Rhine-Main and Rhine-Neckar regions. According to our projections, supply bottlenecks will remain in Berlin, Cologne, Hanover, Leipzig and Stuttgart.

While our calculations point to an end of the supply shortages in Munich and Heidelberg, these outcomes are probably where our method reaches its limits. The market in Munich will remain very tight. However, high absolute and relative market prices are making Munich less and less attractive. International investors in particular may regard risks as higher than return opportunities. The supply surplus in Heidelberg may be only a temporary phenomenon. Any drop in the number of inhabitants of a university city is likely to be pandemic-related and temporary. It would not come as a surprise if Heidelberg registered a fundamental supply shortage again soon.

We continue to expect particularly long cycles for Berlin and Leipzig. Berlin has become a top European research and corporate location, and we continue to see it moving towards becoming a global metropolis. Leipzig is benefiting from the economic upswing in Berlin, too. Moreover, the city is surrounded by many villages and small cities with weak infrastructure. People are likely move from these smaller towns to Leipzig. As a result, demand for housing space in Leipzig should remain structurally high and fuel the cycle for years to come.

Our analysis has shown that cities within a metropolitan region may have quite different housing markets. It is therefore necessary to take a look at each individual city. Despite this heterogeneity, there is a risk that an end to the cycle in one or two cities gives a signal to the market as a whole and triggers a cycle ending in cities where the fundamental situation and the valuations would justify further price increases.

8. Price path after the end of the cycle: Subdued correction more likely than slide

We now want to make a guess at the potential development of house prices after the peak. Using the OECD data, we compare historical paths of the longest international house price cycles we have mentioned above. We will only



Outlook for the German residential property market 2022 and beyond

consider 20 cycles, as the remaining ten are still underway. We examine the following variables: real house prices, price-to-income ratio, price-to-rent ratio, long-term capital market rates, public and private-sector debt, real GDP and inflation. Charts 62 and 63 show both the median and the quintiles. Many cycles ended in 2007 or 2008, when not only house prices, but also GDP dropped in many countries. In addition, several financial companies collapsed. These systemic crises are highly different from isolated, real-estate specific cycle endings. The Japanese real-estate bubble, which burst in 1991, is another example of a systemic crisis. It was one of the largest misallocations in economic history and weighed on the Japanese economy for more than a decade. Overall, 13 cycles belong to the “systemic crisis” group and only 7 do not.

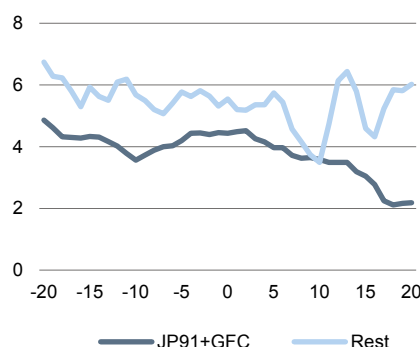
Major differences between cycle endings accompanied by a systemic crisis and isolated cycle endings

Real prices tend to return to the medium price path after the peak. After a systemic crisis they usually drop by 19%, after isolated cycle endings only by a few percentage points. The same applies to the price-to-income and the price-to-rent ratios. Long-term capital market interest rates also differ markedly. In case of a systemic crisis, long-term rates tend to halve, from 4.4% at the peak of the house-price cycle to 2.2% after five years. After isolated cycle endings, interest rates only decline from 5.5% to 3.5% within 2 ½ years and recover strongly afterwards. GDP growth slows after the peak after isolated cycle endings but remains positive. In contrast, a recession sets in after a systemic crisis. The economy reaches the trough after five quarters and GDP shrinks by more than 3%. The recovery path is significantly lower than before the price peak. Inflation develops similarly in both groups during the first four quarters. Afterwards, stronger growth after an isolated cycle ending leads to higher inflation than after a systemic crisis. Both government and household debt in % of GDP rise strongly after the end of the cycle. However, the economic problems after a systemic crisis cause debt to rise more strongly in both sectors.

Long-term bond yields

61

y-axis: in %
x-axis: +/- 20 quarters, 0 = peak



Sources: Bloomberg Finance LP,
Deutsche Bank Research, IMF

Baseline scenario for the German residential market: Isolated cycle ending

This analysis can be transferred to the expected ending of the German house-price cycle. Assuming a cycle-end in 2024 and average yearly price increases like those registered during the entire cycle, German prices will be expensive in an international comparison, but not excessive. Moreover, we do not expect a systemic crisis in our baseline scenario. The adjustment path might follow the development seen after an isolated cycle ending, with prices declining only by a few percent. In view of the historical comparison data we believe that our assessment from the outlook for 2021 is still justified. Back then, our short analysis pointed to an 8% decline in real prices over three years. Assuming an inflation rate of 2% p.a., this suggests that nominal prices decline only by 2% between 2024 and 2026. If inflation is higher, prices will probably decline less. If we assume that prices continue to rise by 7% p.a. in both 2022 and 2023 and by 2.5% p.a. after the correction (this is the average rate for the period from 1970 to 2008), house prices will have increased by an aggregate 24% by 2030 compared to 2021. This is in line with our conclusion from 2021.

Risk scenario: Cycle ending accompanied by another crisis factor

Our analysis also suggests that, in the past, a massive drop in house prices was usually accompanied by a crisis in several sectors of the economy. A loss of competitiveness in the German car sector due to the trend towards e-mobility



Outlook for the German residential property market 2022 and beyond

and autonomous driving or massive difficulties related to the energy transition may play a role in risk scenarios. Alternatively, an emigration wave after strong immigration in the past could be seen as a risk. Or, as we have said repeatedly, persistently high inflation may lead to major interest-rate increases in order to get inflation back under control. All this may reduce house prices much more strongly than expected in our baseline scenario.

Jochen Möbert (+49 69 910-31727, jochen.moebert@db.com)



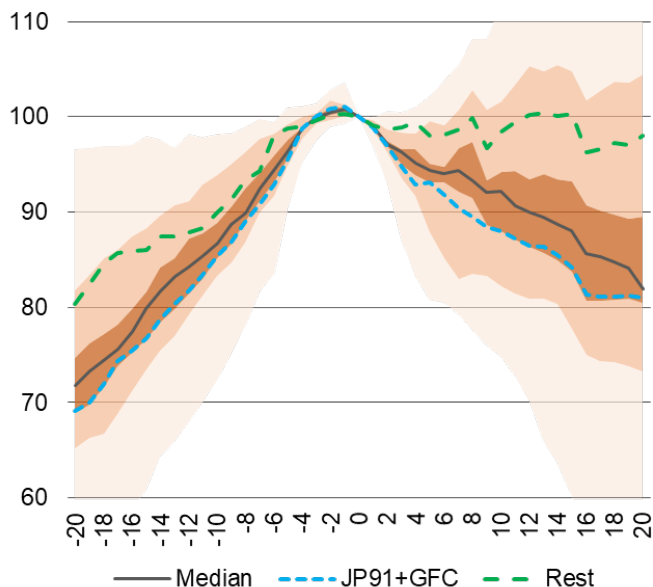
Outlook for the German residential property market 2022 and beyond

Analysis of the 20 longest complete cycles in the OECD database: Percentiles of different variables around their peaks

62

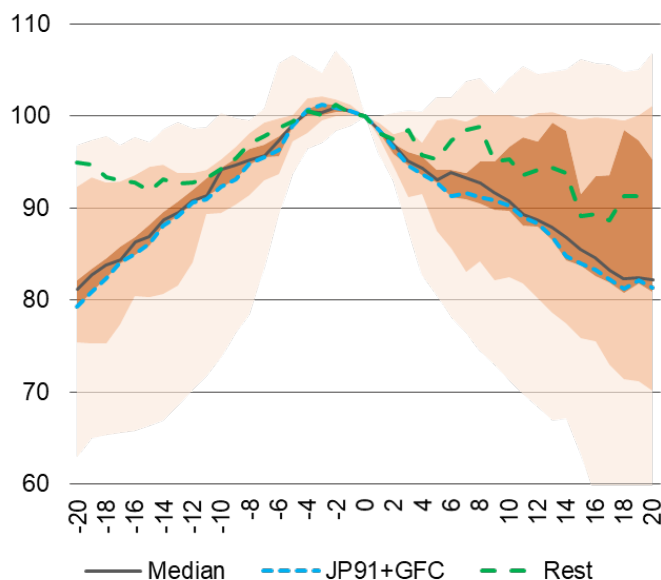
Real house prices

y-axis: peak = 100
x-axis: +-20 quarters



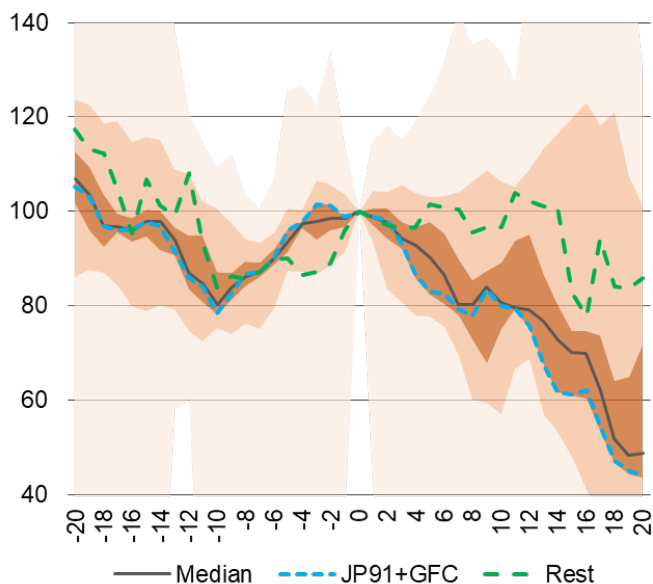
Price-to-income

y-axis: peak = 100
x-axis: +-20 quarters



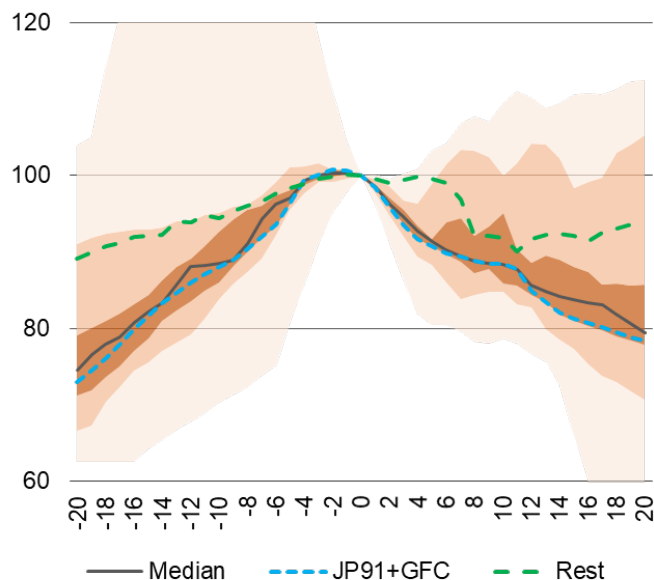
Long-term bond yields

y-axis: peak = 100
x-axis: +-20 quarters



Price-to-rent

y-axis: peak = 100
x-axis: +-20 quarters



20%-Min 40-20% 60-40% 80-60% Max-80%

Note: Median = median across all 20 countries, JP91+GFC = median of the cycles before/after the financial crisis and the Japanese bubble, which ended in 1991, rest = median of all other cycles. Data are not available for all quarters. In some cases, figures from the distant past are not available. Some cycles only ended a few years ago, which is why some of the 20 quarters are still in the future and no data are available yet. For this reason, the time series in the "rest" group are particularly volatile for the quarters 10 – 20.

Sources: Deutsche Bank Research, OECD



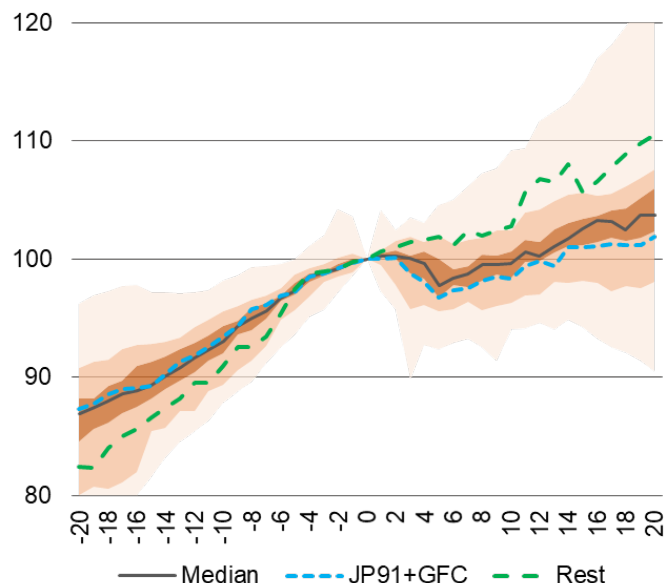
Outlook for the German residential property market 2022 and beyond

Analysis of the 20 longest complete cycles in the OECD database: Percentiles of different variables around their peaks

63

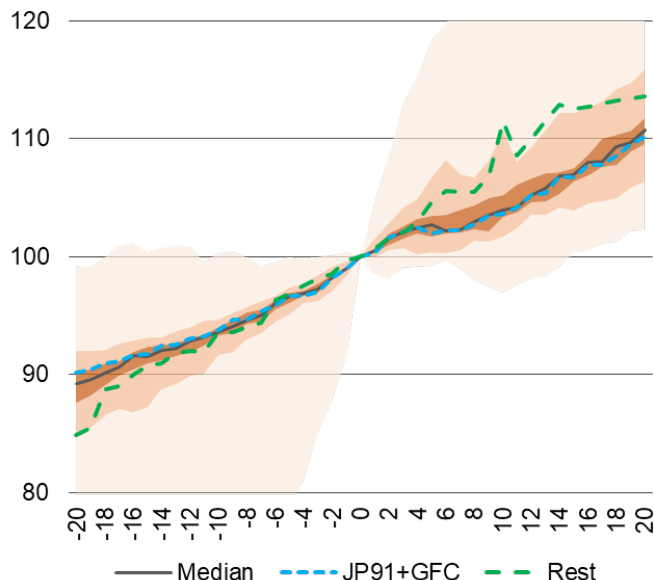
Real GDP

y-axis: peak = 100
x-axis: +-20 quarters



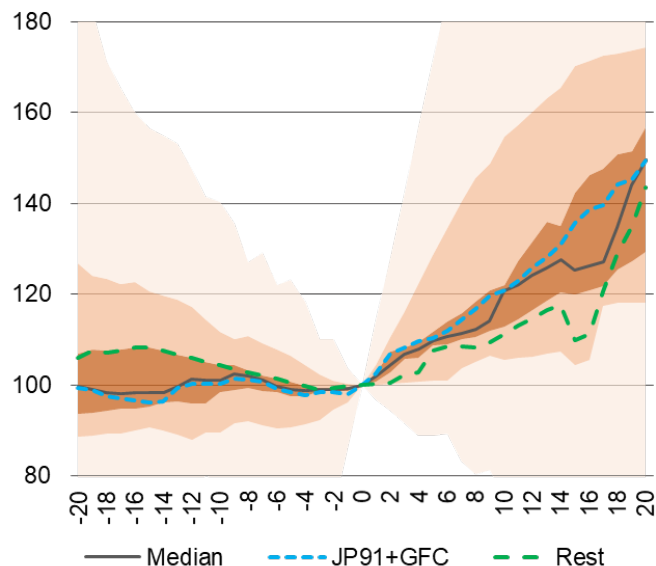
Inflation

y-axis: peak = 100
x-axis: +-20 quarters



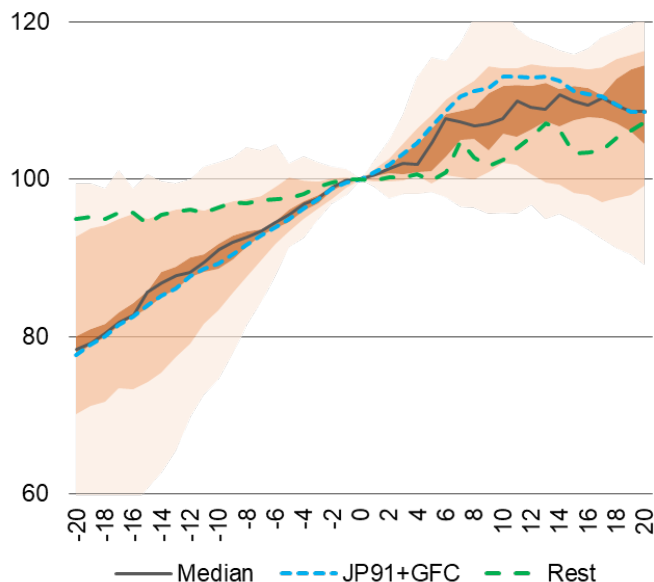
Public debt

y-axis: peak = 100
x-axis: +-20 quarters



Private household debt

y-axis: peak = 100
axis: +-20 quarters



20%-Min 40-20% 60-40% 80-60% Max-80%

Note: Median = median across all 20 countries, JP91+GFC = median of the cycles before/after the financial crisis and the Japanese bubble, which ended in 1991, rest = median of all other cycles. Data are not available for all quarters. In some cases, figures from the distant past are not available. Some cycles only ended a few years ago, which is why some of the 20 quarters are still in the future and no data are available yet. For this reason, the time series in the "rest" group are particularly volatile for the quarters 10 – 20.

Source: Deutsche Bank Research, OECD



Outlook for the German residential property market 2022 and beyond

Appendix: All formulas for the present value model

Model for buying a unit in a condominium

64

Abbreviations: sqm = square metre, MFH = condominium building

Units: interest rate, repayment rate, depreciation rate and tax rate; rent and price growth in % p.a. re-letting rents in EUR/sqm/month.

Purchase price for the unit in 2021 ($t = 0$)

$$\text{net purchase price} = \text{price per sqm} * 75 \text{ sqm}$$

$$\text{gross purchase price} = \text{net purchase price} * (1 + \text{auxiliary costs in \%})$$

Loan formulae

$$\text{loan sum}_{t=0} = \text{gross purchase price} * (1 - \text{equity share in \%})$$

$$\text{interest payment}_t = \text{loan sum}_{t-1} * \text{interest rate}$$

$$\text{repayment}_t = \text{loan sum}_{t-1} * \text{repayment rate}$$

$$\text{loan sum}_t = \text{loan sum}_{t-1} - \text{repayment}_t$$

Rent income

$$\text{rental income}_t = \text{re-letting rents}_{t=0} * (1 + \text{rental growth})^t * 12 * 75 \text{ sqm}$$

$$\text{net rental income}_t = \text{rental income}_t * (1 - \text{administrative costs/operating costs in \%} - \text{rent losses in \%} - \text{maintenance in \%})$$

Cash flow

$$\text{cash flow}_t = \text{net rental income}_t - \text{interest payment}_t - \text{repayment}_t - \text{tax}_t$$

Sale after 51 years

$$\text{net selling price}_{t=51} = \text{net purchase price}_{t=0} * (1 + \text{price growth})^{51}$$

$$\text{fair value} = \sum_{t=1}^{50} \frac{\text{cash flow}_t}{(1 + \text{Bund yield} + \text{risk premium})^t} - \frac{\text{net selling price}_{t=51}}{\text{discounted}}$$

Return on equity

$$\text{equity} = \text{gross purchase price} * \text{equity share in \%}$$

$$\text{return on equity}_t = \frac{\text{cash flow}_t + \text{repayment}_t}{\text{equity}_{t=0}}$$

Tax depreciation

$$\text{net purchase price MFH} = \text{price per sqm} * 675 \text{ sqm}$$

$$\text{net purchase price plot} = \text{price per sqm} * 600 \text{ sqm}$$

$$\text{book value condominium}_{t=0} = \frac{\text{net purchase price MFH} - \text{net purchase price plot}}{9 \text{ units}}$$

$$\text{tax depreciation}_t = \text{book value condominium}_{t-1} * (1 - \text{depreciation rate})$$

$$\text{book value condominium}_t = \text{book value condominium}_{t-1} - \text{tax depreciation}_t$$

Tax calculation

$$\text{tax}_t = \text{income before taxes}_t * \text{tax rate}$$

$$\text{income before taxes}_t = \text{net rental income}_t - \text{tax depreciation}_t - \text{interest payment}_t$$

Source: Deutsche Bank Research



Outlook for the German residential property market 2022 and beyond

Appendix: Correction of the supply shortage in our 126 cities

We would like to explain why our current calculations lifted the supply shortage to almost 270,000 apartments in 2016, up from 250,000 in our residential property market outlook 2021.

- In the case of Munich, data from 2009 and 2010 were inadvertently included in the calculations of aggregate completions. This increased the number of completed residential units by more than 8,000 for each of the years from 2011 to 2030.
- In Berlin, our former calculations found that about 88,000 residential units were lacking in 2016. Our new calculations put the figure at about 96,000 because of adjustments to the number of persons per household. We assumed an average household size of 1.8 persons in 2021, whereas 1.7 would have been correct. As a result, more residential units were lacking in 2016.
- Our database holds figures for both the city and the region of Aachen. All figures used for our new calculations refer to the city. This reduces the supply surplus by 1,500 residential units.

The changes to the supply shortages in 2019 and 2020 are caused by the following factors:

- Data update of the number of inhabitants for 126 cities in 2019 and 2020. The number of inhabitants in 2020 declined from 30.1 million to only 29.9 million.
- Data update of the number of households for 13 cities in 2018 and for 126 cities in 2019 and 2020. The number of households in 2020 declined from 16.55 million to 16.46 million.

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