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Beyond Interest Rates: Upfront Costs and Housing Affordability in Germany

Abstract

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Housing (un-)affordability has become a defining social and economic challenge in German cities, shaping both wealth accumulation and intergenerational inequality. We decompose affordability into two components: the ability to service monthly mortgage payments and the ability to meet the upfront cash requirements for purchasing a home. Combining data on regional mortgage financing conditions, household incomes, and house prices from 1980 to 2024, we find that mortgage payments relative to income have changed little over time. In stark contrast, upfront costs relative to income have risen sharply: whereas households in 1980–1990 needed savings of less than two years of annual income to cover the equity requirement for an apartment purchase, households in 2015–2024 require more than three years. These results show that focusing on mortgage costs alone severely understates the decline in housing affordability. Instead, rising entry costs have become the primary constraint on homeownership, reinforcing advantages for households with existing wealth or familial financial support.

Keywords: Housing affordability, Homeownership, Wealth inequality

JELs: R21, R31, D31, G51

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1 Introduction

Affordable housing, particularly in urban centers, remains one of Germany’s most pressing social and macroeconomic challenges (Sachverständigenrat, 2024). While homeownership is linked to higher life satisfaction and greater wealth accumulation (Bach et al., 2021; Zumbro, 2014), Germany’s homeownership rate is among the lowest in Europe, standing at just 44%—well below the European average of around 70%. In major cities, ownership rates are even lower, ranging from 31% in Stuttgart to only 14% in Leipzig.¹ Moreover, homeownership has been declining steadily in recent years.²

Buying a home typically involves both upfront expenses—such as the down payment, taxes, and fees—and ongoing monthly mortgage payments. Understanding how these two components have evolved over time is essential for gaining a clear picture of housing affordability. This paper presents long-term measures of both for German cities since the 1980s.

To understand what drives these two dimensions of affordability, it is crucial to examine how house prices, household incomes, interest rates, and loan-to-value (LTV) ratios have evolved over time. As shown in Figure 1, house prices and household incomes moved largely in tandem until around 2010, after which house prices began to rise much more rapidly. This divergence affects affordability through two main channels. On the one hand, higher house prices increase monthly mortgage payments, although lower interest rates have partly cushioned this effect. On the other hand, upfront costs—particularly the down payment and the real estate transfer tax—are directly tied to purchase prices, as they are calculated as a percentage of the transaction price. The decoupling of house prices from incomes therefore reduces affordability not only by raising mortgage payments but also, and more critically, by increasing the cash required to enter the housing market. This leads to our central questions: How much of their income must households devote to monthly mortgage payments? How much cash must they provide upfront? And how have these burdens evolved over time?

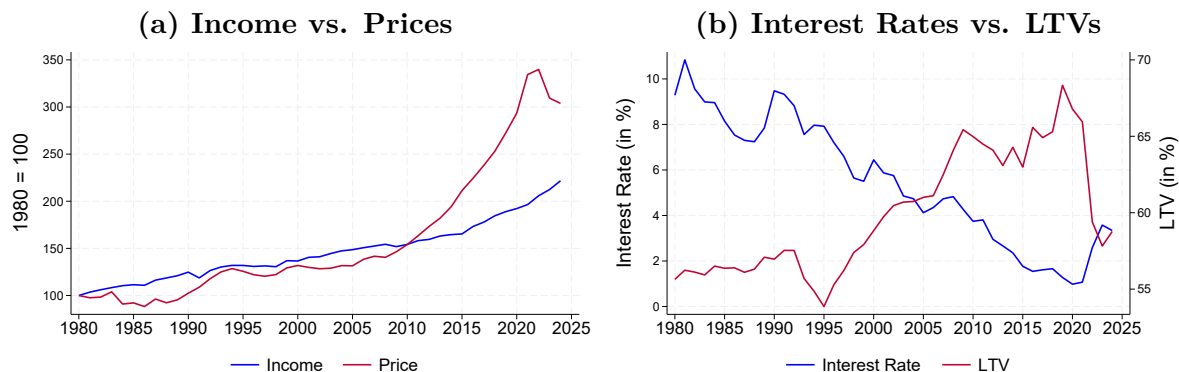
To address these questions, we combine national and regional data on mortgage costs and household incomes with house prices based on detailed microdata from the German Real Estate Index (GREIX). We find that the burden of mortgage payments relative to disposable income has remained almost stable across generations.

While the Baby Boomer generation purchasing homes between 1980 and 1990 devoted around 20% of their household income to mortgage payments for apartments and 46% for single-family houses, their children, the Millennial generation, entering the market between 2015 and 2024 spend about 25% of their income on apartments and 42% on single-family houses. Despite the sharp rise in house prices after 2010, falling interest

¹Figures based on Census 2022; <https://ergebnisse.zensus2022.de/datenbank/online/>.

²C.f. https://ec.europa.eu/eurostat/databrowser/view/ILC_LVH002/default/table . Note that the EUROSTAT estimate of 46.5% is slightly higher than the census figure of 44.3%.

Figure 1: Development of mortgage market variables



Notes: The figure shows the development of four variables crucial for housing affordability: Average house prices, average income of an average household, average mortgage interest rates, and average mortgage LTVs. All data is calculated regionally for urban centers using the 21 GREIX cities and aggregated using the number of transactions per city and year as weights.

Source: Bundesbank, DESTATIS, GREIX, Interhyp group, National accounts of the German states, vdp. Own calculation.

rates offset much of the increase, leaving the overall mortgage burden broadly comparable across generations.

In contrast, upfront costs have reached unprecedented levels due to surging house prices. Baby Boomers buying homes in 1980–1990 faced upfront payments of around 1.7 times their annual disposable income for apartments and 3.6 times for single-family houses, whereas Millennials today must mobilize more than three times their annual income for apartments and over five times for single-family houses. Consequently, millennials must save twice as long, assuming a constant savings rate, as their parents did to accumulate enough capital to cover the upfront costs. These rising upfront requirements have substantially increased entry barriers to homeownership, especially for households with limited savings or wealth.

Focusing the discussion of housing affordability solely on mortgage payments therefore overlooks a crucial dimension: the entry barriers created by high upfront costs. Rising house prices directly increase these barriers, making it especially difficult for younger households with limited savings and without family support to provide the necessary cash payments. Policy measures aimed at improving housing affordability should thus prioritise reducing these upfront costs. Since a large share of these expenses stems from real estate transfer tax (*Grunderwerbsteuer*), which on average amount to roughly 5–6% of the purchase price, we propose significantly reducing this tax and compensating for the resulting revenue losses by increasing the property tax (*Grundsteuer*) making the proposed tax reform neutral to the total government revenue.³ Such a reform would substantially lower entry barriers to homeownership—particularly for young and low-wealth families—and enable broader wealth accumulation through property ownership.⁴

³As the transfer tax is levied at the state level and the property tax at the municipal level, a revenue-neutral reform would therefore require shifting revenues from municipalities to the states.

⁴The actual relief for homebuyers depends on the effect on house prices. Dolls et al. (2025) show that

The remainder of this paper is structured as follows. In Section 2, we give an overview of the existing literature regarding housing affordability with a special focus on the German housing market. Section 3 describes the data sources and methodology, with particular attention to the computation of housing affordability ratios. Section 4 analyses the long-run evolution of mortgage payments and compares the results with existing measures. Section 5 documents trends in upfront costs, while Section 6 discusses a broader macroeconomic implication of our findings—namely, the role of inherited inequality. Section 7 concludes with policy recommendations.

2 Literature review

Housing affordability has long been studied in economics and sociology, yet the literature remains heterogeneous in concepts and measurement. Broadly, two strands can be distinguished: rent affordability and affordability of owner-occupied housing.

The rent affordability literature typically compares rents to household incomes. Schmandt (2025) relates local rent distributions in Germany to income distributions and documents substantial regional heterogeneity, with affordability deteriorating in growing regions and improving in shrinking ones. Accordingly, he concludes that affordability problems in Germany are confined to specific regions and income groups. Similarly, Kholodilin and Baake (2024) show that while the aggregate rent-income ratio has remained stable since the early 2000s, rent burdens for low-income households have increased markedly, alongside rising regional and urban–rural disparities. Last, data by the OECD (2025a) shows that the median rent-to-income ratio stays largely constant with a slight decreasing trend in Germany during the 2010–2024 period.

A second strand focuses on the affordability of homeownership. A common but limited approach compares house prices to incomes. For example, the OECD computes the price to income ratios for its member countries. For Germany, the results show that the price to income-ratio has gone down from 1996–2008 and has been rising ever since (OECD, 2025b). Cox (2023) documents strong heterogeneity across cities and countries when it comes to price-to-income ratios. However, price-to-income ratios neglect key features of housing finance, such as interest rates and loan-to-value constraints. Consequently, recent studies emphasize mortgage payment-to-income ratios. Again, the OECD (2025a) computes such a measure showing that the median mortgage burden has been coconstantly decreasing in Germany during the 2010–2024 period. Sagner and Voigtländer (2025) estimate such mortgage cost ratios for German counties from 2007–2025 and find stable affordability until 2020, followed by a sharp deterioration, particularly in metropolitan areas. Similar regional patterns are reported by Balz (2025). Extending the analysis over

in a seller’s market, sellers may increase prices following a reduction in the transfer tax, thereby limiting the relief for homebuyers. Besley et al. (2014) find that 60% of the benefits from a temporary tax cut accrued to homebuyers.

longer horizons, Voigtländer (2023) and Biljanovska et al. (2023) show that low interest rates sustained affordability despite rising prices until 2020, after which affordability declined.

This paper contributes to the homeownership affordability literature in two ways. First, we construct mortgage cost ratios for German cities over the period 1980–2024 following largely the method of Biljanovska et al. (2023). By doing so, we provide the first long-run, city-level analysis of mortgage-based housing affordability in Germany. Unlike much of the existing literature, instead of imposing affordability thresholds, we report mortgage cost ratio relative to the disposable household income. Second, we complement mortgage-based measures with an upfront cost ratio that captures all mandatory acquisition costs not financed by mortgages, including equity requirements, transaction taxes, and notary fees. While the relevance of upfront costs for housing affordability has long been recognized (Mayer and Engelhardt, 1996), we are not aware of prior work that systematically quantifies such costs for Germany. Combining mortgage costs ratio and upfront costs ratio allows us to assess both long-term payment burdens and short-term liquidity constraints faced by prospective homeowners.

3 Data and methodology

The typical path to homeownership involves financing the purchase through a mortgage loan. Buyers are usually required to make a down payment, which represents a portion of the property’s price paid in cash, while the remainder is financed through the mortgage. The borrower then repays the loan in monthly instalments that cover both the principal and, typically, a long-term fixed interest rate component (Deutsche Bundesbank, 2023). In addition to the purchase price, buyers must also pay transaction-related expenses such as real estate transfer taxes, notary fees, and registration costs.

This combination of upfront cash requirements and ongoing mortgage payments defines the standard route to homeownership for most households. Consequently, housing affordability can be assessed along two key dimensions: upfront costs and mortgage payments. In the following, we analyse both components using detailed data on house prices, household incomes, interest rates, and loan-to-value (LTV) ratios.

3.1 Mortgage cost ratio

To assess the burden of mortgage payments relative to household income, we construct the mortgage costs ratio (MCR) as:

$$MCR = \frac{\textit{Mortgage payment}}{\textit{Income}}, \quad (1)$$

where *Income* denotes the average annual disposable household income. This measure is derived from national accounts for Germany’s federal states and supplemented with data

from the Federal Statistical Yearbooks.⁵ The *Mortgage payment* represents the average annual payment on a newly originated loan. It is computed based on the loan-to-value ratio (LTV), the interest rate (IR), and the repayment rate (RR). Assuming that households pay a fixed annual rate on the mortgage—that is, on the portion of the home’s value financed through borrowing—the yearly mortgage payment is given by:

$$\text{Mortgage payment} = \underbrace{HP \times LTV}_{\text{mortgage principal}} \times (IR + RR), \quad (2)$$

where *HP* denotes the average house price. This formulation captures the total annual financial commitment required to service the loan, reflecting both interest and principal repayments.

To compute the mortgage payment, we use data coming from the German Real Estate Index (GREIX), which provides house price indices and prices per square meter based on detailed micro data on all transactions in 21 German cities and urban counties. We use the price data from 21 GREIX cities, including the nine largest cities as well as smaller urban centers.⁶ Regional data on LTV, IR, and RR are provided by the Interhyp group for the period 2012–2022.⁷ For a longer horizon, we use national LTV data from 1992–2024 provided by the Association of German Pfandbrief Banks (vdp) to extrapolate regional LTVs.⁸ Interest rates are extrapolated using national long-term mortgage rates from the Bundesbank, and repayment rates are extrapolated using national EUROPACE data from 2003–2024. For the 1980–2002 period, we estimate RR via a hedonic model.⁹ Calculating the mortgage payment as specified in Equation (2) and using our estimated data implies an annuity ranging between 21–28 years.¹⁰

⁵Regional income data are available for the period 1995–2022. For these years, we estimate the average annual disposable household income per city and household and aggregate it using a weighted average, with the number of transactions per city and year serving as weights. Federal-level income data are available for 1980–2024. To extend regional coverage, we regress regional income on federal-level income for 1995–2022 and use the estimated relationship to predict regional income for 1980–1994 and 2023–2024. The regression explains more than 96% of the observed variation in regional income.

⁶The cities are Berlin, Bochum, Bonn, Chemnitz, Cologne, Dortmund, Dresden, Düsseldorf, Duisburg, Erfurt, Frankfurt am Main, Hamburg, Hamm, Karlsruhe, Leipzig, Lübeck, Munich, Münster, Potsdam, Stuttgart, and Wiesbaden. An overview for the periods for which data is available in each city can be found in Appendix A.

⁷We thank Dr. Georg Weigert from the Interhyp Gruppe for kindly providing that finance data.

⁸We thank Thomas Hofer from vdp for kindly providing the time series.

⁹To extend the RR series back to 1980, we link repayment behavior to financing conditions and house prices, reflecting that repayment decisions are shaped by mortgage options. The model specification can be expressed as $RR_{i,t} = \alpha \cdot LTV_{i,t} + \beta \cdot IR_{i,t} + \gamma \cdot HP_{i,t} + \sum_{i=1}^{21} \delta_i city_i$ where $city_i$ is a dummy for the i^{th} city in our sample. We estimate the model using data from 2003–2024 and then use the coefficients together with the other series to predict repayment rates for 1980–2002. To avoid negative RR, especially in the 1980s, we impose a minimum RR of 1%. Between 2003–2024, the model explains 82% of the observed variation.

¹⁰This range matches with annuity assumptions of Biljanovska et al. (2023) who assume an annuity of 25 years and Voigtländer (2023) who assumes an annuity of 20 years.

3.2 Upfront costs ratio

To measure the share of annual disposable household income that homebuyers must provide in equity and transaction-related expenses, we construct the upfront costs ratio (UCR) as:

$$UCR = \frac{Upfront\ costs}{Income}, \quad (3)$$

where *Upfront costs* comprise the portion of the purchase price not financed through a mortgage, as well as real estate transfer taxes and notary fees. We use estimates from Boysen-Hogrefe (2017) for national transfer tax rates before 2006 and state-level legal provisions for the post-2006 period to capture the development of the real estate transfer tax (Grunderwerbsteuer). Notary costs are estimated following EMF (2010) and Voigtländer (2016).

The real estate transfer tax is levied as a percentage of the purchase price and applies to all property transactions. Consequently, tax liabilities increase automatically during periods of rising house prices. Moreover, after the 2006 federal reform that transferred rate-setting authority to the states (Bundesländer), transfer tax rates began to diverge and have shown a pronounced upward trend. This institutional change has made the transfer tax a key driver of total upfront costs in recent years. In addition, every real estate transaction requires notarisation, which entails both notary fees and land registry charges. While these fees also depend on the transaction price, they represent only a minor share of total acquisition costs—typically less than 4% of overall upfront expenses.¹¹

4 Housing affordability and the mortgage cost ratio

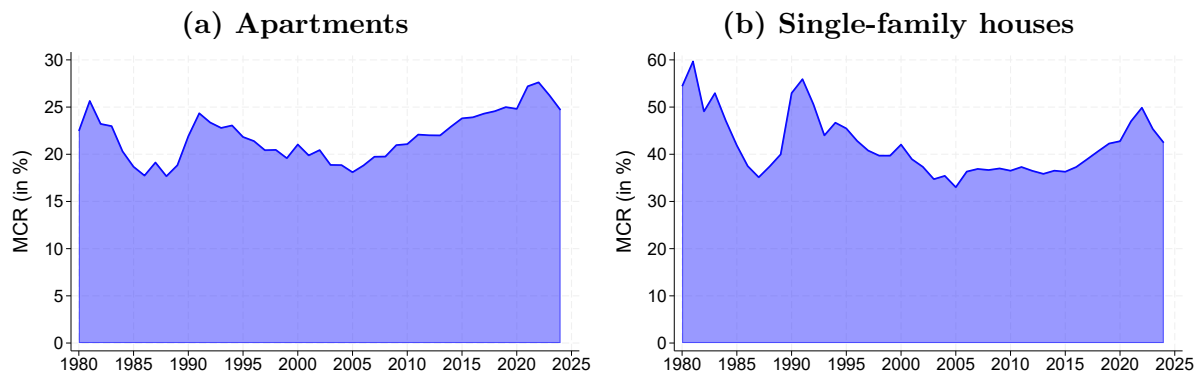
We begin our analysis of housing affordability by examining the first component—the share of household income devoted to servicing an average mortgage. To this end, we compute the average mortgage costs ratio (MCR) for 21 German cities over the period 1980–2024, using Equation (1). The evolution of mortgage costs for apartments and single-family houses is presented in Figure 2.

As shown in Panel (a) of Figure 2, the ratio of average mortgage payments to household income for apartments declined from around 22% in 1980 to 18% in 2005. The pronounced fluctuations during the 1980s correspond to sharp movements in mortgage interest rates.¹² Beginning in 2006, the share of income required to service a mortgage increased steadily, peaking at 28% in 2022 before easing slightly to 25% in 2024.

¹¹On average, notary fees correspond to around 4% of annual disposable household income for apartments and 8% for single-family houses. Real estate agent commissions may also add to total upfront costs; however, since these fees are not centrally regulated and long-term data are unavailable, they are excluded from our analysis. The resulting estimates of upfront costs should therefore be interpreted as a lower bound.

¹²For the growth rates of the main MCR components, see the Appendix, Section C.

Figure 2: Mortgage Costs to Income



Notes: The figure shows the development of mortgage cost relative to the disposable household income as defined in equation (1) for apartments and single-family houses. A mortgage cost ratio (MCR) of 30 means that an average household has to pay 30% of their disposable household income on mortgage costs.

Source: Bundesbank, DESTATIS, EUROPACE, GREIX, Interhyp group, National accounts of the German states, vdp. Own calculation.

Panel (b) of Figure 2 shows the evolution of the mortgage cost-to-income ratio for single-family houses. Compared to apartments, households devote a larger share of their disposable income to mortgage payments for single-family houses, reflecting their higher average prices. The mortgage cost ratio declined from around 60% in 1981 to 34% in 2005, with sharp fluctuations during the 1980s. After 2005, mortgage costs stabilised at approximately 37% before rising again from 2016, peaking at 50% in 2022. Following this peak, the ratio decreased to 43% in 2024.

Notably, unlike apartments, the mortgage cost ratio for single-family houses remains below the peaks observed during the 1980–1995 period. Indeed, eight of the ten years with the highest single-family house MCR fall within that timeframe, while only two occur between 2010 and 2024.¹³

The evolution of mortgage costs is driven by the joint dynamics of house prices, interest rates, and loan-to-value ratios (LTVs). In 1990, both prices and interest rates rose sharply due to inflationary pressures and increases in the central bank's base rate.¹⁴ Consequently, the share of income required for mortgage payments rose significantly.

In 2022, following Russia's invasion of Ukraine, interest rates rose sharply. However, the influence of rising interest rates on the MCR is mitigated both by falling house prices in the second half of 2022 and falling LTVs.¹⁵ Although homebuyers are expected to pay

¹³The years with the highest single-family house MCR are, in descending order: 1981, 1991, 1980, 1990, 1983, 1992, 2022, 1982, 2021, and 1984.

¹⁴Ahead of German reunification, West Germany's economy overheated, leading to higher inflation that the central bank countered by raising base rates. As mortgage interest rates are closely tied to base rates, this policy shift had a substantial impact on the housing market.

¹⁵In the first half of 2022, house prices still rose strongly before starting to drop. Since Figure 1 only displays the average house price for the whole year, the value depicted there is still weakly rising. For a depiction of quarterly price development, refer to the indices provided by the German Real Estate Index:

much higher return to the mortgage, the absolute value of the mortgage shrinks as both house prices and LTVs decrease, mitigating 2022 the spike in MCR.

This pattern highlights that LTVs are an endogenous outcome of borrower and lender decisions. When interest rates rise, buyers may opt for lower leverage to limit total borrowing costs, effectively shifting part of the financial burden toward upfront payments. The capacity to do so, however, depends on household wealth: wealthier buyers can more easily absorb higher upfront costs, while less wealthy households may face borrowing constraints despite sufficient income. To isolate the role of LTV dynamics, we recalculate the MCR using a fixed LTV of 80%. The long-term trends remain nearly identical to those obtained with variable LTVs, indicating that our findings are not primarily driven by endogenous adjustments in LTV ratios.¹⁶

Our results are broadly consistent with existing measures of housing affordability. Similar to our findings, Sagner and Voigtländer (2025) show that mortgage costs for single-family houses remained stable between 2011 and 2016, then rose until 2022 before declining again. For longer-term comparisons, Voigtländer (2023) compute mortgage cost indices for single-family houses until 2000 and for a combined housing category thereafter. Consistent with our evidence, he finds that mortgage costs were substantially higher in the 20th century than today, followed by a period of relative stability in the early 2000s. Likewise, Biljanovska et al. (2023) document a decline in mortgage costs from the 1980s onwards, stabilisation in the 2010s, and renewed increases in the 2020s.¹⁷

5 Housing affordability and the upfront cost ratio

Assessing housing affordability solely through monthly mortgage payments overlooks a crucial component of home acquisition. Even with access to mortgage financing, households must still provide a substantial down payment and cover taxes and notary fees, all of which are proportional to the purchase price. These upfront costs are at least equally relevant to the overall assessment of affordability, as they represent a binding entry barrier to homeownership: even households with sufficient income to service a mortgage may be unable to enter the market without substantial savings.

We measure the upfront cost ratio (UCR) using aggregated data for 21 cities and Equation (3).¹⁸ Figure 3 presents the evolution of upfront costs for both apartments and

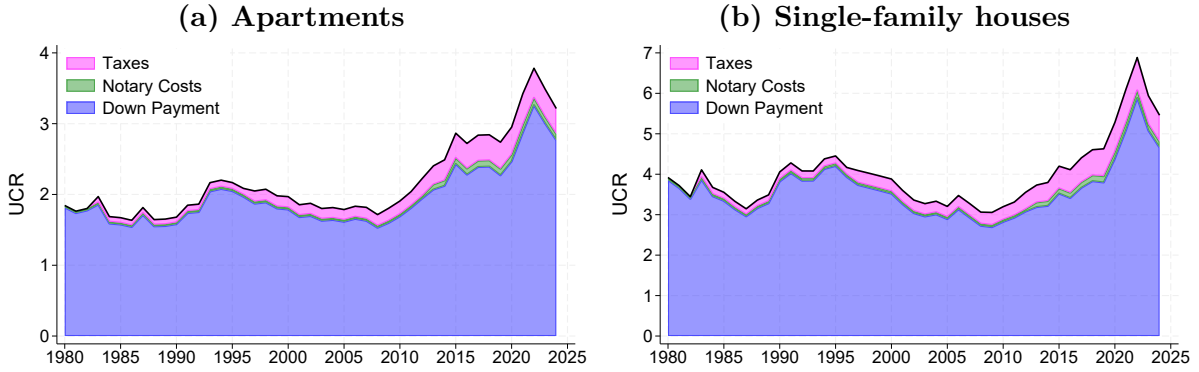
<https://greix.de>. Note that these indices are adjusted by various variables, including the quality and size of the house. Hence, the GREIX indices do not provide the simply averages as we do.

¹⁶See the Appendix, Section D.3.

¹⁷The comparison to our results is limited, as Biljanovska et al. (2023) measure housing prices as the ratio of total housing stock value to total floor space, thereby including multi-family and non-residential properties.

¹⁸Data are aggregated by calculating weighted averages, using the number of recorded transactions per city and market segment as weights.

Figure 3: Upfront Costs to Income



Notes: The figure shows the development of upfront costs when compared to income. A UCR of 3 means that an average household has to pay 3 times their yearly disposable income in upfront costs on average when buying an apartment/single-family house. The share of the upfront costs that is due to taxes is represented by the pink area. Notary fees are represented by the green area. The part of the house price that is not covered by the mortgage loan is represented by the blue area.

Source: Boysen-Hogrefe (2017), DESTATIS, EMF (2010), GREIX, Interhyp group, National accounts of the German states, State-level legislation, vdp, Voigtländer (2016). Own calculation.

single-family houses. These costs primarily consist of two components: the down payment not covered by the mortgage, and the real estate transfer tax.

As shown in Panel (a) of Figure 3, the ratio of upfront costs to disposable household income for apartments starts at approximately 1.8 times the average income in 1980 and remains relatively stable until 2008, when it reaches 1.7. With the onset of rapidly increasing house prices after 2008, upfront costs rise sharply, peaking at 3.8 in 2022 before easing to 3.2 in 2024. A similar pattern emerges for single-family houses, as illustrated in Panel (b) of Figure 3. Upfront costs amount to roughly 3.9 times annual household income in 1980 and reach their lowest point of 3.1 in 2009. Thereafter, they rise steeply, peaking in 2022 at 6.9 times average annual income before declining to 5.5 in 2024.

The increasing role of the real estate transfer tax (Grunderwerbsteuer) is a key factor behind these developments. When the tax was first applied to residential real estate transactions in 1983, it accounted for around 8% of annual household income for apartments and 18% for single-family houses. Over time, these shares rose dramatically, peaking in 2021 at 44% and 84%, respectively. By 2024, households still spent, on average, 45% of their annual income on taxes and notary fees when purchasing an apartment, and 81% when buying a single-family house. Thus, even under a hypothetical scenario where the mortgage covers the full purchase price, legal and transaction costs alone constitute a substantial upfront payment.¹⁹

Two main factors explain this pronounced increase in tax-related costs. First, because the real estate transfer tax is levied as a percentage of the purchase price, rising house prices mechanically translate into higher tax payments. Second, since the 2006 fiscal reform that transferred tax-setting authority from the federal government to the states

¹⁹For a depiction of the UCR under the assumption of a 100% LTV, see the Appendix, Section E.

(Bundesländer), transfer tax rates have diverged and increased markedly. Whereas the uniform national rate stood at 3.5% in 2006, by 2024 the average state-level rate had climbed to 5.7%. The interaction between rising prices and higher tax rates has therefore amplified the overall burden of upfront costs, further exacerbating entry barriers to homeownership. Evidence from international housing markets shows that increased transfer taxes can impose serious challenges to homebuyers, significantly lowering home ownership (Han et al., 2025).

6 Housing (Un-)Affordability and Rising Inequality

Housing represents one of the principal assets of middle-class households and a key vehicle for long-term wealth accumulation (LBS, 2024; Orsetta Causa, 2019). Consequently, declining housing affordability raises important concerns about wealth inequality. When only higher-income and wealthier households can afford to buy a property, lower-income households face growing barriers to wealth accumulation through homeownership. Cross-country evidence supports this pattern: OECD data show that countries with low homeownership rates tend to exhibit higher wealth inequality, even when income inequality remains relatively moderate (Orsetta Causa, 2019).

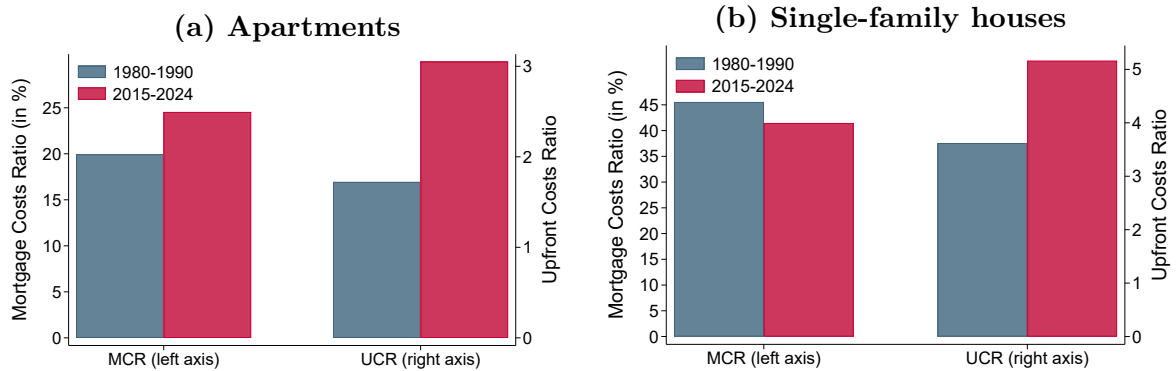
Our analysis of housing affordability in Germany that the baby boomer generation had to devote around 20% of their disposable household income to mortgage payments for apartments and 46% for single-family houses. Millennials — the current generation of buyers — face slightly larger burdens of 25% of their disposable income for apartments and 42% for single-family houses (see Figure 4). At first glance, this suggests that housing affordability, when measured solely through mortgage payments, has increased only slightly over time.

However, this view masks a crucial shift in the structure of housing costs. Upfront costs have increased substantially, transforming the accessibility of homeownership. While baby boomers paid roughly 1.7 times their annual disposable income upfront for apartments and 3.6 for single-family houses, millennials must now provide about 3.1 times their income for apartments and 5.2 for single-family houses. In the apartment sector, this amounts to an increase of about 75% or 1.3 times a yearly family income. As a result, Millennials must save for around 13.9 years at the current gross savings rate of 20% in order to accumulate 3.1 times their annual disposable household income and cover the required equity to buy an apartment. In contrast, Baby Boomers needed to save for only around 6.8 years at the same savings rate to meet the equity requirement.²⁰ In addition, households typically rent before purchasing a home. As the rent burden has risen relative to income, it has become

²⁰The calculations assume a gross savings rate of 20% of disposable income. Compound interest with annual contributions is taken into account, using the average risk-free interest rate on ten-year German government bonds: 7.9% (1970–1990) for Baby Boomers and 1.7% (2005–2024) for Millennials.

even harder for young households to save enough to cover these upfront costs.²¹ Hence, even though ongoing mortgage payments have remained relatively stable, the increasing upfront costs to enter the housing market increasingly exclude households with low-income and limited savings. Consequently, since 2011 the share of low-income households among new buyers has declined, suggesting that rising entry costs are increasingly excluding households with limited savings or without inherited wealth from one of the most reliable paths to wealth building (BBSR, 2023).

Figure 4: MCR development — Different cohorts



Notes: The figure shows the development of mortgage and upfront costs when comparing the 1980–1990 when baby boomer enter the housing market to the 2015–2024 period when millennials enter the housing market. The figures are estimated by taking the MCR/UCR for each period and calculate the average over the years for both apartments and single-family houses separately.

Source: Boysen-Hogrefe (2017), Bundesbank, DESTATIS, EMF (2010), EUROPACE, GREIX, Interhyp group, National accounts of the German states, State-level legislation, vdp, Voigtländer (2016). Own calculation.

Rising upfront costs make savings and access to external capital increasingly decisive for entering homeownership. As a result, recent data point to a sharp increase in the importance of family wealth transfers in financing home purchases. Between 2012 and 2017, households that financed their homes through a mortgage covered roughly 50% of upfront expenses with their own savings, while 21% came from inheritances or gifts—either in cash or real estate form (BBSR, 2019). In the subsequent period from 2018 to 2021, the share of upfront costs financed by personal savings declined to 38%, whereas the contribution from inheritances and gifts rose markedly to 31% (LBS, 2024, p.72). This trend is mirrored in the composition of housing transactions. The share of inherited real estate in the market increased to about 25% between 2018 and 2021, up from a stable 14–16% during the preceding two decades (BBSR, 2019, 2023). These developments underscore the growing role of intergenerational wealth transfers in determining who can enter the housing market. This is supported by Lersch et al. (2025), who show that the share of homebuyers with parents who rent has declined sharply over generations. Among baby boomers (born 1955–1964), 24% had parents who rented, compared to only 9% among millennials (born 1985–1989)—a drop of about 63%.²² Therefore, access to

²¹Kholodilin and Baake (2024) show that the rent burden increased from around 18% in 1990 to about 25% in 2021.

²²Lersch et al. (2025) show that among homebuyers born in 1955–1964, i.e., the baby boomer gener-

family capital increasingly separates those able to buy a home from those who must remain renters, thereby amplifying wealth inequality across and within generations.

7 Summary and policy implications

When assessing housing affordability, it is essential to consider both monthly mortgage payments and upfront costs, as each follows distinct dynamics and carries different implications for homebuyers. Our analysis shows that mortgage costs relative to household income have only increased slightly between 1980–1995 and 2010–2024. Although house prices rose sharply after 2009, this effect was largely offset by lower mortgage rates and higher loan-to-value ratios. In contrast, upfront costs have increased by more than 30%, and because they are directly tied to house prices, they now represent a substantial entry barrier for many households.

Policy efforts to improve housing affordability should therefore focus on reducing upfront costs. Measures that solely aim to lower annual mortgage payments primarily benefit households with sufficient savings or affluent family support, while low-income and low-wealth households remain excluded from homeownership. By contrast, policies that ease upfront financial burdens would also enable households with limited savings and no family support to access the housing market, fostering more equitable opportunities for wealth accumulation through homeownership.

As taxes represent a substantial portion of the upfront costs, one potential policy to reduce the entry barrier to homeownership is a reduction of the transfer tax (*Grunderwerbsteuer*). The resulting loss in government revenue could be offset by an adequate increase in the annual property tax (*Grundsteuer*).²³ This would shift the burden of taxes from the upfront equity requirement to the ongoing costs, thereby easing access to homeownership. Importantly, the actual relief for homebuyers depends on the effect on house prices. Dolls et al. (2025) show that in a seller’s market, sellers may increase prices following a reduction in the transfer tax, thereby limiting the relief for homebuyers. Besley et al. (2014) find that 60% of the benefits from a temporary tax cut accrued to homebuyers, providing evidence that reducing the transfer tax might actually relieve homebuyers. However, even if prices would increase one-to-one with the reduction in the transfer tax, a substantial part of the upfront costs would still be shifted toward higher monthly mortgage payments, lowering the entry barrier.

ation, 24% had parents who rented and 33% had parents who owned their home. In contrast, among homebuyers born in 1985–1989, i.e., the millennial generation, only 9% had parents who rented and 20% had parents living in their own home.

²³Since the transfer tax is levied at the state level and the property tax at the municipal level, the reform would also require reallocating part of the increased property tax revenue to the states.

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A Price data availability

Table 1: Data availability on house prices

City	Apartments	Single-family houses
Berlin	1984 – 2024	1984 – 2024
Bochum	1991 – 2024	1991 – 2024
Bonn	1994 – 2024	1994 – 2024
Chemnitz	1993 – 2024	1993 – 2024
Cologne	1991 – 2024	1992 – 2024
Dortmund	1980 – 2024	1980 – 2024
Dresden	1992 – 2024	1992 – 2024
Duisburg	1980 – 2024	1980 – 2024
Düsseldorf	1980 – 2024	1980 – 2024
Erfurt	1993 – 2024	1993 – 2024
Frankfurt am Main	1983 – 2024	1980 – 2024
Hamburg	1980 – 2024	1980 – 2024
Hamm	1986 – 2024	1986 – 2024
Karlsruhe	1994 – 2024	1994 – 2024
Leipzig	2014 – 2024	2014 – 2024
Lübeck	1993 – 2024	1993 – 2024
Munich	1980 – 2024	NA
Münster	1986 – 2024	1986 – 2024
Potsdam	1995 – 2024	1994 – 2024
Stuttgart	1988 – 2024	1988 – 2024
Wiesbaden	1992 – 2024	1992 – 2024

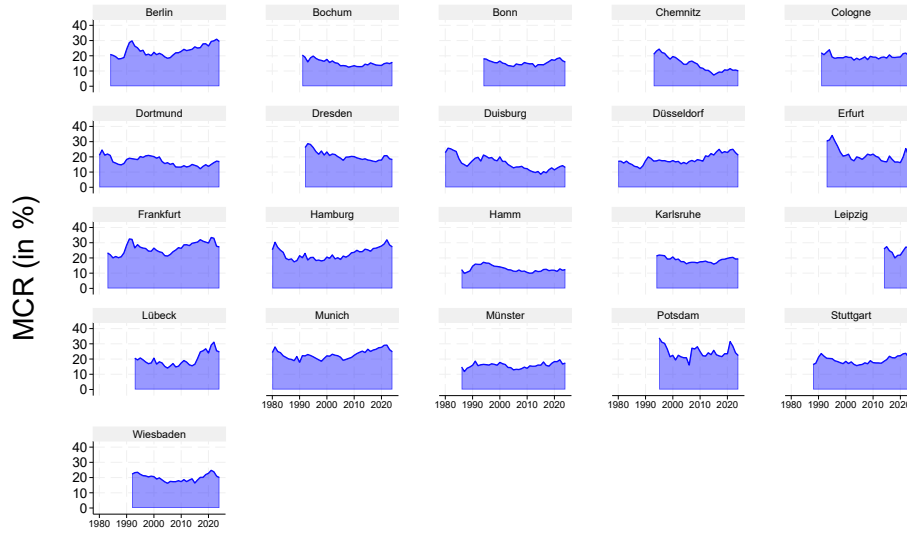
Notes: The table shows the availability of house price data for the 21 cities included in our analysis. The data is provided by the cities' local authorities (*Gutachterausschüsse*) to the GREIX and sourced from there. For single-family houses in Munich, no data is available. The ranges depicted in this table are the ranges in which data for each city is used in the aggregate results.

Source: GREIX.

B Individual City Results

We calculated the MCR and UCR for individual cities using the same methods as for the composite housing affordability ratios. The MCR results are presented in Figures 5 and 6. As can be seen, there is significant variation among cities in the development of mortgage costs, making it difficult to identify an overall trend. In Berlin, for instance, the apartment MCR increases from 21 in 1980 to 29 in 2024 — a rise of nearly 40%. However, the MCR for Cologne remains largely unchanged, starting at 22 in 1991 and ending at 20 in 2024. Finally, cities such as Duisburg experience a significant decline in apartment MCR, starting at 23 in 1980 and ending at 13 in 2024. For single-family

Figure 5: Mortgage Costs to Income — Apartments



Notes: The figure shows the development of mortgage costs relative to the disposable household income as defined in equation (3) for apartments. An upfront cost ratio (UCR) of 2 means that an average household has to pay twice their yearly disposable household income on mortgage costs.

Source: Bundesbank, DESTATIS, EUROPACE, GREIX, Interhyp group, National accounts of the German states, vdp. Own calculation.

houses, although the MCR is relatively high in some cities such as Berlin in the 1980s and decreases subsequently, no clear trend can be observed in the early 2000s. Furthermore, even the most recent upward trend since the 2010s remains moderate.

Examining the UCR results, it is clear that the significant increase in our aggregated UCR results is primarily due to the seven largest cities in Germany.²⁴ While these cities largely exhibit the observed trend of stable UCRs until the 2010s, followed by a rise peaking in 2022, smaller cities such as Bonn and Münster experience a much more moderate increase. Conversely, cities such as Chemnitz and Duisburg either stagnate or even decrease.

C MCR Decomposition

To illustrate the main drivers of mortgage costs, we follow the example of Biljanovska and display the growth rates of the main MCR variables, as well as the MCR itself, in Figure 9. For both apartments and single-family houses, mortgage costs tend to increase during periods of rising prices and interest rates. During the 2009–2020 period, rising house prices were often offset by falling interest rates, which stabilized the MCR.

²⁴These cities are: Berlin, Cologne, Düsseldorf, Frankfurt, Hamburg, Munich and Stuttgart.

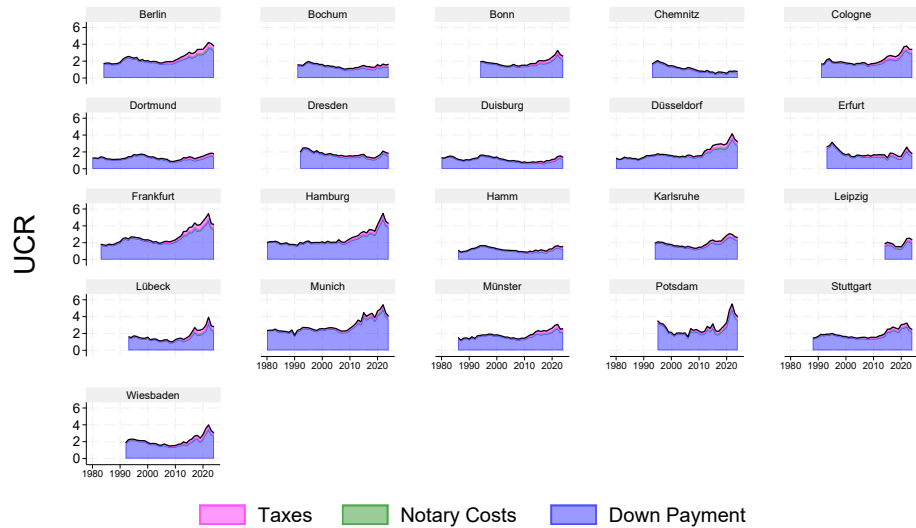
Figure 6: Mortgage Costs to Income — Single-family houses



Notes: The figure shows the development of mortgage costs relative to the disposable household income as defined in equation (3) for single-family houses. An upfront cost ratio (UCR) of 2 means that an average household has to paytwicef their yearly disposable household income on mortgage costs.

Source: Bundesbank, DESTATIS, EUROPACE, GREIX, Interhyp group, National accounts of the German states, vdp. Own calculation.

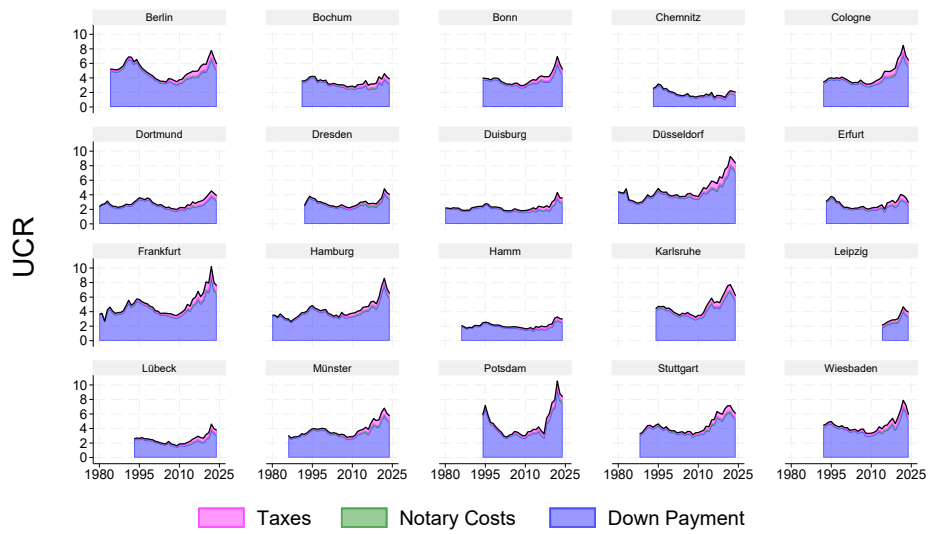
Figure 7: Upfront Costs to Income — Apartments



Notes: The figure shows the development of upfront costs relative to the disposable household income as defined in equation (3)for apartments. A UCR of 3 means that an average household has to pay 3 times their disposable household income in upfront costs.

Source: Boysen-Hogrefe (2017), DESTATIS, EMF (2010), GREIX, Interhyp group, National accounts of the German states, State-level legislation, vdp, Voigtländer (2016). Own calculation.

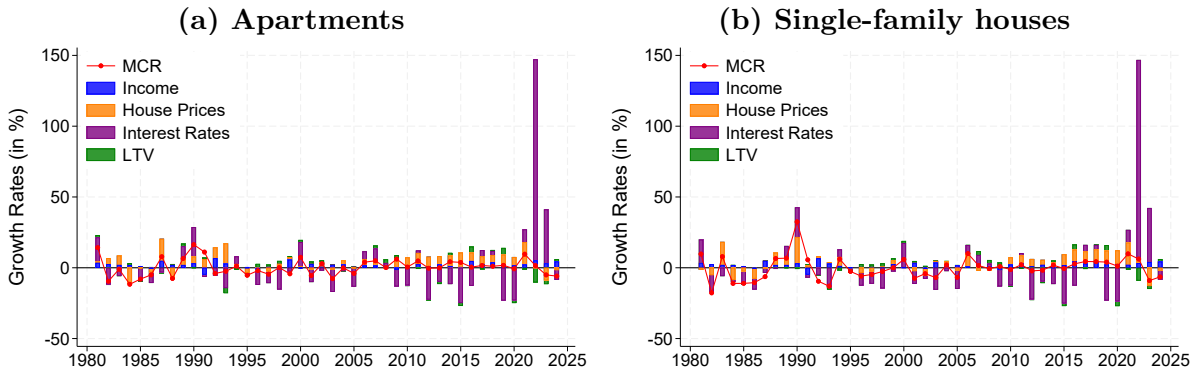
Figure 8: Upfront Costs to Income — Single-family houses



Notes: The figure shows the development of upfront costs relative to the disposable household income as defined in equation (3) for apartments. A UCR of 3 means that an average household has to pay 3 times their disposable household income in upfront costs.

Source: Boysen-Hogrefe (2017), DESTATIS, EMF (2010), GREIX, Interhyp group, National accounts of the German states, State-level legislation, vdp, Voigtländer (2016). Own calculation.

Figure 9: Growth rates of the MCR and its key drivers

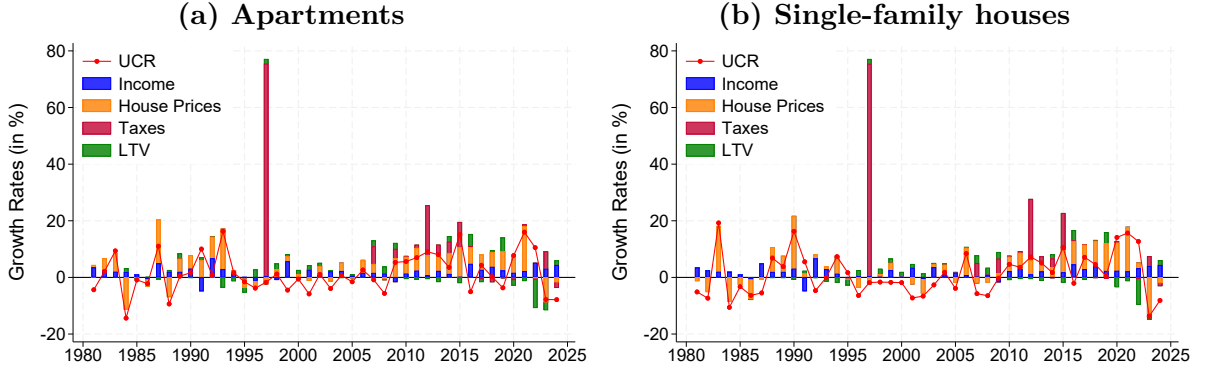


Notes: The figure shows the growth rates of core MCR variables as well as the MCR itself in per cent. The red line represents the MCR. A growing MCR means that households face on average a higher increase in yearly mortgage expenses than in income. The bars represent the overall growth of the main MCR variables.

Source: Bundesbank, DESTATIS, GREIX, Interhyp group, National accounts of the German states, vdp. Own calculation.

Additionally, we display the main drivers of upfront costs in a similar fashion (see Figure 10). While the UCR was mainly driven by price development pre-2006, growing tax rates exacerbated price development in the post-2006 period. LTVs play a minor role, except in 2022 when they drop significantly.

Figure 10: Growth rates of the UCR and its key drivers



Notes: The figure shows the growth rates of core UCR as well as the UCR itself in per cent. The red line represents the UCR. A growing UCR means that households face on average a higher increase in upfront costs than in income. The bars represent the overall growth of the main UCR variables.

Source: DESTATIS, GREIX, Interhyp group, National accounts of the German states, vdp, Voigtländer (2016). Own calculation.

D Robustness tests

In this section, we perform a series of robustness tests on our computations and data sources to demonstrate that our results are insensitive to changes in assumptions and data sources.

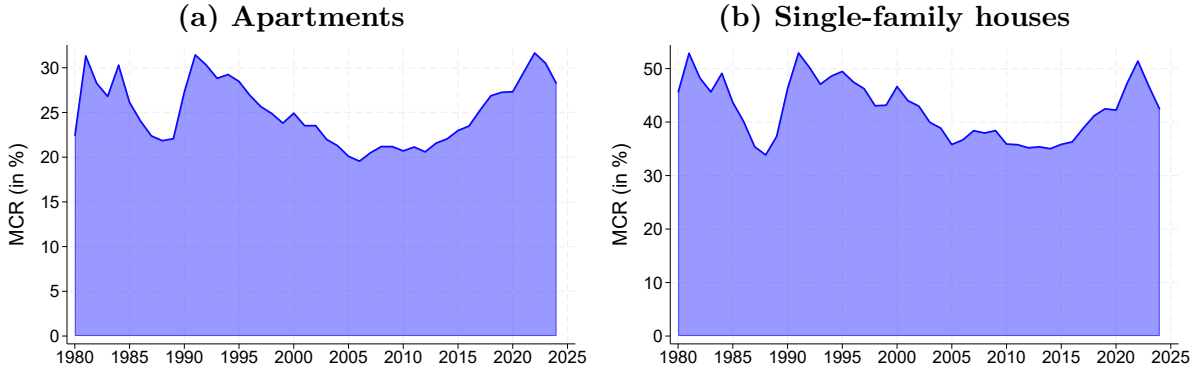
D.1 Hedonic price series

In our analysis, we rely on the usage of average prices to calculate our housing affordability ratios. However, this approach implies that we are likely comparing different types of housing over time. Characteristics such as the quality or the location of sold units are likely to develop over time. For example houses sold in 2024 may be more energy efficient than those in 1980. Moreover, it is possible that the composition of the housing stock differs as home buyer's preferences evolve. For example, if home buyers start buying bigger houses, the average house price will mechanically go up even if smaller and more affordable housing would might theoretically be available.

To account for shifts in housing characteristics, we use growth rates from the German Real Estate Index. The GREIX indices are based on the universe of transactions in the observed periods. Furthermore, for each city and segment, GREIX controls for multiple fine-grained variables. While these variables vary between cities and segments, certain core variables, such as housing size, are always included.²⁵ We calculate the average price per segment and city in 2014. We then track the development of house prices for apart-

²⁵A detailed documentation of the indices is [provided on the GREIX Website](#).

Figure 11: MCR — hedonic approach



Notes: The figure shows the development of mortgage cost relative to the disposable household income as defined in equation (1) for apartments and single-family houses. We use the average price in each city for 2014 and the growth rates of the GREIX indices to estimate the development of the house prices holding important characteristics such as size and housing quality constant. A mortgage cost ratio (MCR) of 30 means that an average household has to pay 30% of their disposable household income on mortgage costs.

Source: Bundesbank, DESTATIS, EUROPACE, GREIX, Interhyp group, National accounts of the German states, vdp. Own calculation.

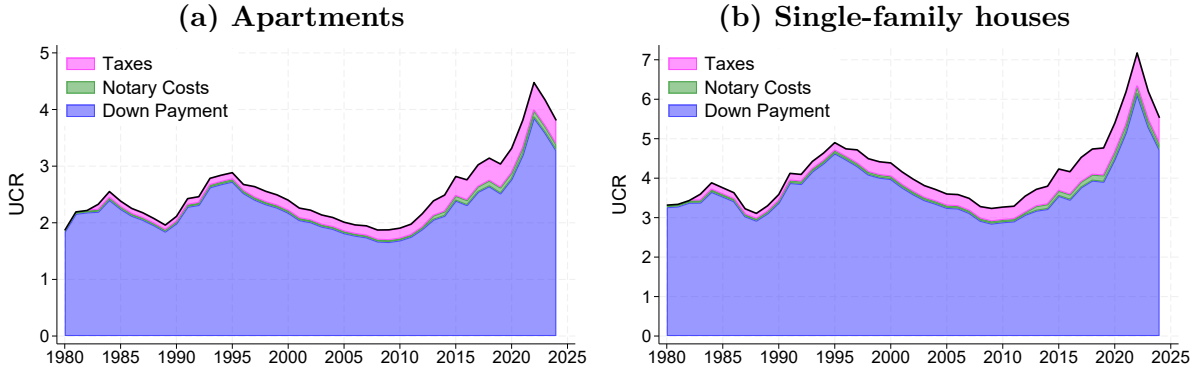
ments and single-family houses in individual cities during the 1980–2013 and 2015–2024 periods using GREIX growth rates. The results are presented in Figures 11 and 12.

As the results show, using hedonic growth rates yields similar results to our approach of using average house prices. We do not observe a clear long-term trend for the MCR. Hedonic-based MCRs support the results from Figure 2. Both apartments and single-family houses exhibit significant fluctuations during the period from 1980 to 2000. Afterwards, apartments show strong growth beginning around 2010, while single-family houses have a low MCR until 2016.

Analyzing UCR development using hedonic methods yields similar results to those obtained using the average price method, as shown in Figure 3. Both apartments and single-family houses exhibit relatively stable UCRs during the 1980–2010 period, with fluctuations occurring in the 1990s. Afterwards, the UCR rises drastically for both segments, peaking in 2022 at around 4.5 times the yearly disposable household income for apartments and around 7.2 for single-family houses.

Overall, a comparison of the hedonic approach and the average price approach reveals that changes in housing characteristics do not drive our results. Even when holding the typical house for each city in 2014 fixed, the same trends are observed. Furthermore, the peak in 2022 becomes even more pronounced when controlling for changes in housing characteristics in both the UCR and apartment MCR. Therefore, the most recent decline in affordability appears to be even more severe when controlling for other factors.

Figure 12: UCR — hedonic approach



Notes: The figure shows the development of upfront costs when compared to income. We use the average price in each city for 2014 and the growth rates of the GREIX indices to estimate the development of the house prices holding important characteristics such as size and housing quality constant. A UCR of 3 means that an average household has to pay 3 times their yearly disposable income in upfront costs on average when buying an apartment/single-family house. The share of the upfront costs that is due to taxes is represented by the pink area. Notary fees are represented by the green area. The part of the house price that is not covered by the mortgage loan is represented by the blue area.

Source: Boysen-Hogrefe (2017), DESTATIS, EMF (2010), GREIX, Interhyp group, National accounts of the German states, State-level legislation, vdp, Voigtländer (2016). Own calculation.

D.2 Different income types

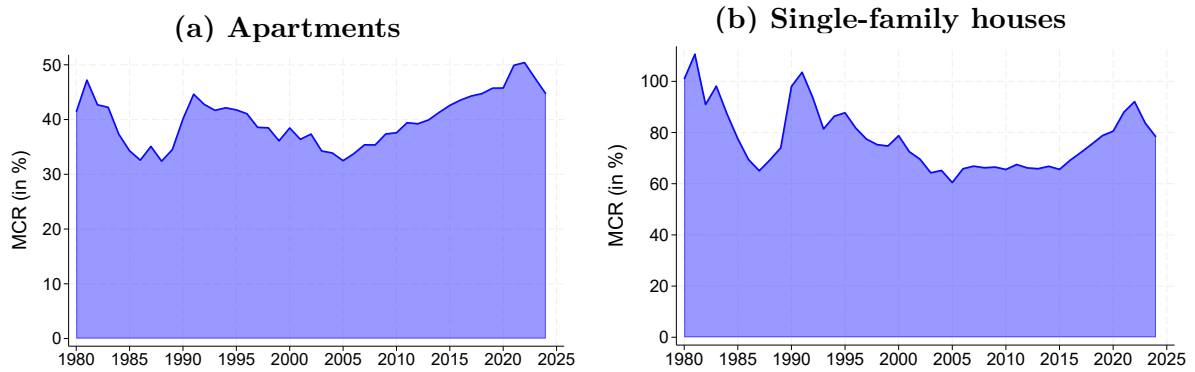
Another possible concern is that our results are influenced by the type of income we consider. To calculate household income, we combine data from a wide range of sources, which can lead to errors. Additionally, the average household size in cities is small, never exceeding two people. However, one could argue that the typical home-buying household is larger than average. For example, consider a young family with two children. This household would focus on a certain market segment, i.e., homes with enough space for four people.²⁶ Finally, different sources of income may influence our results. To address these concerns, we gathered a series of alternative income sources and calculated the MCR and UCR using different assumptions. The results are displayed below:

Disposable income per capita: To address the concern that merging multiple data sources might introduce bias into our results, we calculated the average disposable income per capita directly from the national accounts of states that provided both the total disposable income of private households and the number of inhabitants at the regional level. The results of this analysis are shown in Figures 13 and 14. As can be seen, the overall trend is consistent with our earlier results. The difference in levels can be explained by the fact that we did not correct for household size. Note that this method has significant limitations: Homes are rarely financed by a single person, but rather by an entire household. Thus, per capita disposable income is not well-suited to estimating housing affordability. Furthermore, since the total number of residents includes nonworking people,

²⁶Sagner and Voigtländer (2025) aim to solve this issue by constructing a model household with 1.5 full-time earners from the upper-end of the income distribution that buys a single-family house of 130m².

such as retirees and young children, this income measurement is expected to significantly underestimate the average income of a working person.

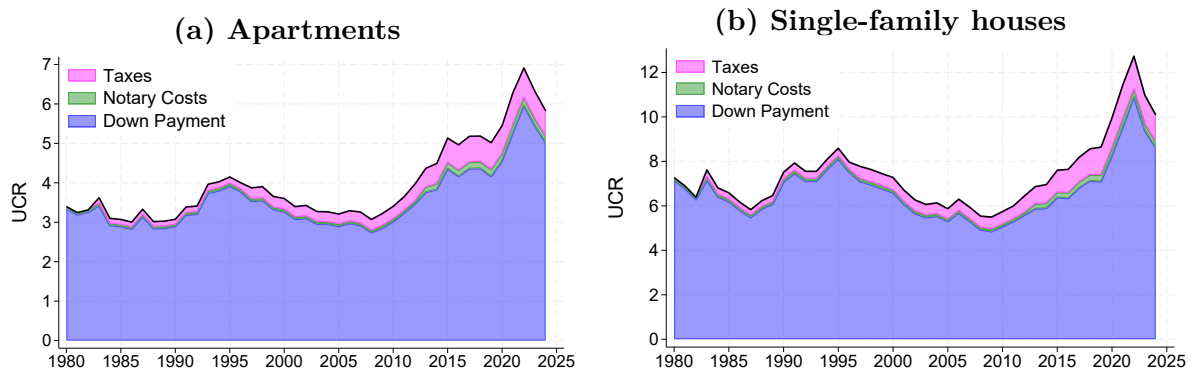
Figure 13: MCR — per-capita income



Notes: The figure depicts the development of the MCR over time, using the average income per person for reference. While the absolute value of the MCR differs from our findings in section 4 as households typically consists of more than just one person, the overall trend stays the same for both apartments and single-family houses.

Source: Bundesbank, DESTATIS, EUROPACE, GREIX, Interhyp group, National accounts of the German states, vdp. Own calculation.

Figure 14: UCR — per-capita income



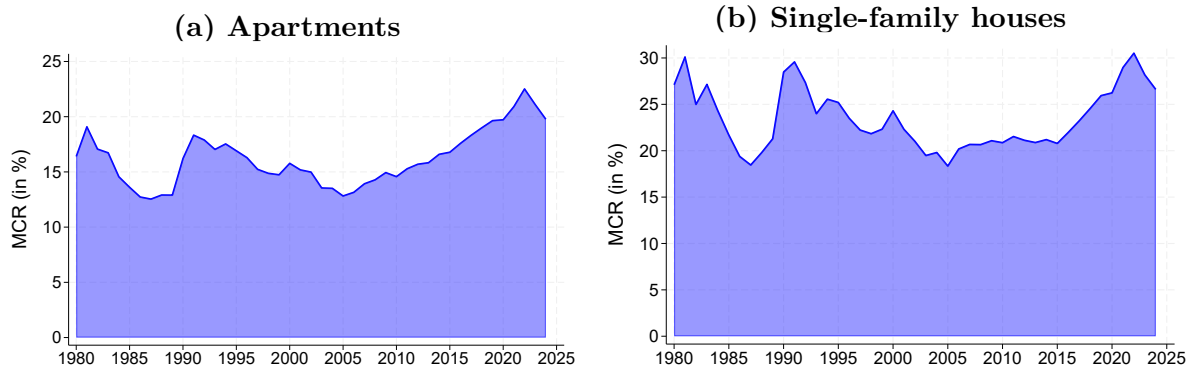
Notes: The figure depicts the development of the UCR over time, using the average income per person for reference. While the absolute value of the UCR differs from our findings in section 5 as households typically consists of more than just one person, the overall trend stays the same for both apartments and single-family houses.

Source: DESTATIS, EMF (2010), GREIX, National accounts of the German states, State-level legislation, vdp, Voigtländer (2016). Own calculation.

Model family income: To model the income of the average family, we estimate income per employee using data on the number of employees from the statistical offices of the German states. Then, we combine this data with the national accounts to compute the average disposable income per employee. Assuming each family has two earners, we multiply this value by two. Additionally, we account for families' higher demand for space by including only apartments larger than 80m² in our sample. For single-family houses, we use the full sample. The results of this analysis are displayed in Figures 15 and 16. Once again, the levels differ because the estimated model family has a much higher income than

the average household. This is by design, as there are fewer employees than total residents, and the average household size in our cities is below two. Additionally, since we only considered a non-random selection of apartments, the prices in that segment are higher than in our previous calculations. Note that this method has two main caveats. First, as total disposable income includes transfers such as pensions or unemployment benefits, our calculations likely overestimate the average income of an employee. Furthermore, it seems unrealistic to assume that the total number of employees per home-buying family has remained constant at two since the 1980s, given that the number of women in the workforce has decreased substantially since then. While it might be reasonable to assume a constant number of employees for the model family for short-term housing affordability measures constructed by Sagner et al. (2025), this assumption is unfit for our endeavor.

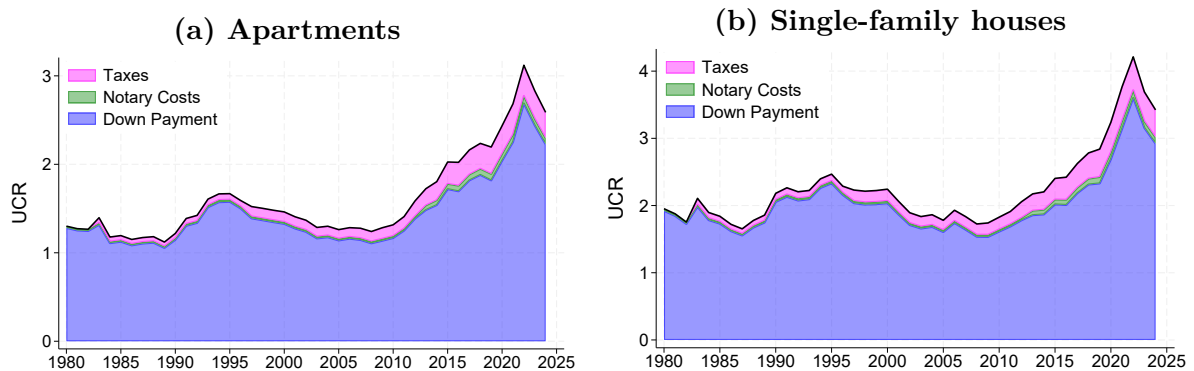
Figure 15: MCR — model-family income



Notes: The figure depicts the development of the MCR over time, using the income of a model family with two average employees as a reference. While the absolute value of the MCR differs from our findings in section 4, the overall trend stays the same for both apartments and single-family houses.

Source: DESTATIS, EUROPACE, GREIX, Interhyp group, National accounts of the German states. Own calculation.

Figure 16: UCR — model-family income

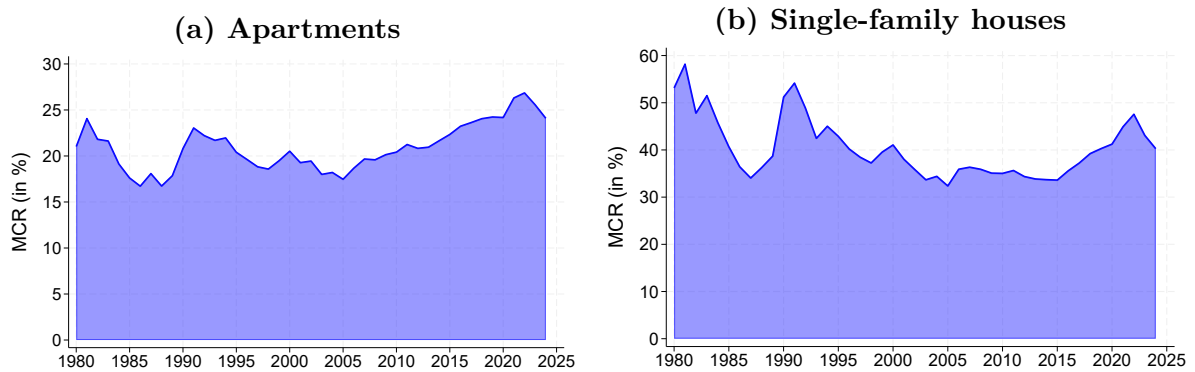


Notes: The figure depicts the development of the UCR over time, using the income of a model family with two average employees as a reference. While the absolute value of the MCR differs from our findings in section 4, the overall trend stays the same for both apartments and single-family houses.

Source: DESTATIS, EMF (2010), GREIX, National accounts of the German states, State-level legislation, vdp, Voigtländer (2016). Own calculation.

Gross median income: To test the robustness of our findings with respect to the usage of different income sources and measurements, we begin by comparing them to data from the Federal Employment Agency (Bundesagentur für Arbeit).²⁷ This data includes the gross median income for all full-time employees from 19 of our 21 cities, excluding Hamm and Bochum.²⁸ Using this income introduces major problems to our method. First, we use average values for house prices and housing finance data, which makes the median income unfit for comparison with the rest of our data. Second, since we have the gross income, we do not know how much money the median full-time employee actually has. Third, the income type focuses only on a subsample of the working population — the full-time employed — and may therefore not be representative of the population as a whole. Despite these caveats, using the gross median income once again reveals the same overall trend in MCR and UCR as shown in Figures 17 and 18.

Figure 17: MCR — gross median income



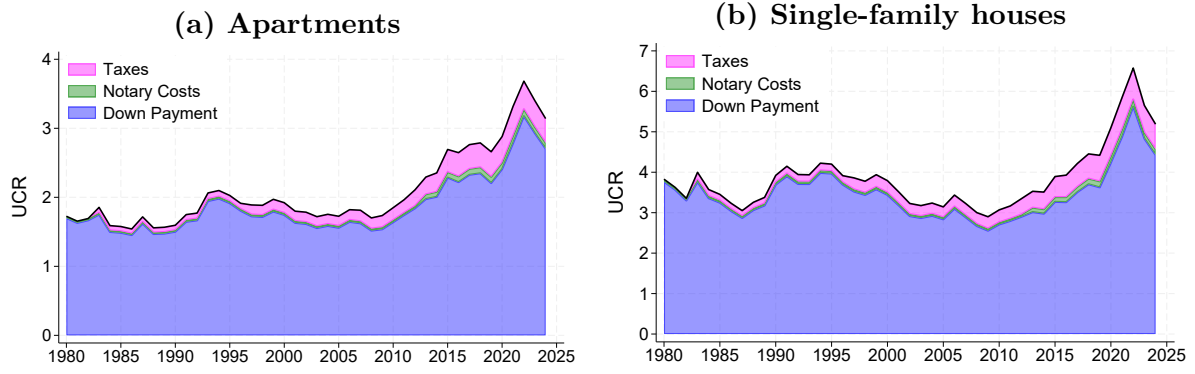
Notes: The figure depicts the development of the MCR over time, using the gross median income of a full-time employed resident as a reference. While the absolute value of the MCR differs from our findings in section 4, the overall trend stays the same for both apartments and single-family houses.

Source: DESTATIS, EUROPACE, Federal Employment Agency, GREIX, Interhyp group. Own calculation.

²⁷Note that the preceding tests are all based on the same source of income, which is sourced from the national accounts and statistical yearbooks.

²⁸Note that Sagner and Voigtländer (2025) source their income from the same source although their sample focuses on the 75th percentile of the income distribution and includes every region in Germany. While we use the gross income, Sagner and Voigtländer (2025) aim to estimate the net income from this data.

Figure 18: UCR — gross median income

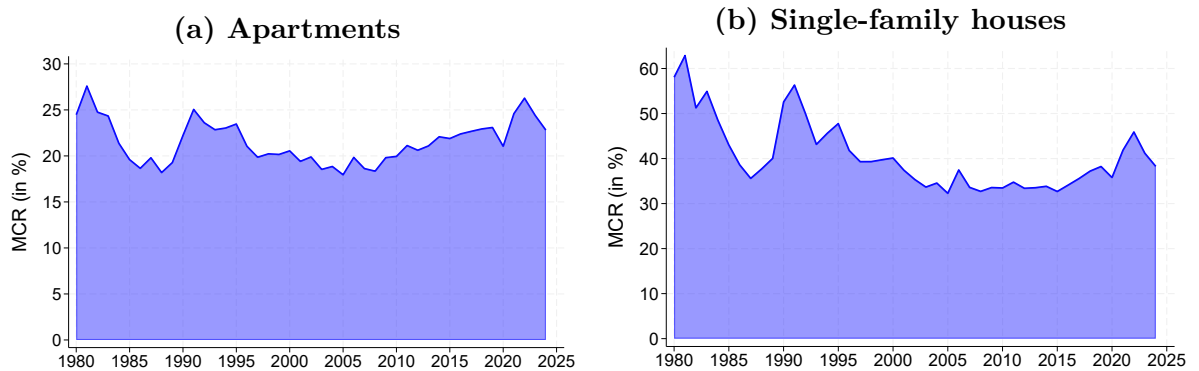


Notes: The figure depicts the development of the UCR over time, using the gross median income of a full-time employed resident as a reference. While the absolute value of the MCR differs from our findings in section 4, the overall trend stays the same for both apartments and single-family houses.

Source: DESTATIS, Federal Employment Agency, EMF (2010), GREIX, State-level legislation, vdp, Voigtländer (2016). Own calculation.

Eurostat disposable income: Finally, we calculate the MCR and UCR using Eurostat data on disposable household income and household sizes, as set out in Biljanovska et al. (2023). Conceptually, this is the same approach that we used. However, as the Eurostat data is national rather than urban-specific, two important structural differences emerge. Firstly, the average disposable income per capita is lower than our estimate, as cities tend to offer higher-paid jobs. Secondly, the average household size estimated by us is smaller than that estimated by Eurostat, as urban regions tend to be home to larger families. These differences render the Eurostat data suboptimal for addressing the issue of urban housing affordability. Nonetheless, we once again find that, despite the differences in levels, the overall trend remains consistent when using the Eurostat data, as illustrated in Figures 19 and 20.

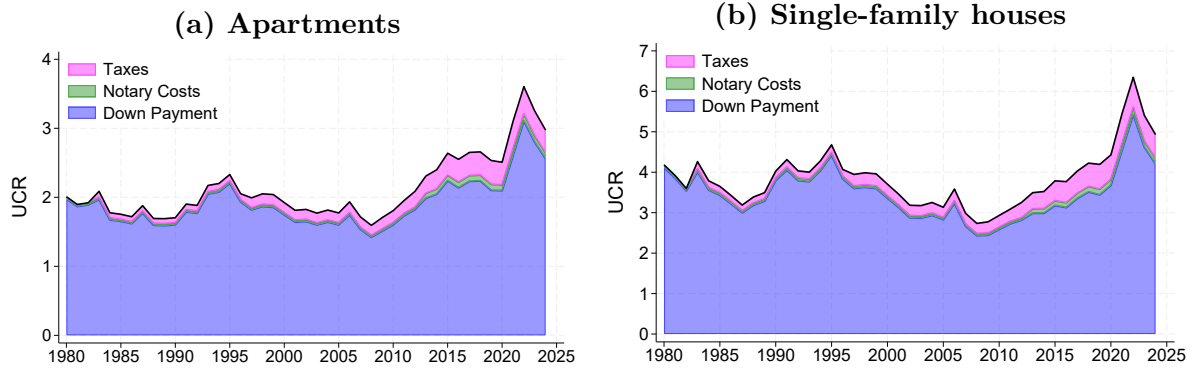
Figure 19: MCR — Eurostat income



Notes: The figure depicts the development of the MCR over time, using the average disposable income of a German household including urban areas as a reference. While the absolute value of the MCR differs from our findings in section 4, the overall trend stays the same for both apartments and single-family houses.

Source: DESTATIS, EUROPACE, Federal Employment Agency, GREIX, Interhyp group. Own calculation.

Figure 20: UCR — Eurostat income



Notes: The figure depicts the development of the UCR over time, using the average disposable income of a German household including urban areas as a reference. While the absolute value of the MCR differs from our findings in section 4, the overall trend stays the same for both apartments and single-family houses.

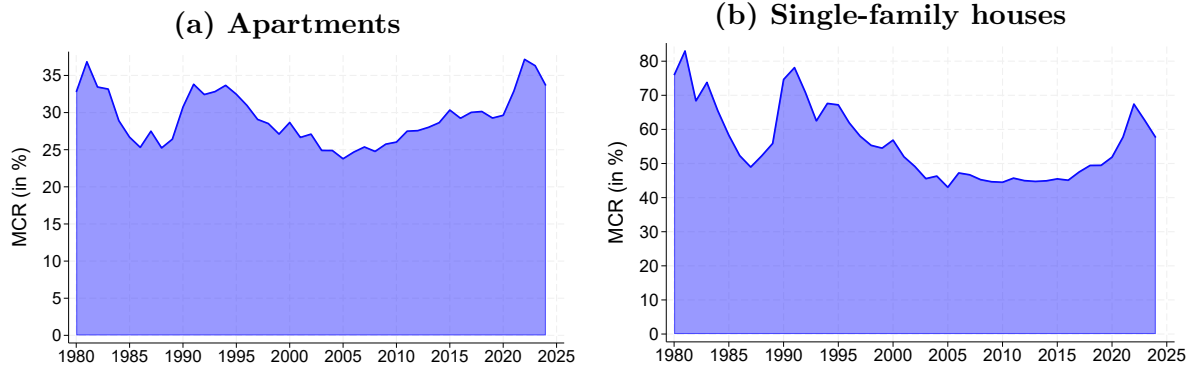
Source: DESTATIS, Federal Employment Agency, EMF (2010), GREIX, State-level legislation, vdp, Voigtländer (2016). Own calculation.

D.3 Housing Affordability assuming constant LTV

Another possible point of concern for our analysis is the endogeneity of the loan-to-value (LTV) ratio. As previously explained, changes in LTV influence both the mortgage and the upfront costs, as the LTV essentially defines the proportion of housing costs allocated to monthly payments and upfront costs, respectively. For example, if households' preferences change over time, making paying costs up front more attractive — for example, as German households accumulate wealth over the generations — we would observe a decrease in LTV and an increase in upfront costs, which would not be due to a decrease in housing affordability, but rather the voluntary decision of German households. To account for this effect, we calculate the MCR and the UCR keeping the LTV fixed at 80% of the house price. As shown in Figures 21 and 22, the overall trends for both apartments and single-family houses align with our previous findings in Sections 4 and 5.²⁹

²⁹Note that the overall trend is independent of the level of LTV chosen. Changing the level of LTV would alter the absolute values and growth rates of the MCR/UCR, but not the trend.

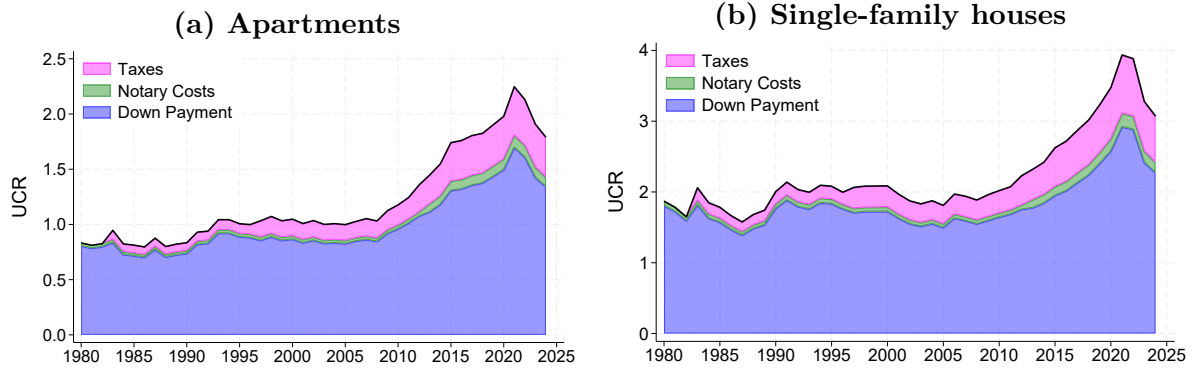
Figure 21: MCR assuming LTV=80%



Notes: The figure depicts the development of the MCR over time, assuming a constant LTV of 80%. While the absolute value of the MCR differs from our findings in section 4 as the assumed LTV is much higher than the LTV values in our data, the overall trend stays the same for both apartments and single-family houses.

Source: Bundesbank, DESTATIS, EUROPACE, GREIX, Interhyp group, National accounts of the German states. Own calculation.

Figure 22: UCR assuming LTV = 80%



Notes: The figure depicts the development of the UCR over time, assuming a constant LTV of 80%. Despite differences in levels — Since 80% LTV is much higher than what we observe in the data, the UCR is lower than in our results — the overall trend for both apartments and single-family homes prevails.

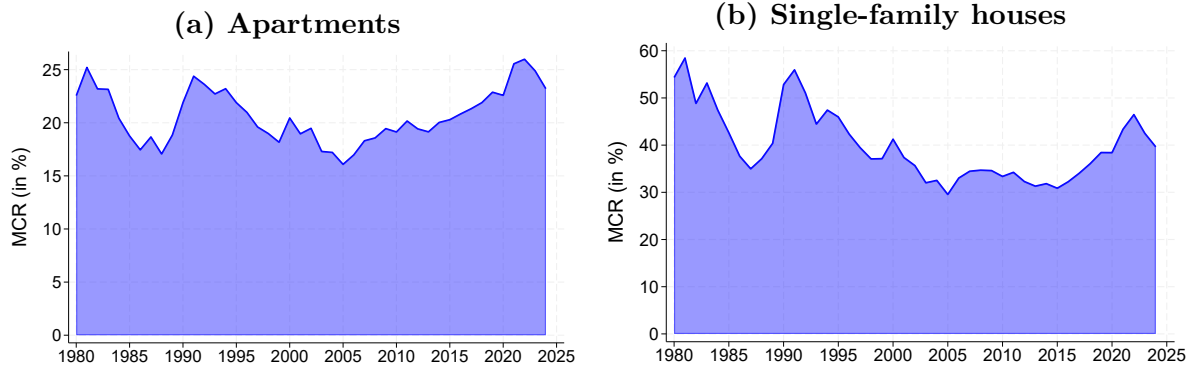
Source: DESTATIS, EMF (2010), GREIX, National accounts of the German states, State-level legislation, Voigtländer (2016). Own calculation.

D.4 Housing Affordability assuming constant maturities

As data on mortgage repayment rates is particularly scarce in Germany, we use a regression model to derive values from existing data for our main calculations. As previously mentioned, the results of this regression are consistent with typical assumptions about maturity. However, concerns may be raised about the validity of our approach. To address these, we calculate the MCRs for apartments and single-family houses based on the assumption of a constant term to maturity. By assuming that mortgage loans will be repaid within 25 years, we adopt the strategy of Biljanovska et al. (2023) and avoid using any data on repayment rates whatsoever. As repayment rates do not influence the development of upfront costs, we do not include the UCR in this robustness check. The

results are presented in Figure 23. As can be seen, the estimated MCRs differ neither significantly in trend nor in level from our main results. This is not surprising, given that the estimated range of maturities in our results — 21–28 years — aligns well with the assumption of a maturity of 25 years.

Figure 23: MCR assuming a maturity of 25 years



Notes: The figure depicts the development of the MCR over time, assuming constant term to maturities of 25 years.

Source: Bundesbank, DESTATIS, GREIX, Interhyp group, National accounts of the German states, vdp. Own calculation.

D.5 Composition effects

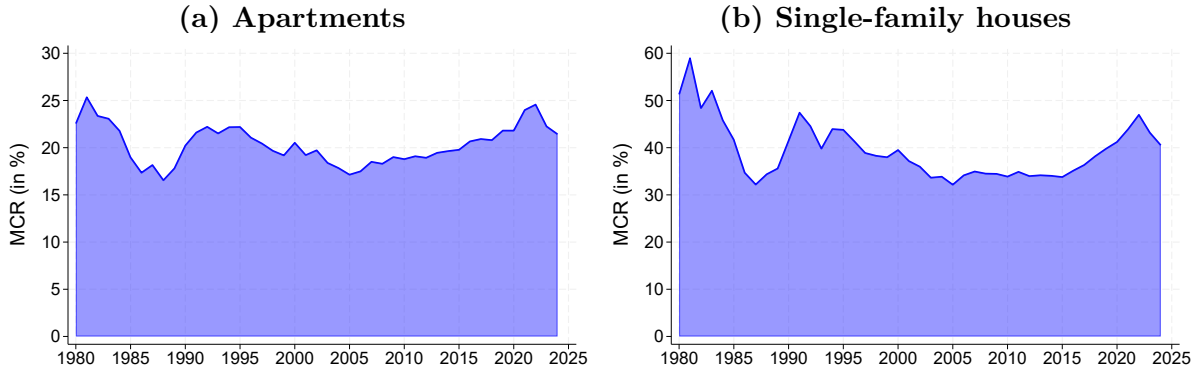
Third, we address the question of whether changes in the composition of cities alone drive our housing affordability ratios. As we weight by the number of transactions and do not have observations for each city prior to 1980 (see Table 1), two potential issues arise. First, our results may be dominated by the largest cities, which also have the greatest number of observations. Second, our results may be distorted by cities that joined the calculation after 1980, particularly the East German cities that joined in the 1990s following reunification and the introduction of the market economy. To address these concerns, we perform two types of robustness test.

Giving each city equal weights: To address the first concern, namely whether the results are driven by the largest German cities, we re-calculated the MCR and UCR, allocating a weight of one to each city instead of weighting by the number of observations per year. The results are shown in Figures 24 and 25. The trend remains unchanged, showing that our general results are not due to an overweighting of large cities.

Balanced panel: To address the concern that our results may be influenced by the inclusion of new cities in our analysis during the observed period, we calculate our housing affordability rates using a balanced panel comprising only those cities for which we have a sizeable amount of observations from 1980 onwards.³⁰ The results are displayed in

³⁰For apartments, these cities are: Dortmund, Duisburg, Düsseldorf, Hamburg and Munich. For single-family houses, these are: Dortmund, Duisburg, Düsseldorf, Frankfurt am Main and Hamburg.

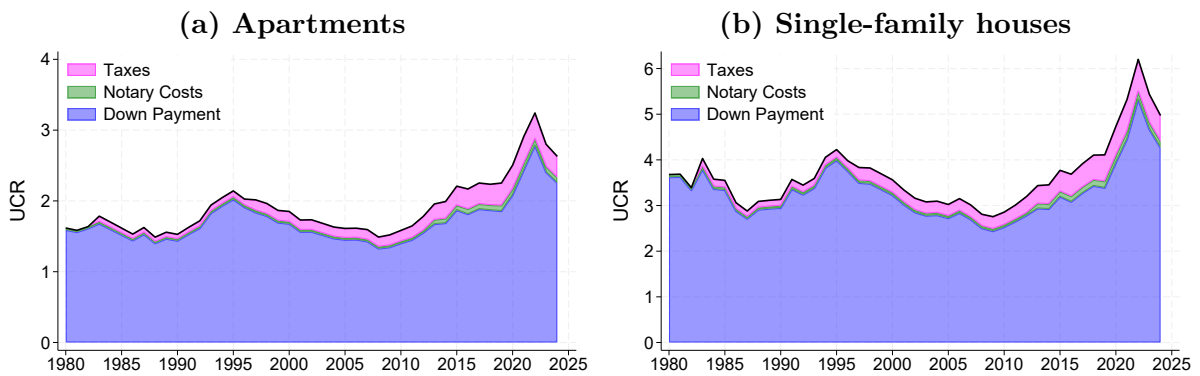
Figure 24: MCR — equal weights



Notes: The figure shows the development of mortgage cost relative to the disposable household income giving each city a constant weight of one when aggregating income, house prices, and finance variables to the national average.

Source: Bundesbank, DESTATIS, EUROPACE, GREIX, Interhyp group, National accounts of the German states, vdp. Own calculation.

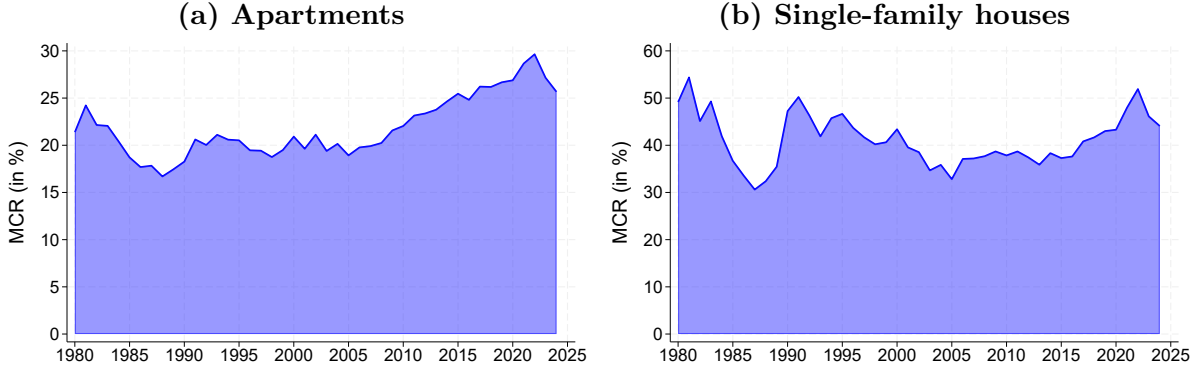
Figure 25: UCR — equal weights



Notes: The figure shows the development of upfront costs cost relative to the disposable household income giving each city a constant weight of one when aggregating income, house prices, and finance variables to the national average.

Source: Boysen-Hogrefe (2017), DESTATIS, EMF (2010), GREIX, Interhyp group, National accounts of the German states, State-level legislation, vdp, Voigtländer (2016). Own calculation.

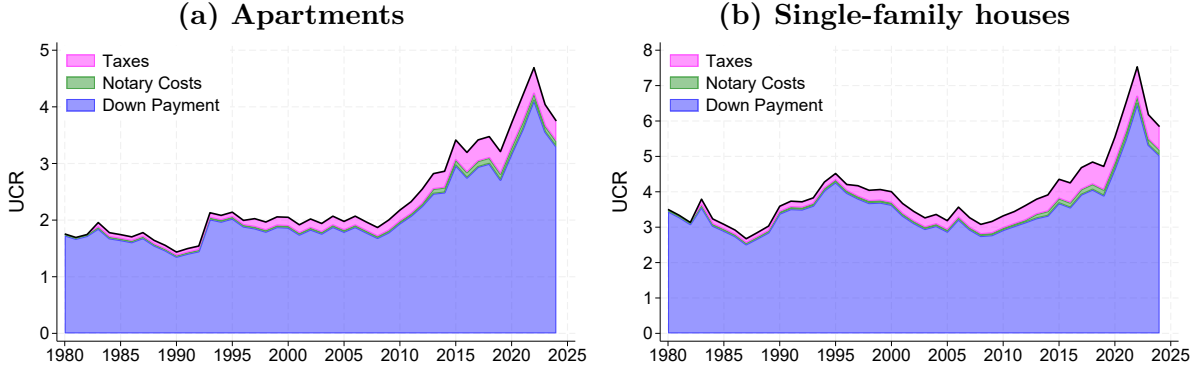
Figure 26: MCR — balanced panel



Notes: The figure shows the development of mortgage cost relative to the disposable household income for a balanced panel of cities weighted by the number of transactions.

Source: Bundesbank, DESTATIS, EUROPACE, GREIX, Interhyp group, National accounts of the German states, vdp. Own calculation.

Figure 27: UCR — balanced panel



Notes: The figure shows the development of upfront costs cost relative to the disposable household income for a balanced panel of cities weighted by the number of transactions.

Source: Boysen-Hogrefe (2017), DESTATIS, EMF (2010), GREIX, Interhyp group, National accounts of the German states, State-level legislation, vdp, Voigtländer (2016). Own calculation.

Figures 26 and 27. Notably, our overall trend remains unchanged, and the fluctuations observed in the 1980s and 1990s, when many cities are included into our sample, are still present in the balanced panel, albeit sometimes reduced, as in the case of single-family houses in the 1990s.

D.6 Alternative MCR calculation

Finally, we note that many of our scholars opt for calculating mortgage costs via term-to-maturities rather than IR and RR. Biljanovska et al. (2023) assume maturities of 25 years and estimate the mortgage payment using equation 4:

$$\text{Mortgage payment} = HP * LTV * \frac{IR}{12} * \left[1 - \frac{1}{\left(1 + \frac{IR}{12}\right)^{MA}}\right]^{-1}, \quad (4)$$

where MA stands for term-to-maturity. Additionally, although Sagner and Voigtländer (2025) have data on RR and IR , they also opt to estimate the required mortgage payment by first estimating maturities. To make our results more comparable to existing literature, we estimate the term to maturity, assuming — as before — that households pay a fixed rate of

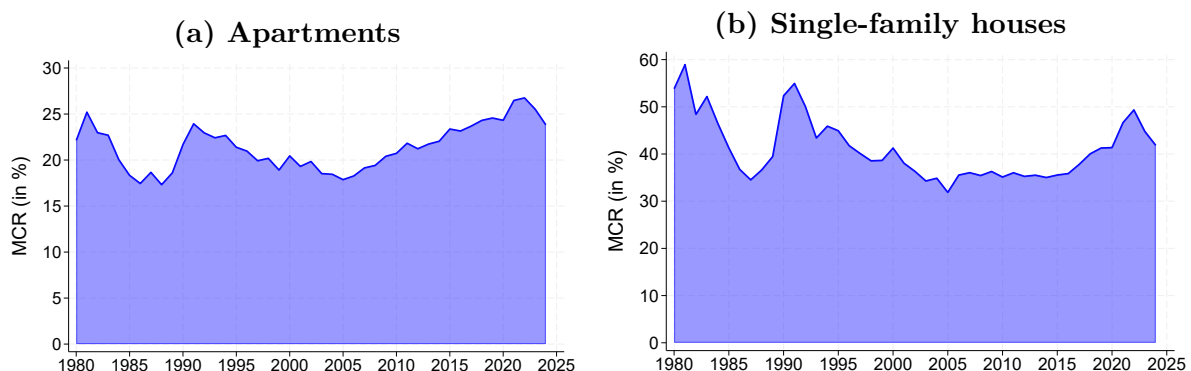
$$HP * LTV * (IR + RR).$$

We also assume that, in each period t , a value of

$$mortgage_t * IR$$

is added to the mortgage. Using this framework, we run a loop in Stata to estimate the number of periods required to reduce the mortgage to zero. The estimated term to maturity is then substituted into equation (4). The results are displayed in Figure 28. They differ from our findings neither in level nor in trend.

Figure 28: MCR using the computation of Biljanovska et al. (2023)



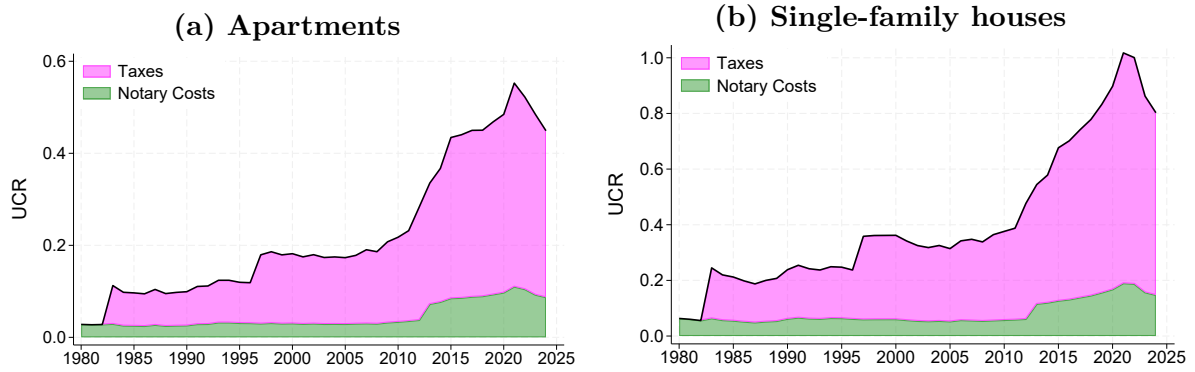
Notes: The figure depicts the development of the MCR over time, using an alternative computation via term-to-maturities. The results are the same in trend and level to our main findings.

Source: Bundesbank, DESTATIS, EUROPACE, GREIX, Interhyp group, National accounts of the German states, vdp.. Own calculation.

E The development of taxes and notary fees

To demonstrate the growing significance of taxes and notary fees, we plot the evolution of the initial costs under the assumption that the mortgage loan covers 100% of the house price. In this case, the upfront costs only comprise the obligatory administrative costs: taxes and notary fees. Figure 29 displays the UCR's development under this assumption. For apartments, the UCR increases more than fourfold between the introduction of transfer tax in 1983 and its peak in 2021, rising from 13% to 55% of the average yearly household income for single-family houses. In the same segment, the UCR increases by around 35 percentage points, from 29% to 103%, in the same period.

Figure 29: The role of taxes and notary costs in the UCR



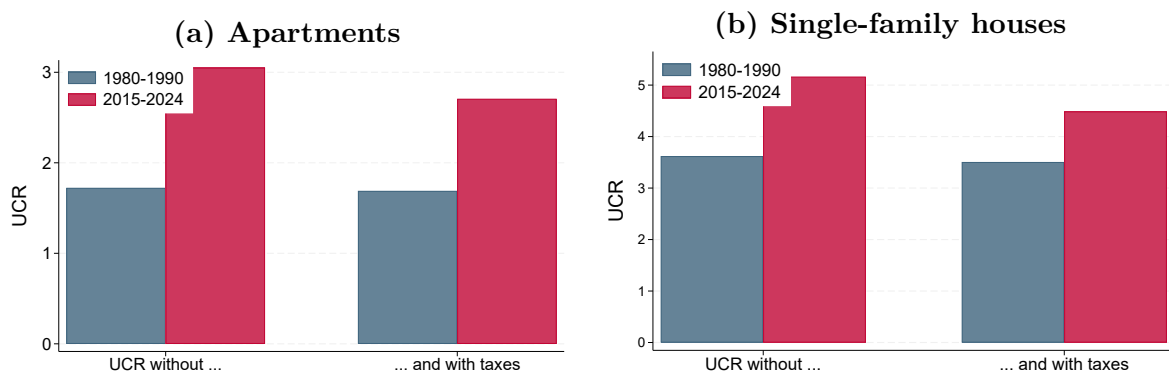
Notes: The figure shows the development of the UCR under full price coverage by the mortgage — i.e. under an LTV of 100%. The green area describes the development of the notary costs, including land registry costs. The pink area displays the role of taxes. A UCR of 0.3 means that households need to pay 30% of their yearly disposable income in notary costs and taxes.

Source: DESTATIS, EMF (2010), GREIX, National accounts of the German states, State-level legislation, Voigtländer (2016). Own calculation.

F UCR — Tax vs. no tax

Another way to demonstrate the impact of the real estate transfer tax on housing affordability is to consider a world without such a tax. Figure 30 uses comparative statics to illustrate this. While the UCR increases by 32% in the current scenario with the tax, this increase drops to 21% in the scenario without the tax. Additionally, overall UCR levels are significantly lower. In 2024, some buyers must pay 3.2 times their yearly disposable income upfront, but without the tax, this amount falls to 2.8.

Figure 30: UCR development — tax vs. no tax



Notes: The figure shows the development of mortgage costs comparing baby boomers buying houses in 1980–1990 and millennials buying houses in 2015–2024 for apartments and single-family houses respectively. On the left side of each panel, the current situation including the real estate transfer tax is depicted. The right side shows a hypothetic scenario, using comparative statics to estimate the development of the UCR without the presence of the real estate tax but including the notary costs. As the figure shows, absent of the transfer tax, not only would overall upfront costs be lower but they would have also risen much less.

Source: Boysen-Hogrefe (2017), DESTATIS, EMF (2010), GREIX, Interhyp group, National accounts of the German states, State-level legislation, vdp, Voigtländer (2016). Own calculation