HOUSING EXPENDITURE AND INCOME INEQUALITY*

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The trend of rising income inequality in Germany since the mid-1990s is strongly amplified when considering income after housing expenditure. The income share of housing expenditure rose disproportionally for the bottom income quintile and fell for the top quintile. Factors contributing to these trends include declining relative costs of homeownership versus renting, changes in household structure, declining real incomes for low-income households and residential mobility towards larger cities. Younger cohorts spend more on housing and save less than older cohorts did at the same age, which will affect future wealth accumulation, particularly at the bottom of the income distribution.

Inequality of both earnings and household incomes has sharply increased in Germany since the mid-1990s (Dustmann *et al.*, 2009; 2014; Fuchs-Schündeln *et al.*, 2010; Biewen and Juhasz, 2012). Work for the United States suggests that regional mobility and differences in the regional costs of living may offset some of the rise in inequality between high-skilled and low-skilled workers (Moretti, 2013). On the other hand, increases in housing costs can also amplify income inequality *after* housing expenditure (Albouy *et al.*, 2016). This may be particularly so for Germany, where a far higher share of households at the lower end of the income distribution are renters in comparison to the UK and the United States, so that changes in rental versus housing prices can have dramatic effects on inequality in income after housing. Disproportional changes in housing expenditure along the distribution of income can also be induced by demographic alterations in, e.g., the share of single households, changes in the quality of living space or how individuals along the distribution of income are affected by housing support and rent regulation. Whether and, if so, to what extent and why inequality in income after housing has changed more than inequality income before housing is a central yet understudied question. It has important direct implications for our understanding of consumption inequality, savings patterns and wealth accumulation. Moreover, it is essential for assessing future opportunities of young generations (Belfield *et al.*, 2015; Saez and Zucman, 2016; Goodman and Mayer, 2018).

We address these questions in this paper. Our analysis shows that differential trends in housing expenditure along the distribution of income have dramatically increased inequality in income after housing expenditure. Whereas the 50/10 ratio of net equivalised household income increased

from 1.75 to 1.97 (by 22 percentage points, henceforth pp) between 1993 and 2013, the same ratio *after* housing expenditure increased threefold, from 1.97 to 2.59 (by 62 pp). For individuals in the bottom income quintile, the share of income spent on housing increased from 27% in 1993 to 39% in 2013, while the share of non-housing expenditure decreased from 72% to 63% and the savings rate decreased from 2% to −1%. Hence, the increase in real housing expenditure vastly amplified the effect of the loss in real income. For high-income groups, in contrast, these changes were reversed, with the share spent on housing decreasing from 16% to 14% in the top quintile of net household income.

To understand the reasons for these trends, we first focus on the change in housing costs for renters versus owner-occupiers. Rental prices increased overall during the 1990s due to privatisation, a reduction in the availability of social rental housing (whose subsidised rents are cheaper than those in private markets) and an increase in residential mobility (since new rental contracts are set at higher prices than existing agreements). These trends mostly affected individuals in the lower part of the income distribution, who are disproportionally renters with higher rates of residential mobility. Individuals further up the income distribution, who are more frequently homeowners, were hardly affected by these trends, but benefited from falling mortgage interest rates, especially since the late 2000s, which further amplified inequality after housing expenditure. Holding constant the quality of housing and socio-demographic characteristics, differential changes in the cost of housing explain 41% of the increase in the housing expenditure share for the bottom income quintile, and 75% of the reduction for the top income quintile.

Compositional changes were another important factor for the increase in after-housing inequality. Household size was shrinking throughout the 1990s and 2000s, due primarily to a rising share of single households. This trend was strongest at the bottom of the income distribution, where it led to an increase in housing expenditure per capita. Moreover, migration from East to West Germany during the 1990s and movements of low-income individuals to more expensive urban areas during the 2000s additionally contributed to an increase in after-housing inequality. Lastly, because housing is a necessity good, declining real incomes at the lower end of the distribution further increased the share of income spent on housing. Together, these changes in observed household and housing characteristics account for 59% of the increase in the housing expenditure share in the bottom income quintile and for 25% of the decline in the top quintile.

Incomes between owner-occupiers and renters are not straightforwardly comparable, as they include on the side of owner-occupiers not only the imputed rental value of the home minus the actual housing expenditure ('net imputed rents'), but also capital gains and losses on housing wealth.[1] Adjusting incomes of owner-occupiers by net imputed rents and capital gains, we find that this changes trends in inequality (both in levels and in changes over time) only slightly. That capital gains played only a minor role for changes in the income distribution in Germany is not surprising given the modest movements in house prices. It stands in contrast to the United States and the UK, due to their sharper long-run rise in house prices (Knoll *et al.*, 2017).

Turning to the intertemporal implications of our findings, we illustrate that successive birth cohorts experience higher inequality at any given age. Younger cohorts also spend more of their income on housing, and save less, than older cohorts did at the same age. This holds in particular

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[1] The role of net imputed rents is analysed in Frick and Grabka (2003). For capital gains, Kaplan *et al.* (2020) emphasised that adjusting income for capital gains for owner-occupiers is important in understanding the boom and bust in the US housing market, where the user costs of housing property plays a key role. Smeeding and Thompson (2011) and Larrimore *et al.* (2021) for the United States and Eika *et al.* (2020) for Norway considered the role of capital gains when measuring income inequality.

for young individuals at the bottom of the income distribution. These trends are concerning and likely to translate into future wealth inequality.

Our paper contributes to the inequality literature by demonstrating that changes in the housing market can be a key driver for increased inequality in income after housing expenditure, leading to a divergence in consumption and savings patterns across income groups.[2] Our work also relates to the literature on consumption inequality. While existing papers (e.g., Heathcote *et al.*, 2010; Meyer and Sullivan, 2013; Attanasio and Pistaferri, 2016 for the United States, Blundell and Etheridge, 2010 for the UK and Fuchs-Schündeln *et al.*, 2010 for Germany) concentrate mostly on overall consumption, we focus instead on housing as consumption's most important component, especially for low-income individuals. By showing that prices for one important consumption good—housing—differ across the income distribution, our work complements research by Kaplan and Schulhofer-Wohl (2017), who illustrated that low-income individuals face higher inflation rates than high-income individuals for consumer goods sold in retail stores.

Our research adds also to the literature on housing markets by investigating developments in Germany, where homeownership is not only less common than in the United States or the UK, but also less equally distributed along the income distribution, driven by stricter mortgage regulations and the virtual absence of a sub-prime lending market (German Council of Economic Experts, 2013; Voigtländer, 2014).[3] We demonstrate that, although Germany is often seen as an outlier due to its (until recently) far more moderate house price development (Knoll *et al.*, 2017), it shows similar trends as the United States and the UK in rising housing expenditure shares for renters and low-income individuals (Quigley and Raphael, 2004; Albouy *et al.*, 2016; Larrimore and Schuetz, 2017 for the United States and Belfield *et al.*, 2015 for the UK).[4] Lastly, our paper contributes to the literature on the role of regional price differences for inequality (Moretti, 2013; Diamond, 2016). In contrast to findings by Moretti (2013) for the United States, our analysis shows that in Germany, trends in regional mobility reinforce the rise in income inequality in real terms rather than mitigating it.

In the next section we develop a simple model to derive the implications of changes in prices for housing, subsistence level and household structure for income inequality and household welfare, which serves as a framework to interpret our empirical results. Subsection 2.1 provides background information on the German housing market and compares some basic features with the UK and the United States. Subsection 2.2 describes the datasets used. Section 3 discusses the core facts of the trends in household income inequality and housing expenditure across income groups. It also addresses the measurement of income and housing expenditure for owner-occupiers. Section 4 explores explanations for the observed trends and Section 5 concludes the paper.

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[2] Our analysis ignores behavioural responses to changing housing expenditure on, e.g., labour supply, household formation or fertility. Analysis of these aspects is beyond the scope of this paper.

[3] To our knowledge, we are the first to provide a comprehensive analysis of these issues for Germany. Most existing papers for Germany focus on renters only (see, e.g., Backhaus *et al.*, 2015; Grabka and Verbist, 2015; Fitzenberger and Fuchs, 2017). Schier and Voigtländer (2015) used aggregate data and showed that the costs of homeownership versus renting have decreased in recent years, driven by a fall in mortgage interest rates, but these authors did not consider distributional effects.

[4] The literature for Anglo-Saxon countries has also focused on housing affordability for younger cohorts (Belfield *et al.*, 2015; Goodman and Mayer, 2018) and in large cities (Gyourko *et al.*, 2013; Glaeser and Gyourko, 2018; Metcalf, 2018).

1. Conceptual Framework

We develop a simple theoretical framework that has clear-cut predictions on the relationship between housing consumption, income inequality before and after housing, and household welfare. The model also motivates the analysis of income after housing expenditure as a measure of welfare.

We build on a Stone-Geary utility function with housing being a necessity.[5,6] Consumers maximise utility (1a) by choosing the optimal levels of housing and non-housing consumption subject to a budget constraint (1b):

$$\max_{h,x} u(h, n, x) = n^{-\phi}(h - n^{\phi}\bar{h})^a x^{1-a} \tag{1a}$$

$$\text{such that} \quad p_h h + x = y. \tag{1b}$$

Here h and x denote the household's total housing and non-housing consumption and y is household income. There are n household members and n^{ϕ} denotes the equivalence scale with ϕ being the congestion parameter. Here, $\phi = 1$ denotes the case of no economies of scale (full rivalry in consumption), whereas $\phi = 0$ denotes the case of full economies of scale (no rivalry in consumption).[7] The terms $n^{-\phi}h$ and $n^{-\phi}x$ are the equivalised consumption flows of housing and non-housing consumption per person, and $n^{-\phi}y$ is the equivalised income. Furthermore, $\bar{h}$ is the equivalised subsistence level of housing and $n^{\phi}\bar{h}$ is the subsistence level of the entire household. The price of housing is given by p_h, and we choose x to be the numeraire whose price is set to one. For simplicity, we ignore savings, so that non-housing consumption in our model is the same as income after housing.

We provide detailed derivations of this maximisation problem in Online Appendix A. Analogous to the usual Cobb-Douglas case, the implied demand functions are $x = (1 - a)(y - p_h n^{\phi}\bar{h})$ and $h = n^{\phi}\bar{h} + a(y - p_h n^{\phi}\bar{h})/p_h$. Here, $y - p_h n^{\phi}\bar{h}$ denotes the income after subtracting the subsistence level of housing and a and $1 - a$ are the shares of the remaining income allocated to further housing and non-housing consumption, respectively.[8]

Our model shows that the ratio of equivalised non-housing consumption between two households is a sufficient statistic for the relative welfare of the two households. This ratio is in turn affected by changes in the ratio of equivalised incomes and other determinants of consumption choices such as household size and the price of housing. In particular, the comparative statics of the model (see Online Appendix A for details) give rise to the following implications.

1. The share of housing in total expenditures, $s_h = a + (1 - a)p_h n^{\phi}\bar{h}/y$, falls in income y and increases in the subsistence level of housing $\bar{h}$ and housing price p_h.

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[5] Housing is not the only necessity, but it is the largest single component of consumption for most households. Its expenditure share has increased over time for low-income individuals, which stands in stark contrast to other necessities such as food or clothing (Albouy *et al.*, 2016).

[6] Albouy *et al.* (2016) specified a more general non-homethetic separable CES utility function to account for economies of scale and the existence of a subsistence level in the consumption of housing. The simpler Stone-Geary specification allows one to use the same equivalence scale for housing and non-housing consumption, as done in our empirical analysis. Making the effect of the subsistence level of housing explicit allows us to focus on housing as the key necessity of interest.

[7] To simplify the notation, we use this equivalence scale in our model. Our empirical analysis uses the new OECD equivalence scale (see Subsection 2.2), but this does not affect any predictions of the model.

[8] A Stone-Geary utility function can be interpreted as a two-stage process in budget allocation. In the first stage, households pay for the subsistence level—here for the indispensable amount of housing—like a 'fixed cost' component. In the second stage, the remaining budget is spent in constant shares, as is standard for a Cobb-Douglas utility, on consumption in excess of the subsistence level. Since the remaining budget in the second stage involves a higher share of the original income if the original income is higher, the budget share spent on the other consumption good increases.

2. Take two households with different income levels y_1, y_2 and different household sizes n_1, n_2. The ratio of equivalised non-housing consumption $n_2^{-\phi} x_2/(n_1^{-\phi} x_1)$ exceeds the ratio of equivalised income $n_2^{-\phi} y_2/(n_1^{-\phi} y_1)$, i.e., inequality in non-housing consumption is <u>higher</u> than inequality in income. Furthermore, a rise in income inequality translates into a stronger rise in inequality in non-housing consumption.

3. For the assumed utility function with zero subsistence level for the other consumption good, the ratio of equivalised non-housing consumption $n_2^{-\phi} x_2/(n_1^{-\phi} x_1)$ is a sufficient statistic for the ratio of welfare of the two households u_2/u_1.[9]

4. The ratio of equivalised non-housing consumption $n_2^{-\phi} x_2/(n_1^{-\phi} x_1)$ between a high-income and a low-income household increases if

    (*i*) per capita income of the poorer (richer) household remains constant and household size of the poorer (richer) household falls (increases);

    (*ii*) the price of housing p_h or the subsistence level of housing $\bar{h}$ increases;

    (*iii*) the two households pay different prices for housing $p_{h,1}$, $p_{h,2}$ and the price of housing for the poorer household $p_{h,1}$ increases relative to the price of housing for the richer household $p_{h,2}$;

    (*iv*) the two households have different sizes n_1, n_2 and the size of the poorer household n_1 increases or the size of the richer household n_2 falls.

These comparative static results translate directly into empirical implications and point at the various reasons why income inequality after housing costs may increase by more than inequality in before-housing income. In particular, the income share of housing expenditure is higher the lower the income level (result 1) and the ratio of non-housing consumption (high-income relative to a low-income household) is higher than the ratio of income for households with different income levels (result 2). Furthermore, a decline in real income for low-income households increases the share of income spent on housing and an increase in income inequality results in an even stronger increase in inequality of non-housing consumption (both according to result 4(i)). Moreover, residential mobility of low-income households towards areas with higher housing prices increases inequality in non-housing consumption (results 4(ii) and 4(iii)). Result 3 motivates our focus on inequality in non-housing consumption.

2. Background and Data

2.1. *The German Housing and Rental Market*

We briefly describe some key features and trends of the German housing market. We contrast them with those in the United States and the UK, which helps contextualising our empirical findings in the sections below.

Homeownership rates in Germany are much lower than in the UK or the United States (see Table 1). In 2014, 45% of German households lived in a property they owned (19% were owner-occupiers with a mortgage and 26% outright owners). This compares to 64% in the UK and 65% in the United States. Homeownership is also more unequally distributed in Germany, with only 22% of German households in the bottom income quintile being owners, while almost 50% of UK and 36% of US households in the bottom income quintile own their home.

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[9] This result will not hold exactly for more general utility functions, but it holds approximately if the true utility function is well approximated by a log linear utility in non-housing consumption x.

Table 1. *Percent of Households Living in Various Tenure Types (2014).*

| | All households | Income quintile | | | | |
		Lowest	2nd	3rd	4th	Highest
Germany						
Renter	54.7	77.2	60.2	51.1	44.6	35.0
Owner with mortgage	19.0	5.4	13.6	20.0	25.8	33.9
Owner outright	26.0	16.9	25.9	28.4	29.5	30.9
United States						
Renter	34.9	59.0	41.4	32.1	24.1	16.8
Owner with mortgage	40.3	15.6	29.3	42.2	53.7	61.4
Owner outright	22.9	21.4	26.8	24.1	21.1	21.2
UK						
Renter	35.6	48.4	49.7	36.7	24.6	14.0
Owner with mortgage	30.7	14.4	18.4	29.8	42.2	54.1
Owner outright	32.6	35.4	31.1	32.6	32.4	31.2

Notes: Missing shares from 100% include the category "other/not available".
Source: OECD Affordable Housing Database, available at http://oe.cd/ahd.

The rental market in Germany is primarily a private rental market (Kemp and Kofner, 2010) and the number of social housing units has decreased sharply between 2002 to 2014, from 2.6 million to 1.4 million (Gedaschko, 2016). In 2014, the share of dwellings in the social housing sector amounted to only 4%.[10]

Figure 1(a) shows that average real rents (deflated by the general consumer price index) increased by about 20% between 1991 and 2000, and—if anything—slightly declined after 2000. In contrast, rents for new contracts, and especially rents for new contracts in big cities (the dashed and dotted lines in the figures) strongly diverged from existing rental rates after 2010 and increased by 16% and 20%, respectively, until 2016. This divergence is partly explained by the regulatory environment, where rents for existing contracts are capped at the level of comparable average rents in the local market and cannot be raised by more than 20% over a three-year period (unless the dwelling is modernised). On the other hand, rents for new contracts can be freely set by landlords over the entire period we study, subject only to weak constraints. Comparing real rent indices in Germany to those in the United States and the UK (Figure 1(b)) shows a far larger increase for the UK (by 34% between 1991 and 2016), while the increase in the United States over the same period is at 15%, similar to that in Germany (14%).

Real house prices in Germany remained stable in the early 1990s, fell slightly from the late 1990s onward for about a decade, and rebounded modestly after 2010 (Figure 2). This stands in sharp contrast to the United States and the UK, which not only show a much stronger long-term upward trend (especially before the financial crisis), but where house prices also tend to be more volatile than in Germany. The trend in rents and house prices in Germany in the late 1990s and over much of the 2000s is consistent with a construction boom after reunification and a subsequent slowdown (see Online Appendix Figure A1). Only more recently, after 2010, construction has increased again.

Real interest rates for new mortgages have declined since the early 1990s in Germany, the UK and the United States. However, the mortgage-to-GDP ratio is much lower in Germany and fell

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[10] This is similar to the US share (4%), but much smaller than shares in the UK (18%) or France (19%). See the OECD Affordable Housing Database, available at http://oe.cd/ahd.

(a) Real rent indices for Germany (2010=100)

(b) Real rent indices for Germany, the UK and the United States (1991=100)
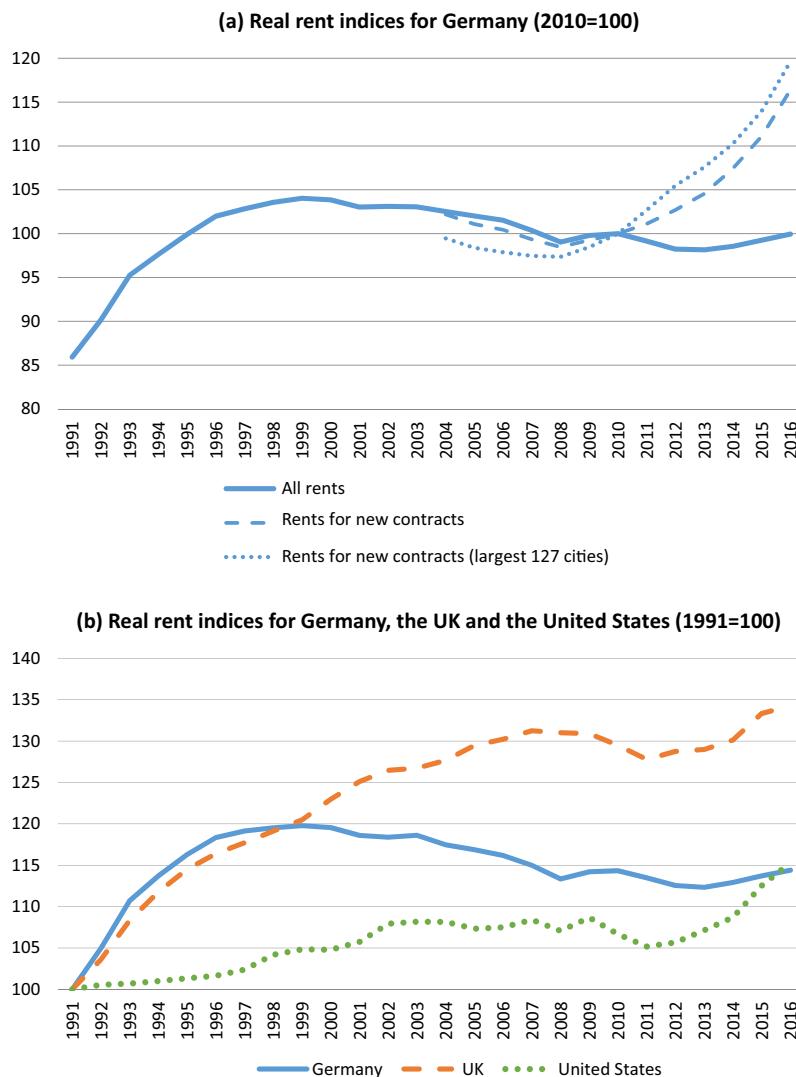
Fig. 1. *Real Rent Indices.*
Notes: All indices are deflated using the CPI for each country.
Source: Index for all rents: German Federal Statistical Office. Index for rents for new contracts:
Bundesbank/Bulwiengesa. US and UK indices come from the OECD Analytical house price indicators,
available at https://stats.oecd.org/Index.aspx?DataSetCode=HOUSE_PRICES.

over time (see Online Appendix Figure A2). This is due to stricter mortgage lending requirements (e.g., higher down payments compared to other countries) that inhibit an increase in mortgage debt (German Council of Economic Experts, 2013) and also preclude a subprime lending market for households with low equity and unstable income. Hence, mortgage holders in Germany are a select group whose wealth or income enables them to meet the required down payment, leading to individuals acquiring property relatively late in life (Kemp and Kofner, 2010).
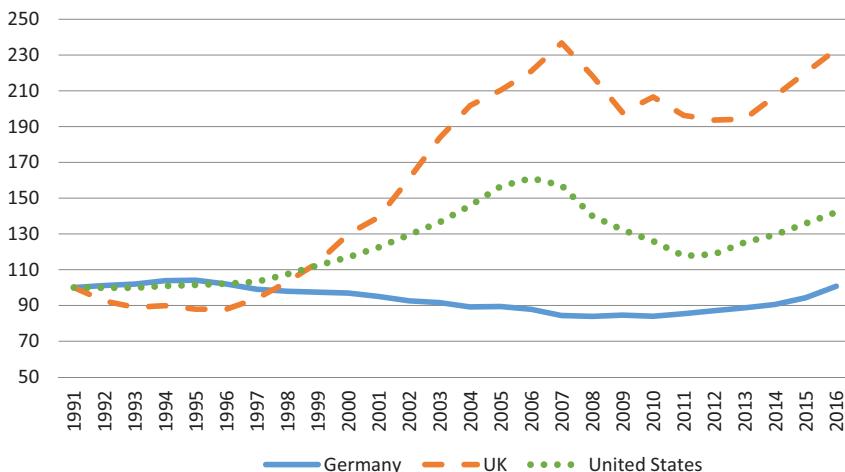
Fig. 2. *Real House Price Indices (1991 = 100).*
Source: OECD Analytical house price indicators, available at
https://stats.oecd.org/Index.aspx?DataSetCode=HOUSE_PRICES. House prices include prices for the sale
of newly built and existing dwellings. All indices are deflated using the CPI for each country.
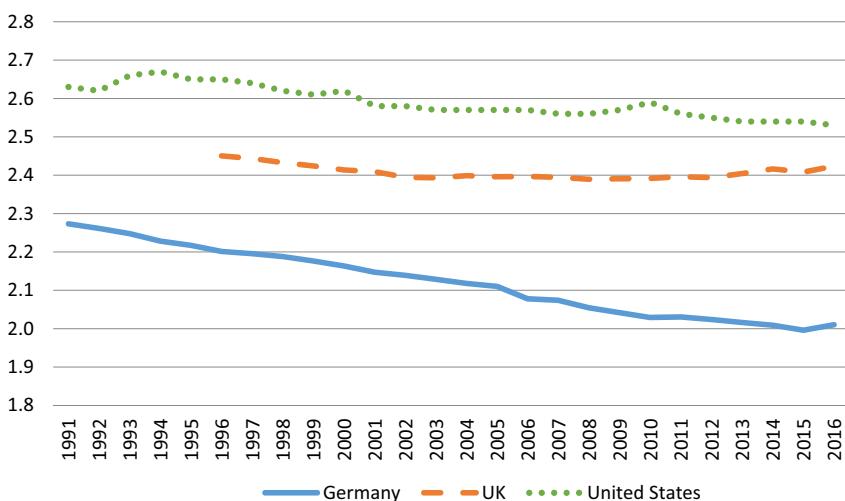
Fig. 3. *Demographic Trends: Average Household Size.*
Source: Germany: German Federal Statistical Office; UK: Office for National Statistics; United States:
Census Bureau.

There have been noticeable demographic trends in Germany, with the average household
size decreasing from 2.27 in 1991 to 2.00 in 2015 (Figure 3), which increased the demand for
housing space per capita and led to an increase in individual housing expenditure over time. This
contrasts with the United States and the UK, where households are larger on average and where
the household size decreased more slowly than in Germany.

To summarise, these figures show that homeownership is not just lower in Germany than in the United States and the UK, but also more unevenly distributed along the distribution of income. As we explore below, this has consequences for inequality in response to changes in housing prices that affect renters and homeowners differently. Homeowners with outstanding mortgages benefit from falling real interest rates in all countries. On the other hand, house prices have increased by less in Germany than in the other countries, suggesting that home-owners have realised far lower capital gains. While average rents have increased during the 1990s and remained stable since the 2000s, rents for new contracts have sharply increased in recent years, especially in big cities, which affects those who move either by choice, or through necessity.

2.2. *Data*

Our main analysis is based on the 1993, 1998, 2003, 2008 and 2013 waves of the Income and Expenditure Survey (*Einkommens- und Verbrauchsstichprobe,* EVS), which is administered every five years by Germany's Federal Statistical Office to large repeated cross sections of households.[11] The data have three features that make them particularly well suited for our analysis. First, the sample size is large (about 40,000–50,000 households per wave in the raw data). Second, the survey examines numerous categories of both income and expenditure in great detail, allowing us to study various dimensions of inequality. Third, the EVS differs from other household surveys (e.g., the German Socio-Economic Panel, SOEP) because it uses a consumption diary kept for (at least) one quarter rather than relying on retrospective survey questions. More details on the data can be found in Online Appendix B. For our main analysis, we form a sample of working age individuals in the age range 20 to 60 years.[12]

For some of our analyses, we use the yearly SOEP (see Becker *et al.*, 2003; Goebel *et al.*, 2019), which provides a more detailed set of housing characteristics (e.g., whether the dwelling is in the social or public housing sector), as well as longitudinal information. We also compare EVS and SOEP outcomes to check whether both data sets show the same key trends.

In our analysis, both incomes and expenditure/savings are *equivalised* by dividing the total household's income and expenditure/savings by the number of equivalent adults in the household and assigning the outcome equally to all household members.[13] We then calculate all inequality measures and other statistics at the individual level. All monetary values are converted to 2010 euros using the Federal Statistical Office's consumer price index (CPI).

Throughout the paper, *income* refers to net household income and is defined as the sum of a household's labour income (from both dependent employment and self-employment of all household members), capital income, non-public transfer income, and public transfer income minus tax payments and social security contributions. We define *housing expenditure* for *renters*

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[11] For detailed data documentation, see Federal Statistical Office of Germany (2005a; 2005b; 2012; 2016). The EVS does not include households with very high incomes, a restriction that affects less than 1% of all households. This omission is unlikely to affect our analysis, as these households are not affected by a growing income share of housing expenditure as are low-income households (the focus of our analysis). Moreover, the impact of this exclusion on percentile ratios (such as the 90/50 or 50/10 ratios) is likely to be negligible.

[12] We verify our key results using other age ranges (see Online Appendix B and Online Appendix Figure A4).

[13] We use the new OECD equivalence scale, which assigns a weight of 1 for the first adult in the household, 0.5 for each additional household member aged 14 and above, and 0.3 for each additional household member under 14. The same scale is used, e.g., in Biewen and Juhasz (2012) for Germany, as well as Attanasio and Pistaferri (2016) for the United States. Alternative equivalence scales are investigated in Online Appendix Figure A5.

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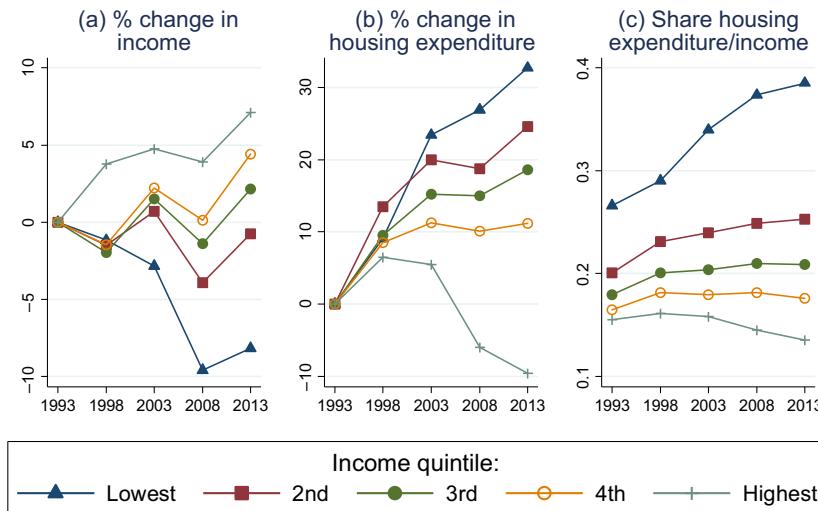
Fig. 4. *Change in Equivalised Housing Expenditure and Income (in %, Relative to 1993), by Income Quintile.*
Notes: Income refers to net household income, i.e., the sum of labour income, capital income, private and public transfers, minus taxes and social security contributions. Housing expenditure for renters include basic rent (including utilities such as water and waste charges) and energy costs, while housing expenditure for owner-occupiers involves mortgage interest payments, energy costs, as well as maintenance and operating costs. Both housing expenditure and household income are equivalised using the modified OECD equivalence scale and assigned equally to all household members. The sample consists of individuals age 20–60.
Source: EVS, author calculations.

as the basic rent (including utilities such as water and waste charges) and energy costs. Housing expenditure for *owner-occupiers* are mortgage interest payments, energy costs, and maintenance and operating costs (following Belfield *et al.*, 2015).[14] Housing benefits are part of the income and the cost of housing recorded.

We also conduct analyses where we adjust incomes and housing expenditures of owner-occupiers for net imputed rents and capital gains (see Subsection 3.3 for a detailed discussion). However, since these two components are estimated only with statistical imprecision, they are not included in our baseline analyses.

3. Inequality Trends and Measurement Issues

3.1. *Income Inequality and Housing Expenditure*

Between 1993 and 2013, inequality in equivalised net household income has increased sharply (Figure 4(a)). Average real incomes dropped by 8% for individuals in the lowest income quintile

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[14] Because repayment of mortgage capital constitutes an accumulation of net wealth and is thus part of savings rather than consumption, we include only mortgage interest payments in regular housing expenditure. We consider the total expenditures for all housing properties owned by the individual as the data do not distinguish between mortgage payments for the primary residence and potential other properties.
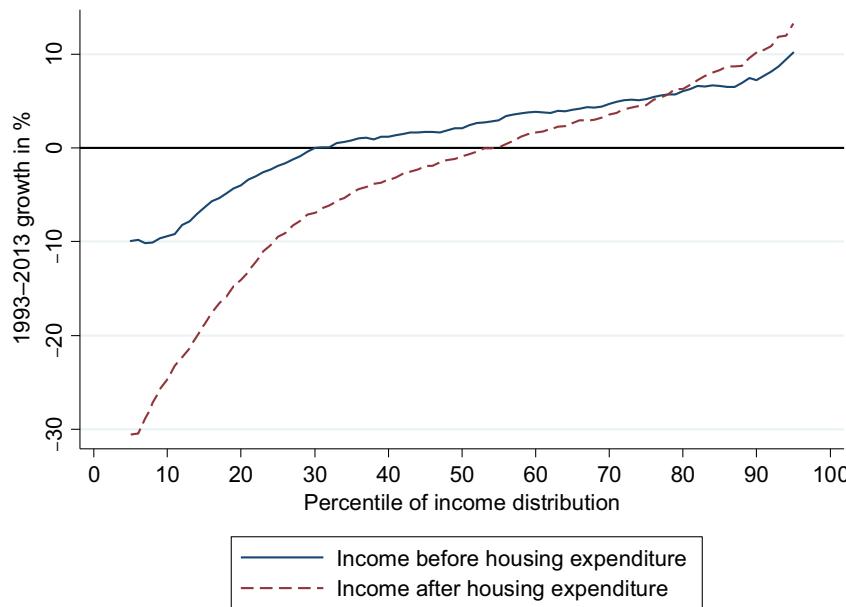
Fig. 5. *Change in Equivalised Net Household Income 1993–2013 (in %), Before and After Housing.*
Notes: Income and housing expenditure are defined as in Figure 4.
Source: EVS, author calculations.

and increased by 7% for individuals in the highest income quintile.[15] At the same time real housing expenditure increased by 33% for those in the lowest income quintile but declined by 10% for those in the highest (Figure 4(b)). Combining these trends, the right-hand panel (Figure 4(c)) shows a striking increase in the share of household income spent on housing in the lowest income quintile (from 27% in 1993 to 39% in 2013), with more modest increases further up the distribution. For the top income quintile, in contrast, the share of income spent on housing declined from about 16% in 1993 to 14% in 2013.

Figure 5 plots the cumulative real income growth along the income distribution before and after deduction of housing expenditure. While the 10th percentile of income before housing declined by 10% between 1993 and 2013, it declined by 25% after housing. In contrast, incomes above the 80th percentile increased more when considered after housing, reflecting declining housing expenditure for high-income individuals. Thus, income losses at the lower end of the distribution have been much larger when considering income after housing, while there are gains further up the distribution.

Comparing the 50/10 and 90/50 percentile ratios for net household income before and after housing (Figure 6) illustrates not only that the level of income inequality is much larger once housing expenditures are deducted (see the difference in levels), but also that the two income concepts diverge over time. Between 1993 and 2013, the 50/10 ratio of income before housing increased by 22 pp (from 1.75 to 1.97), but by 62 pp (from 1.97 to 2.59) after housing, which is

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[15] Online Appendix Figure A3 illustrates these trends along finer percentiles, showing a 10% drop at the 10th percentile, a slight increase of +2% at the median and a large increase of 7% at the 90th percentile.
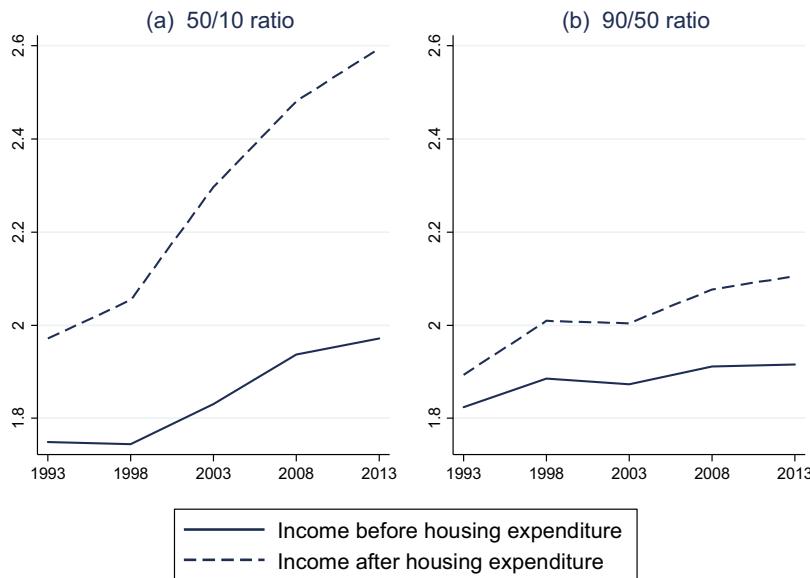
Fig. 6. *Inequality of Equivalised Net Household Income—Before and After Housing Expenditure.*
Notes: Income and housing expenditure are defined as in Figure 4.
Source: EVS, author calculations.

an almost tri-fold increase once housing expenditure is deducted. The 90/50 ratio also shows a stronger increase over time after housing, but the difference is smaller than its 50/10 counterpart. These dramatic trends are in line with our theoretical model in Section 1, which shows that a fall in real income at the bottom implies a rise in the share of housing expenditure, and that a rise in income inequality leads to an even higher increase in inequality in income after housing expenditure.

We turn next to the share of household income spent on housing expenditure, non-housing expenditure and on savings (Figure 7). For individuals in the bottom income quintile, the share of housing expenditure increased from 27% in 1993 to 39% in 2013, while the share of non-housing expenditure decreased from 72% to 63% and the share of savings decreased from 2% to −1%.[16] Further analyses (not shown here, but available upon request) reveal that the share of individuals in the bottom quintile with positive savings fell from 64% to 53%. The other income groups saw less dramatic changes in their consumption and savings patterns.

Finally, we show various robustness checks in the Online Appendix. In particular, the results are confirmed using alternative age ranges (Online Appendix Figure A4) and alternative equivalence scales (Online Appendix Figure A5). In Online Appendix Figures A6–A8, we use the SOEP data to replicate the analysis based on the EVS. The two data sets document the same key trends: rising inequality of equivalised net household incomes and a rising share of income spent on housing by low-income groups.

Given the above evidence of a considerable divergence in housing expenditure shares between income groups, we next explore different factors that may contribute to this trend.

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[16] Among the different non-housing expenditure items, the biggest drop for the lowest income quintile is in food expenditures (by about 5 pp), although most other items (e.g., clothes, transport) also decrease.

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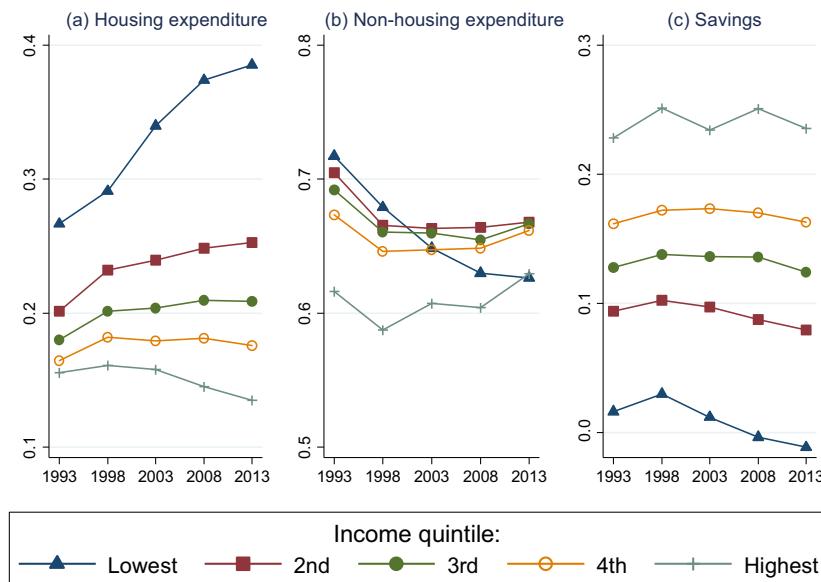
Fig. 7. *Expenditure Shares by Quintile of Equivalised Net Household Income.*
Notes: Income and housing expenditure are defined as in Figure 4.
Source: EVS, author calculations.

3.2. *Housing Expenditure for Renters and Owner-Occupiers*

Because homeownership rates vary along the income distribution (as illustrated in Subsection 2.1), a divergence in housing expenditure components for renters versus owner-occupiers will lead to a corresponding divergence in after-housing income. Between 1993 and 2013 housing expenditure for renters increased by 36% (from 3,600€ to 4,900€), but only by 12% for homeowners who own outright (see Figure 8).[17] In contrast, for owner-occupiers with an outstanding mortgage, housing expenditure increased from 1993 to 2003, but then decreased from 2003 onward leading to an overall decline by 4% between 1993 and 2013.[18] The decrease after 2003 is the result of both falling mortgage interest rates and falling construction rates in the 2000s that led to a maturing housing stock with fewer outstanding mortgages (see Online Appendix Figures A1 and A2).

We next break down the shares of the three tenure types by income quintile (Figure 9). Around 70% of the individuals in the lowest quintile are renters, leaving only a few owner-occupiers with a mortgage, while in the top income quintile, only about one-third are renters and around half are owner-occupiers with a mortgage. On the other hand, the share of owner-occupiers who own their homes outright is similar in all income groups. From 1993 to 2003, however, the share of renters declined in almost all income quintiles, with the exception of the lowest quintile. Possible

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[17] Note that the increase of housing expenditure for renters exceeds the growth of the aggregate rent index shown in Figure 1. As we will explore in detail in Section 4, part of this difference is due to an improvement in quality of rented dwellings, a fall in household size and renters moving to more expensive regions.

[18] For the years after 2008, Schier and Voigtländer (2015) also documented (at the aggregate level) a falling share of housing expenditure for owner-occupiers relative to the cost of renting, which confirms our findings. Moreover, Germany is the only major euro area country in which the ratio of rents to house prices has increased since the mid-1990s (Hiebert and Sydow, 2011).

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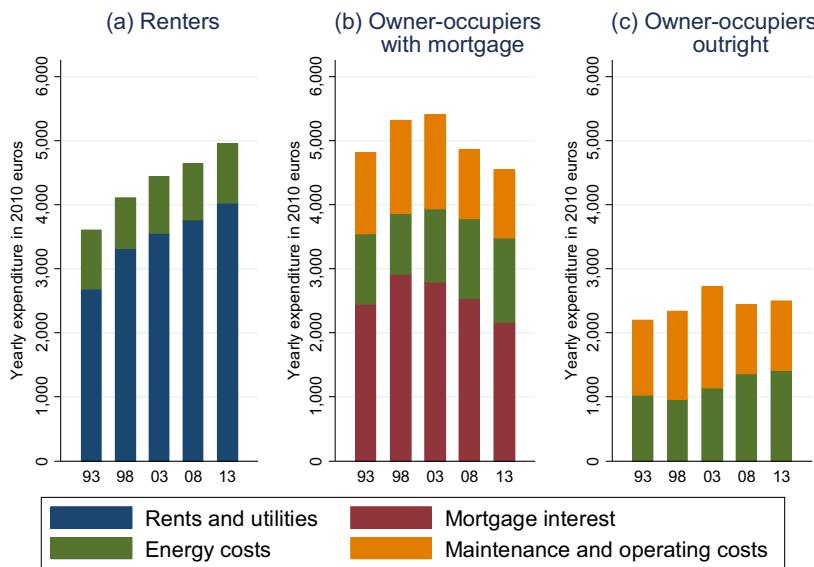
Fig. 8. *Components of Equalised Housing Expenditure, by Type of House Tenure.*
Notes: Housing expenditure is on a yearly basis and measured in 2010 euros, equivalised using the
modified OECD scale.
Source: EVS, author calculations.
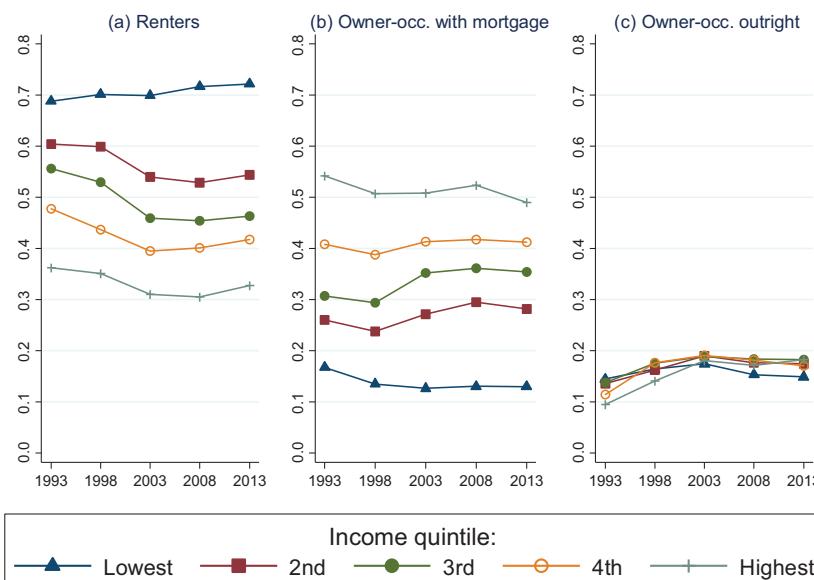
Fig. 9. *Share of Tenure Types, by Quintile of Equalised Net Household Income.*
Notes: Income is defined as in Figure 4.
Source: EVS, author calculations.

explanations for why the low-income group did not see a similar increase in homeownership are the decline in real income making homeownership less affordable as well as other demographic trends (in particular, rising shares of single households and city dwellers, as discussed in the next section). Interesting is also that the falling interest rates from the early to mid-2000s onward did not lead to higher homeownership rates. Rather, according to Figure 9, for most quintiles after 2003 and for all quintiles after 2008, the share of renters increased slightly. One likely explanation is German banks' conservative lending policies that restrict mortgage access to households with sufficiently high income and savings to afford a sizeable down payment (German Council of Economic Experts, 2013; Voigtländer, 2014).

3.3. *Measuring Income and Housing Costs for Owner-Occupiers: the Role of Net Imputed Rents and Capital Gains*

The previous analyses used 'cash flow' measures of *income before housing*, ybh_t, and *income after housing*, $yah_t = ybh_t - hexp_t$, in period t, where $hexp_t$ denotes 'cash' housing expenditure. These measures neglect that owners do not have to pay rents and that they receive capital gains on their housing property. Regarding the former, owners' housing consumption includes the imputed rental value of the home (an implicit rent that the owner pays to himself). That is, owner-occupiers 'consume' more housing than represented by their current housing expenditure. Moreover, owner-occupiers experience capital gains (or losses) on their housing property that can be viewed as an additional income component.[19,20]

To investigate whether these components, which are unreported in our data, affect our findings on inequality trends, we calculate adjusted incomes before and after housing, ybh_t^* and yah_t^*, by adding estimated net imputed rents (NIR) and estimated capital gains as additional income components for owner-occupiers. Since these additional components are zero for renters, their income measures remain unadjusted ($ybh_t^* = ybh_t$ and $yah_t^* = yah_t$).

Adjusted income before housing of an owner-occupier, ybh_t^*, is given by

$$ybh_t^* = ybh_t + NIR_t + Capgains_t,$$

where the term $NIR_t = R_t - hexp_t$ represents the *net imputed rents* assuming that renters of comparable apartments pay the *real user cost of housing* R_t. The user cost of housing represents the arbitrage-free rental rate for the housing unit, i.e., if owner-occupiers were to rent their home, they would have to pay R_t as rents.[21] In a frictionless housing market, R_t equals the market rental income generated by the owner-occupier's housing unit if occupied by a renter. To compare the relative costs of renting versus owning for constant

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[19] See, e.g., Smeeding and Thompson (2011) and Larrimore *et al.* (2021). It is an open question whether capital gains for sitting homeowners should be considered as income even when the income is not realised as long as they do not sell the house. One possible rationale is that homeowners can borrow against the value of their home to increase consumption (see, e.g., Mian and Sufi, 2014, who showed that home equity-based borrowing played an important role for increasing household debt in the United States during the 2002–06 period). It is not clear whether that reasoning can be applied to the German context where such financing instruments are less common.

[20] As a caveat, note that we do not account for unrealised capital income on other assets. Because housing wealth is the dominant form of asset accumulation over most of the income distribution in Germany (see, e.g., Knoll *et al.*, 2017) and realised interest/dividend payments are included in our income measure, this is a negligible issue for our analysis—possibly except for the very top of the distribution; see also Online Appendix B.

[21] The user cost is defined as $R_t = (r_t + d)V_t - Capgains_t$ (see Quigley and Raphael, 2004), where r_t is the real interest rate (which we assume equals the mortgage rate, reflecting the return of homeowners on alternative financial assets), d is the maintenance/operating cost rate, V_t is the real value of the housing unit at the beginning of period t and $Capgains_t$ are the expected real capital gains on the housing unit in period t.

characteristics, we estimate the counterfactual housing expenditure for owner-occupiers if the dwelling was rented instead of owned minus the actual housing expenditure. We estimate counterfactual expenditures for owner-occupiers based on observed expenditures for sitting renters with similar housing and household characteristics.[22] The term NIR_t is then obtained by subtracting owners' actual 'cash' housing expenditure from their counterfactual housing expenditure as renters. Positive NIR_t will increase owners' income levels if owner-occupiers 'consume' more housing than represented by their current ('cash') housing expenditure. Hence, a positive (negative) NIR_t indicates that an owner-occupier has lower (higher) 'cash' housing expenditure than a renter for a comparable dwelling. Finally, the owner's capital gains on her housing property, $Capgains_t$, further increase her income before housing.

Adjusted income after housing for an owner-occupier, yah_t^*, is given by the adjusted income before housing ybh_t^* minus the total costs of housing R_t:

$$yah_t^* = ybh_t^* - R_t = yah_t + Capgains_t.$$

Thus, NIR_t cancels out as it is both a component of income before housing and part of the housing cost (is not available for non-housing consumption). This way, quite intuitively, adjusted income after housing yah_t^* equals 'cash' income available for non-housing consumption yah_t plus capital gains as an unrecorded additional income component.

Our empirical implementation for net imputed rents uses a stochastic imputation approach based on conditional quantile regressions (similar to Machado and Mata, 2005 and Melly, 2005) to predict the conditional distribution of net imputed rents for each owner-occupier based on observable dwelling and household characteristics (see Online Appendix C for more details). To estimate capital gains/losses, we use the housing values reported in the data that are based on the respondents' self-assessment of the current market value of their home. These housing values are multiplied with the change in the real house price index to obtain a measure of real capital gains.[23]

We display the evolution of the median relative NIR over time (calculated *relative* to the owners' hypothetical rent expenditure) in Figure 10. The values are positive both for owners with and without a mortgage, but as expected, far larger for the latter group. For owners with mortgages, the NIR increased from 14% in 1993 to 29% in 2013, as this group benefited from declining interest rates, as well as from an ageing housing stock.

Accounting for NIR and capital gains as additional income components of owner-occupiers does not affect the 90/50 ratios of income before and after housing and their changes over time, and it affects only slightly the 50/10 ratio and its changes (see Figure 11). One reason is that most of the changes in housing expenditure take place in the lower part of the income distribution where the share of owner-occupiers (who benefit from NIR/capital gains) is small. Moreover, the adjustment of income even in the middle and upper part of the distribution is small (relative to income without NIR/capital gains) and quite uniform along the distribution, with only a small effect on inequality of income before and after housing expenditure. All this means that

[22] Because of the residency discount (Fitzenberger and Fuchs, 2017), it is likely that owner-occupiers would pay higher 'market' rents for a new lease of the dwelling they own—and rents for new leases may show a different time trend than average rents (Figure 1(a)). However, considering a long-term rent-versus-buy decision the 'market rent' for an owner-occupier is an average rent over different tenure levels. Given our findings that trends in inequality are only affected slightly when accounting for NIR, we do not explore this point further.

[23] The measure ignores transaction costs because we have no data on actual transaction prices of comparable housing units for the entire time period investigated.
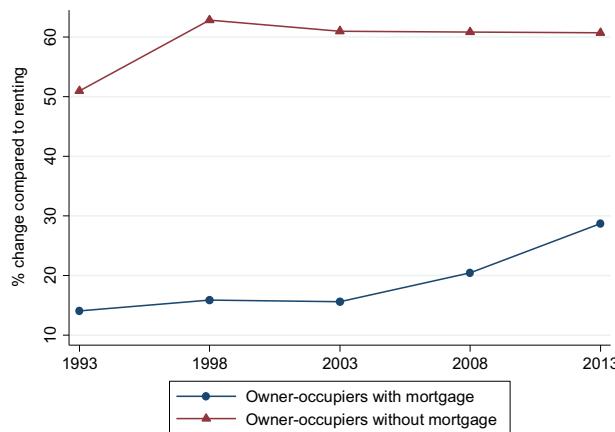
Fig. 10. *Median Relative Net Imputed Rents (NIR) for Owner-Occupiers, in %.*
Notes: To calculate NIR, we use a stochastic imputation approach based on conditional quantile
regressions as described in Online Appendix C. We first regress housing expenditure for renters on
housing and household characteristics and then use the coefficients to impute owners' counterfactual
expenditure based on their characteristics and deduce owners' actual housing expenditure. Relative net
imputed rents are in % of counterfactual expenditure when renting.
Source: EVS, author calculations.

our results in Subsection 3.1 are not affected by accounting for NIR and capital gains among
owner-occupiers. Since both additional income components are imputed with statistical impre-
cision, the subsequent findings are based on the income measures that do not account for NIR
and capital gains.

4. Explanations of Inequality Trends

4.1. *Determinants of Housing Expenditure*

We next discuss further determinants of housing expenditure (in particular, demographics, hous-
ing quality, regional migration, residential mobility and social housing provision) and ask how
these can explain the inequality trends documented above.

4.1.1. *Household size and demographics*
One important factor driving housing expenditure is household structure. In the German case, the
share of individuals living in single households increased over the 1993–2013 period, particularly
among the bottom income quintile, where the share of single households increased from 23% to
42% (see Figure 12(a)).[24] This trend towards smaller households means that individuals are less
able to use economies of scale in housing consumption, which increases the share of their budget
to be spent on housing.

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[24] This includes single adults with and without children. In the bottom quintile, the share of single adults without
children increased from 16% to 33% and the share of single adults with children increased from 6% to 9%.

(a) Income before housing
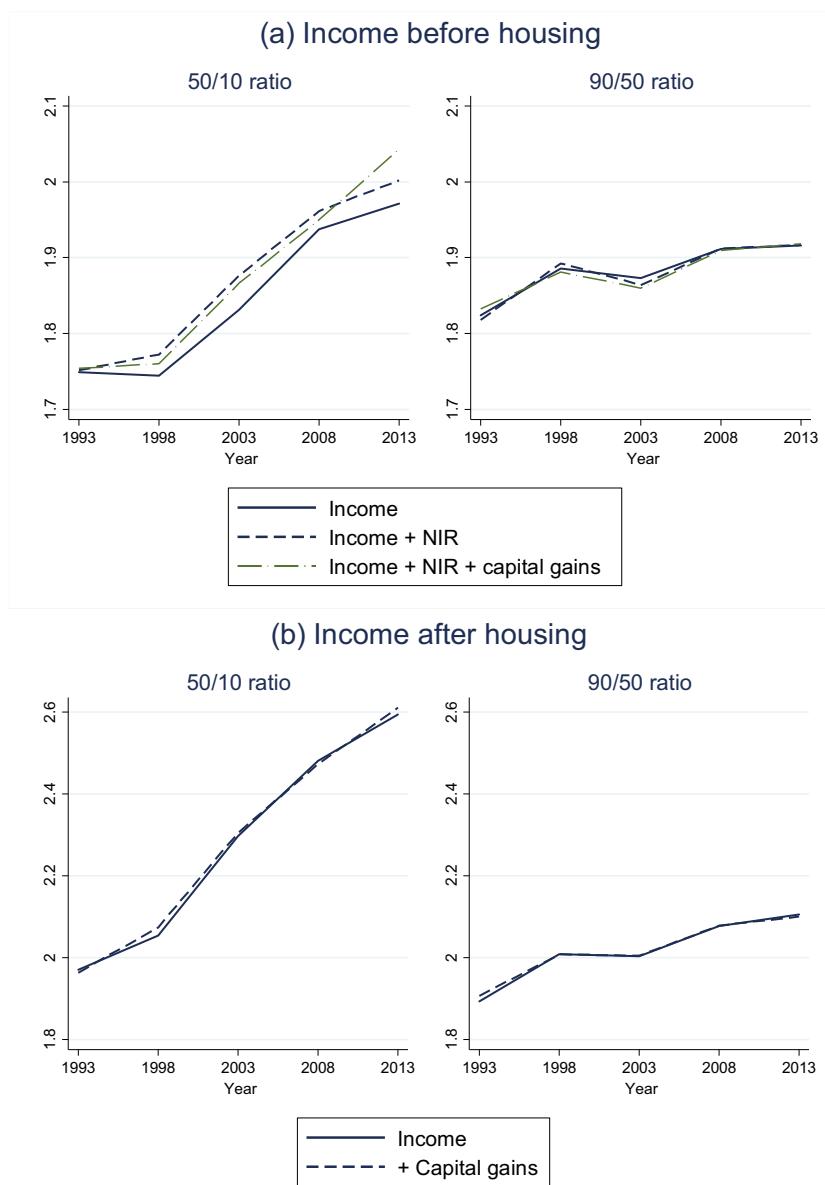
Fig. 11. *Inequality Using Different Income Measures for Owner-Occupiers.*
Notes: Income and housing expenditure are defined as in Figure 4. Net imputed rents (NIR) are calculated as described in Figure 10 and Online Appendix C. Capital gains are calculated based on the self-reported current value of the house multiplied by the real growth in the house price index.
Source: EVS, author calculations.

4.1.2. *Dwelling size and quality*

Living space per equivalent adult increased for all income groups (Figure 12(b)). However, the increase is particularly salient for the middle-income quintiles, which means that the rise in
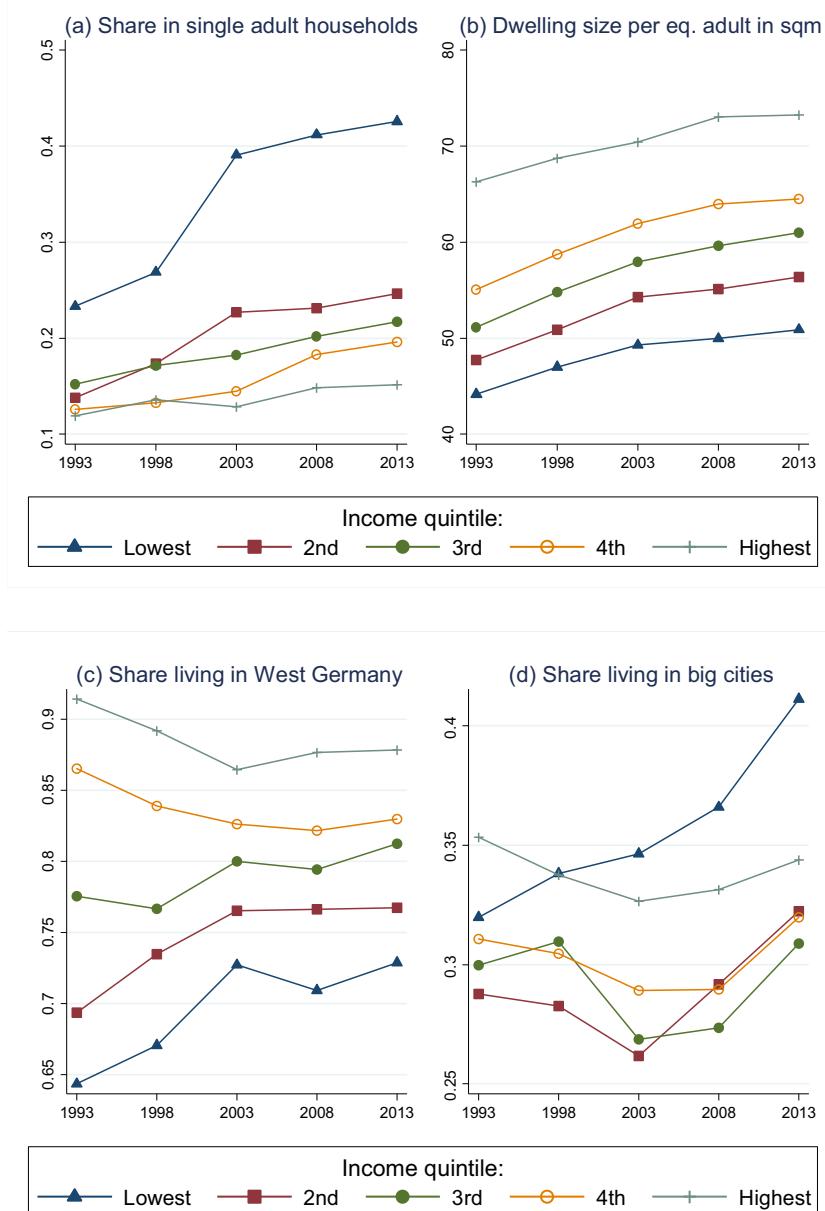
Fig. 12. *Changes in Household Demographics, Housing Quality and Regional Distribution, by Quintile of Equivalised Net Household Income.*
Notes: Income is defined as in Figure 4. Big cities are cities with one hundred thousand or more inhabitants.
Source: EVS, author calculations.

housing space does not explain the disproportionate increase in housing expenditure at the lowest quintile.

These quality improvements can be demand driven (i.e., by households' choice to consume more or better living space) or supply driven (i.e., by a changing housing stock induced partly by government regulations). If supply driven then this may reduce welfare through a loss in income after housing expenditure (see Quigley and Raphael, 2004 who make this point). Supply side factors may indeed have played a role in the 1990's housing construction boom through government subsidies for private investment in modernisation and new construction (Frick and Grimm, 2009). Moreover, the prevailing rent regulation also incentivises modernisation, since landlords can partly shift costs of housing modernisation investment to renters (see Subsection 2.1). Not only may this new construction and modernisation have made it harder for low-income households to find smaller and more affordable housing, but also patterns of new housing construction may have adapted only slowly to changing household structures such as the rise in single households.

4.1.3. *Regional migration patterns*

Individuals in the lowest income quintile living in large cities (more than 100,000 inhabitants) spend an about 10 pp larger share of their income on housing than those living in small municipalities (less than 20,000 inhabitants) (see Online Appendix Figure A9), with this share increasing over time across all size categories. At the same time, individuals in the lowest income quintile have disproportionately relocated to West Germany and to larger cities, both of which have higher housing costs (Figure 12(c) and 12(d)). During the 1990s (a time of considerable migration flows from East to West Germany), the share of individuals in the bottom income quintile who live in West Germany increased from 65% to 73%, while the share of those living in cities with over 100,000 inhabitants increased from 32% in 1993 to 42% in 2013. For other income groups, the share living in large cities did not increase by that much. Figure 12(d) further shows an increasing residency polarisation over time; that is, in 2013 individuals in both the bottom and the top quintiles are more likely to live in large cities than those in the middle of the distribution.

All this suggests that changes in the regional allocation of the population did not compensate for the increase in nominal income inequality, but rather amplified it. This finding seemingly contrasts with Moretti (2013), who showed for the United States that between 1980 and 2000, college-educated workers increasingly moved to more expensive cities where they faced larger increases in housing costs, explaining about one-quarter of the increase in the nominal wage difference in the United States between college and non-college workers. However, Moretti (2013) also found that the 90/50 and 50/10 wage gaps—inequality measures that are more closely related to our analysis—are little affected by changes in the regional costs of living.

To relate our investigation closer to Moretti (2013), we repeat our analysis using skill groups. Both high-skilled and low-skilled individuals are more likely to live in large cities than medium-skilled individuals, with similar increases over time (Online Appendix Figure A10). We also use data on regional CPIs and show that the increase in the 50/10 ratio over time is hardly larger when taking account of regional price differences (+23 pp instead of +22 pp between 1993–2013) (Online Appendix Table A1). Furthermore, when considering wage inequality and wage skill premia, we find that the increase in inequality in real wages for both overall wages and skill wage premia is virtually the same irrespective of whether wages are deflated by different regional price indices (Online Appendix Tables A2 and A3).[25]

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[25] This part of the analysis is based on data from the Sample of Integrated Employment Biographies (SIAB); see Ganzer *et al.* (2017) for a description of the dataset.

Moretti (2013) argued that the welfare consequences of regional mobility depend upon whether it is driven by labour market conditions or by movers' preferences for amenities in cities.[26] In our case, job-related reasons (and not preferences) are a key driver for rural-to-city moves. Among those in the lowest quintile who recently moved from a rural area to a city, 35% cite job-related reasons for the move. This compares to 11% job-related reasons for any other type of move, i.e., not those from a rural area to a city (see Online Appendix Table A4, based on data from the SOEP). Moreover, rural-to-city moves in all skill groups are more strongly driven by job-related reasons (Online Appendix Table A5).

4.1.4. *Costs of residential mobility*

In addition to housing costs being higher in urban areas, residential mobility per se involves costs for renters. This is because rent increases are far higher for movers than for stayers, as rents for new contracts are freely negotiable, while rents for existing contracts are tied to the average local rent and can only be raised by a certain limit within any three-year period (Fitzenberger and Fuchs, 2017; see Subsection 2.1).

To estimate the effect of moving on rent changes, we regress the annual log change in rent expenditure on a mover dummy, controlling for changes in other housing and household characteristics.[27] We find that residential mobility is associated with an increase in rents in all years, with the effect ranging from 3% to 12%. The effect is particularly large in the 1990s, then flattens off, before increasing again since the late 2000s (Online Appendix Figure A11, panel A). Moreover, individuals in the lowest income quintile show by far the highest residential mobility (Online Appendix Figure A11, panel B), making this group most vulnerable to rent increases associated with a new lease. In contrast, homeownership rates are higher, and residential mobility is lower among high-income individuals. Thus, residential mobility is a likely contributor to housing costs being higher for low-income individuals, and thus to rising inequality in income after housing expenditure.

4.1.5. *Provision of social and municipal housing*

Many dwellings in the social and municipal housing sector are provided at a below-market rent. The requirement to keep rents low typically expires after 20 years, after which social housing units lose their status and become part of the general private rental market. Likewise, municipal housing, owned or co-owned by city governments to provide housing for below-market rents, shrinks as municipalities increasingly privatise their housing stock to consolidate their budgets (Held, 2011). The share of individuals living in social and municipal housing declines for all income quintiles, but this drop is largest for the lowest income quintile, from about 29% in 1993 to 15% in 2013 (see Online Appendix Figure A12).

4.2. *Decomposition Analysis*

To quantify how much the various factors documented above contribute to the trends in housing expenditure shares across income groups, we now decompose the 1993–2013 change for each income quintile into a composition effect and a coefficients effect. We do that by regressing the income share of housing expenditure separately for each income quintile on five sets of variables:

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[26] Building on Moretti (2013), Diamond (2016) argued that changes in amenities compensate high-skilled individuals for higher city housing costs.

[27] See the footnote to Online Appendix Figure A11 for the exact variables included in the specification.

Table 2. *Decomposition of Changes in Housing Expenditure Shares, 1993 to 2013.*

	Quintile of equivalised net household income				
	Q1	Q2	Q3	Q4	Q5
Panel A: Aggregate decomposition					
1993	0.266***	0.201***	0.180***	0.165***	0.155***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
2013	0.385***	0.253***	0.209***	0.176***	0.135***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Change	0.119***	0.052***	0.029***	0.011***	−0.020***
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Coefficients	0.049***	0.032***	0.018***	0.004***	−0.015***
	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)
Composition	0.070***	0.020***	0.011***	0.007***	−0.005***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Panel B: Detailed decomposition of the composition effect					
Household demographics	0.034***	0.010***	0.006***	0.005***	0.003***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Region	0.010***	0.005***	0.002***	0.001	−0.001**
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Tenure type	0.001*	−0.004***	−0.004***	−0.003***	−0.008***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Dwelling quality	0.006***	0.008***	0.010***	0.007***	0.004***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Income	0.019***	0.001*	−0.002***	−0.003***	−0.003***
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)

Notes: The table shows a Blinder-Oaxaca decomposition of changes in housing expenditure shares separately for each quintile of equivalised net household income. *Household demographics* includes dummies for the number of adults in the household, dummies for the number of children, dummies for four age groups (20–29, 30–39, 40–49, 50–60) and a dummy for German nationality. *Region* includes dummies for sixteen federal states and four categories of city size. *Tenure type* includes dummies for being a renter, owner with mortgage or owner without mortgage. *Dwelling quality* includes a cubic in household size and dummies for whether the dwelling is equipped with central heating or a garage. *Income* includes a cubic in equivalised net household income. SEs are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The counterfactual used for the decomposition is based on the composition in 2013 and the coefficients in 1993.
Source: EVS, author calculations.

household demographics, region, tenure type, dwelling quality and income (see the footnote to Table 2 for the variables included in the specification).

The share of housing expenditure increased between 1993–2013 for the lowest quintile by 11.9 pp, while it decreased by 2 pp for the highest quintile (panel A of Table 2). Changes in the coefficients explain 41% (0.049 of 0.119) of the increase in the housing expenditure share for the bottom quintile, and 75% (−0.015 of −0.020) of the reduction for the top quintile. This mirrors our finding in Subsections 3.2 and 3.3 that the relative cost of renting versus homeownership increased over the 1993–2013 period, as the bottom income quintile consists mainly of renters more affected by rent increases, while the top income quintile consists mainly of homeowners with outstanding mortgages who benefit from falling mortgage interest rates.[28] Composition changes explain the remaining 58% of the increase in expenditure shares at the bottom quintile, and 25% of the decrease at the top.

Breaking the composition effect further down into the contributions of various factors (Table 2, panel B) shows that changes in household demographics (in particular, the rising share of single households) are a key driver for the bottom income quintile, explaining 3.4 pp (or 29%) of the

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[28] Further analyses (available upon request) show that after controlling for household and housing characteristics the growth of housing costs between 1993 and 2013 is higher for lower income quintiles.

increase in housing expenditure shares for this group. The decline in real income at the bottom of the distribution during the 1990s and especially in the 2000s contributes a further 0.019 pp (15%) to the increase in the share of income spent on housing, in line with our model in Section 1. Movement of households to more expensive regions (*Region)* contributes an additional 0.010 (8%) to the rise in housing expenditure at the lower end of the distribution. In contrast, for individuals in the top income quintile, the same three factors either decrease housing expenditure shares (e.g., *Income* or *Region*) or have far smaller effects (*Household demographics*).

Improvements in housing quality push up housing expenditure shares for all quintiles, with effects being strongest for the 3rd quintile (with +1 pp), and weaker for both the bottom (+0.6 pp) and the top (+0.4 pp) quintiles. Therefore, changes in housing quality do not explain the divergence in expenditure shares of low- versus high-income individuals. Rising home ownership rates (*Tenure type*) decrease housing expenditure, as owners pay less than renters conditional on quality (see Subsections 3.2 and 3.3). The effect of tenure type is therefore negative for the higher quintiles that see an increase in homeownership rates, but positive for the bottom quintile whose homeownership rate decreases.

We replicate the decomposition in Online Appendix Table A6 using incomes and housing expenditure adjusted for net imputed rents and capital gains (see Subsection 3.3) and find very similar results. We also replicate the decomposition using the SOEP data, which highlights again the strong role of the coefficient effect, household demographics and income (Online Appendix Table A7). The SOEP data allow us to additionally consider the role of changes in social/municipal housing and residential mobility, which also contribute to the increase in the share of income spent on housing by those in the bottom quintile.

To summarise, while compositional factors are among the key drivers of the rise in the income share of housing expenditure for low-income households, there remains an unexplained increase of 4.9 pp or 41% for the bottom income quintile. This suggests that the rise in inequality in income after housing expenditure is only partly due to composition effects, and that the cost of housing increased disproportionately for low-income individuals, also holding composition constant.

4.3. *Lifecycle Inequality and Intergenerational Trends*

The inequality trends that we established above also have important implications for intergenerational inequality. In Table 3a, we report the 50/10 and 90/50 ratios of net equivalised household income for different birth cohorts and age groups. Successive cohorts begin with higher inequality at any given age, for both the 50/10 and the 90/50 ratios, with the latter being more muted.

Moreover, the share of income spent on housing has changed across cohorts, both overall and for the bottom and the top income quintiles (Table 3b, panels A–C).[29] There are also strong differences across income quintiles, with the share of income spent on housing increasing strongly across cohorts for all age groups in the bottom income quintile but remaining constant or even falling for those in the top income quintile. Finally, homeownership rates change both within and across cohorts (Table 3b, panels D–F).[30] For a given cohort, the share of homeowners increases with age. Within age groups, this share increases until the 1964–73 cohort, but then declines for

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[29] The quintiles are defined within each cohort-age group cell.

[30] Individuals who live with homeowning parents are not counted as homeowners, an exclusion that is mainly relevant for the 20–29 age group.

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Table 3a. *Cohort Changes in Income Inequality.*

	Birth cohort					
	1934–43	1944–53	1954–63	1964–73	1974–83	1984–93
Panel A: 50/10 ratio of equivalised net household income:						
Age 20–29				1.828	1.896	1.912
Age 30–39			1.631	1.700	1.832	
Age 40–49		1.786	1.805	1.885		
Age 50–59	1.813	2.047	2.151			
Panel B: 90/50 ratio of equivalised net household income:						
Age 20–29				1.700	1.755	1.780
Age 30–39			1.823	1.837	1.888	
Age 40–49		1.869	1.898	1.943		
Age 50–59	1.902	1.969	2.015			

Notes: Inequality measures and income quintiles are defined within each age-cohort cell. Income and housing expenditure are defined as in Figure 4.
Source: EVS, author calculations.

Table 3b. *Cohort Changes in Homeownership and Housing Expenditure Shares.*

	Birth cohort					
	1934–43	1944–53	1954–63	1964–73	1974–83	1984–93
Panel A: Share of income spent on housing—all						
Age 20–29				0.194	0.230	0.242
Age 30–39			0.212	0.231	0.231	
Age 40–49		0.190	0.218	0.221		
Age 50–59	0.189	0.221	0.233			
Panel B: Share of income spent on housing—lowest income quintile						
Age 20–29				0.274	0.355	0.388
Age 30–39			0.269	0.326	0.350	
Age 40–49		0.257	0.328	0.361		
Age 50–59	0.277	0.360	0.417			
Panel C: Share of income spent on housing—top income quintile						
Age 20–29				0.143	0.148	0.143
Age 30–39			0.180	0.167	0.149	
Age 40–49		0.161	0.156	0.138		
Age 50–59	0.144	0.146	0.124			
Panel D: Share of owner-occupiers—all						
Age 20–29				0.118	0.122	0.093
Age 30–39			0.365	0.444	0.407	
Age 40–49		0.548	0.577	0.587		
Age 50–59	0.563	0.601	0.608			
Panel E: Share of owner-occupiers—lowest income quintile						
Age 20–29				0.052	0.039	0.028
Age 30–39			0.259	0.279	0.236	
Age 40–49		0.401	0.368	0.358		
Age 50–59	0.428	0.374	0.335			
Panel F: Share of owner-occupiers—top income quintile						
Age 20–29				0.223	0.260	0.175
Age 30–39			0.463	0.539	0.490	
Age 40–49		0.715	0.730	0.722		
Age 50–59	0.742	0.786	0.803			

Notes: See Table 3a.

younger cohorts. For instance, the share of homeowners at age 30–39 is 36.5% for the 1954–63 cohorts, increases to 44.4% for the 1964–73 cohorts and then declines to 40.7% for the 1974–83 cohorts (panel D). The drop in homeownership rates for younger cohorts seems to affect both the bottom and top income quintiles (panels E–F) and may reflect changing patterns of household and family formation.

Taken together, low-income individuals in more recent cohorts spend considerably more on housing than low-income individuals of previous generations, and experience falling homeownership rates. This implies that low-income individuals among the young will have lower savings and wealth to accumulate over their lifetime.

5. Discussion and Conclusion

We show in this paper that the increase in 50–10 inequality in net household incomes between 1993 and 2013 is almost three times as large once housing expenditure is considered. The share of income spent on housing increased at the bottom of the income distribution, while it declined at the top, a trend that can be attributed to a combination of changes in housing costs and compositional changes. We rationalise these findings using a simple consumer model where housing is a necessity and that allows us to derive and interpret the implications of changes in housing prices, subsistence level and household demographics for the link between income inequality before and after housing expenditure.

Our finding that the costs of housing (holding quality constant) increase more for low-income than for high-income households adds to the literature that has found larger price increases for the same goods for low-income households (see Kaplan and Schulhofer-Wohl, 2017). Through the lens of our model, this development implies a growing welfare gap between low- and high-income groups as measured by inequality of income after housing expenditure. The disproportionate rise in inequality of income after housing expenditure may also contribute to the perception of an ongoing rise of inequality in Germany, which has been a growing concern in the public debate in recent years (German Council of Economic Experts, 2017, ch. 9).

Many of our findings for Germany mirror those for Anglo-Saxon countries. Rising housing expenditure shares, especially for renters and low-income individuals, are also documented for both the United States (Quigley and Raphael, 2004; Albouy *et al.*, 2016; Larrimore and Schuetz, 2017) and the UK (Belfield *et al.*, 2015), although the *magnitude* of both levels and changes is more moderate in Germany.[31] At the same time, and in contrast to the UK, where per capita household living space falls (Belfield *et al.*, 2015), housing quality for low-income individuals in Germany improves over time. Likewise, while homeownership rates in Germany slightly decrease for the most recent cohorts, the changes across generations are far smaller than in the United States or the UK (Belfield *et al.*, 2015; Goodman and Mayer, 2018).[32] Interestingly, and

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[31] For example, 2014 data from the OECD Affordable Housing Database show that, for renters in the bottom income quintile, the median share of income spent on rents (excluding heating costs and utilities) was 27% in Germany, 42% in the UK and 50% in the United States. The OECD data, however, concern the household level and exclude heating costs and utilities, so the expenditure shares for Germany are lower than the shares reported in our paper (see http://oe.cd/ahd). Using the OECD definition for the EVS data used in our paper, we obtain an income share spent on rents of 28% in the lowest income quintile, which is quite similar to the OECD number for Germany.

[32] For example, Belfield *et al.* (2015) reported that homeownership at age 25 in the UK more than halves between cohorts born in the mid-1960s (45%) and those born in the mid-1980s (20%). For the United States, Goodman and Mayer (2018) reported a sharp decline in homeownership among young individuals aged 25–34, down from 49% in 2005 to 35% in 2015.

in contrast to Moretti's (2013) findings for the United States, regional mobility does not mitigate, but rather aggravates trends in inequality in Germany.

One important difference between Germany on the one hand, and the United States and the UK on the other, is the more restrictive access to mortgages in Germany, due to tighter regulations and larger down payment requirements. This severely reduces the possibility of wealth accumulation through housing property, particularly for the less well off, for whom the sizeable increase in the share of income spent on housing is already associated with an overall decrease in savings, as shown above. Rising inequality in savings is thus even more likely to contribute to higher wealth inequality in the future.[33] This development is worrying due to its long-term effect on wealth accumulation, in particular at a time of significantly reduced public pension benefits and government efforts to stimulate private savings as complementary retirement funding, moving the German model closer to that of Anglo-Saxon countries.[34]

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Additional Supporting Information may be found in the online version of this article:

Online Appendix
Replication Package

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[33] For the United States, Kuhn *et al.* (2020) showed that housing wealth is the most important component of the wealth portfolio for the middle class, and that changes in the housing market are key drivers for wealth inequality. Saez and Zucman (2016) showed that rising inequality of savings rates in the United States over the last decades are a driver for rising wealth inequality.

[34] See also Corneo *et al.* (2009), who concluded that attempts to boost the savings rate of low-income households via government subsidies have so far not been successful.

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