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Working Paper

Evolution and determinants of rent burdens in Germany

SOEPpapers on Multidisciplinary Panel Data Research, No. 806

Provided in Cooperation with:
German Institute for Economic Research (DIW Berlin)

Suggested Citation: Backhaus, Teresa; Gebers, Kathrin; Schröder, Carsten (2015) : Evolution and determinants of rent burdens in Germany, SOEPpapers on Multidisciplinary Panel Data Research, No. 806, Deutsches Institut für Wirtschaftsforschung (DIW), Berlin

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ISSN: 1864-6689 (online)

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Evolution and Determinants of Rent Burdens in Germany

Teresa Backhaus[*], Kathrin Gebers[†], and Carsten Schröder[‡]

Abstract

The affordability of housing has become a major topic of discussion in Germany among both social scientists and the public at large. Using data from the German Socio-Economic Panel (SOEP), we provide rent-income ratios over more than two decades and show how they change with households' disposable needs-adjusted income. We find a substantial increase in the ratios over the 1990s. In the decade that followed, they remained relatively constant. Moreover we find that rent-income ratios decrease in income at a decreasing rate, suggesting that rising square-meter prices put particular financial pressure on low-income households. Our analysis also indicates economies of scale from shared living space for multi-member households.

JEL codes: D1, D3, D6, I3, O18

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1 Introduction

Households have to provide for their members' basic needs, which include goods and services such as food, clothing, and housing. The single largest item in many households' budgets is housing. In recent years, the rising costs of both rental and owner-occupied housing have brought the issue of housing affordability—that is, the ability of households to meet their (basic) housing needs—to the fore as a major issue of public debate. Responses of policy makers to "unaffordable" housing costs include regulation of rental and housing prices, subsidizing housing and rents, the provision of public housing. The German government, for instance, recently instituted new rent-control legislation to ensure that rents remain affordable into the future.

Housing affordability, however, is not directly measurable because it lacks a clear definition. As Quigley and Raphael (2004, p. 191) argue, it is an imprecise concept, mixing up aspects such as "the distribution of housing prices, the distribution of housing quality, the distribution of income, the ability of households to borrow, public policies affecting housing markets, conditions affecting the supply of new or refurbished housing, and the choices that people make."

The present study does not provide an overarching solution to the measurement of "housing affordability." Instead, we focus on a measurable indicator of affordability: households' rent-income ratios and their dependence on household income. If, after controlling for further determinants other than income (i.e., living space, quality of residential space), rent-income ratios systematically increase over time at the bottom of the income distribution, this is an indication that housing has become less affordable.

Despite the great social relevance of housing affordability, the literature on rent-income ratios and their determinants is scarce. One exception for Germany is Frick and Grimm (2009). The authors find a strong increase of rent prices in eastern Germany and a moderate increase in western Germany during the 1990s. The Federal Statistical Office publishes average rent-income ratios for each county by the number of household members. However, these numbers do not reveal changes in the shape of rent-income ratios. In the international context, an exception is Davis and Ortalo-Magné (2011). They find remarkably constant aggregate rent-income ratios for US metropolitan statistical areas between 1980 and 2000. They argue that Cobb-Douglas preferences are responsible for constant housing expenditures in equilibrium. However, they do not analyze the influence of income on the rent-income ratio for individual households. Quigley and Raphael (2004) examine the low-income rental market in the US. They find that the rent-income ratio for the median renter has not increased substantially after the 70s but in lower quintiles of the income distribution ratio has increased slightly. In the period between 1980 and 2000, the median renter in bottom quintile experienced an increase of the rent-income ratio from 53% to 55%. However, they find that at the same time the

share of those who spend more than 30% of their income on rent has increased by 10 percentage points to 79% in the first quintile.[1] We contribute to the previous literature by offering a detailed analysis of rent-income ratios and how they change with income. The German Socio-Economic Panel (SOEP) serves as our database (Wagner et al. 2007). We estimate rent-income ratios and show how the ratios have changed over the last two decades after conditioning for living space, household composition, region of residence, and other factors.

Our results can be summarized as follows. First, consistent with Frick and Grimm (2009) we find a substantial increase in average rent-income ratios during the 1990s, especially in Germany's new Laender of the former East Germany. Today, rent-income ratios in the new Laender have reached close to the same level as in the old Laender of the former West. In the last ten years, the rent-income ratio stabilized and has not shown any further trend. One reason for the rise in average rent-income ratios in the 1990s are rents per square meter: similar to rent-income ratios, we observe a strong increase during the 1990s and stabilization over the last decade. Another reason is changes in the demand patterns of households. Over time, we observe a systematic increase in average living space per capita. This increase in demand for living space is concentrated among middle income earners. Among households in the first decile of the income distribution there was no such increase in living space. Second, rent-income ratios systematically vary with needs- and inflation-adjusted household income. That is, the ratios decrease with equivalent income at a decreasing rate. The same holds for net household incomes and the relationship between rent-income ratios and the percentiles of the equivalent income distribution. This convex pattern is relatively robust over time. However, the rent-income ratio of a household with a particular income today is systematically higher than 20 years ago. Third, regression analysis shows that households with more members profit from economies of scale in living space. This is especially true for poor households, which need to spend more on basic needs without economies of scale like food and clothing.

The remainder of the paper is structured as follows. Section 2 describes our data source and explains the data preparation. Section 3 provides results of the descriptive analysis. Section 4 summarizes the results of our regression analysis, and Section 5 concludes.

2 Data and data preparation

2.1 Database and construction of the working sample

The German Socio-Economic Panel (SOEP) provided by the German Institute for Economic Research serves as our database. The SOEP is a multidisciplinary, wide-ranging representative longitudinal

[1] The proportion of people spending more than 30% of their income on rent is another common measure for the rent burden in the US besides the rent-income ratio.

study of private households in Germany. The SOEP provides household- and personal-level data going back to 1984 on an annual basis. In 1990, even before the new Laender joined the economic, social, and currency union, the sample was expanded in order to include households of the former German Democratic Republic. The survey sample is constantly adjusted to represent current social developments and therefore also covers foreigners and recent immigrants to Germany. The variable spectrum ranges from socio-economic to demographic, socio-psychological, and political questions. The sample size increased from approximately 6,000 in 1984 to 12,000 households in 2012.

Our period of analysis starts after German reunification (1992) and ends with the most recent SOEP wave in 2012. Our working sample is restricted to tenants in private households, so that individuals in owner-occupied housing, whether apartments or houses, are excluded. Further, we have excluded households with missing information in variables relevant for our analysis (i.e., rent, size of home, household net income, region, and household composition).

We also eliminate implausibly high rent-income ratios by replacing observations with a value larger than the 99th percentile by the value of the 99th percentile in each year. The wave-specific working sample sizes are summarized in Appendix A.

2.2 Definitions of core variables

In order to assess households' monetary burdens for rent, we compute households' rent-income ratios: gross rent (rent plus utility costs and excluding heating costs) relative to net household income:

$$(1)\ \text{rent-income ratio} = \frac{\text{gross rent (excl. heat)}}{\text{net household income}}$$

We deflate monetary variables like income, equivalent income, rent, and utilities with the consumer price index. This deflation converts the nominal amounts in terms of 2012 prices. The underlying price indices are provided by the Federal Statistical Office (2012). For the years 1992 to 2000 the index differs for eastern and western Germany. Afterwards, a uniform index is provided.

An appropriate proxy is required to assess how rent-income ratios vary over the distribution of living standards. Because different types of households have different needs, household disposable income is not an appropriate proxy. To account for differences in needs, we apply the so-called modified OECD equivalence scale (S). It represents how a household's income needs depend on the number of household members under the age of 14 (n_C) and adults (n_A) living in the household. The modified OECD equivalence scale is defined as:

$$(2)\ S(n_A, n_C) = 1 + 0.5(n_A - 1) + 0.3n_C.$$

For single adults, the OECD equivalence scale is normed to 1.0. A couple with one child yields the value of 1.8. Accordingly, the couple with one child needs 1.8 times the income of a single adult to attain the same material standard of living. The household income is divided by the household specific equivalence scale in order to obtain the comparable measure of household income for the different types of households. This ratio is denoted as need-adjusted income or equivalent income.

In the analysis, we distinguish between different types of households to assess how the rent-income ratios vary with the household composition. The considered types of households are: single, single parent, couple without children, couple with one child, couple with two or more children, others with children, and others without children. Single households serve as base category. Household members below age 16 count as children. Hence, the variable *others with children* includes households containing children only under the age of 16.

Because region of residence might affect rent burdens, we further distinguish households living in urban regions (cities), regions undergoing urbanization, and rural regions. This distinction follows the Federal Institute for Research on Building, Urban Affairs and Spatial Development. The following spatial structure characteristics are used to define the categories: share of county's population in large or medium-sized cities, population density of the county, population density of the county excluding large or medium-sized cities. Also, we distinguish between households living in new and old Laender according to pre-1990 borders.[2]

3 Empirical Analysis

Rent-income shares are analyzed in two steps. First, we provide descriptive inter-temporal information on rent income shares and potential determinants like home size and household size. Second, to isolate the role of each determinant, we study relationships in a regression analysis.

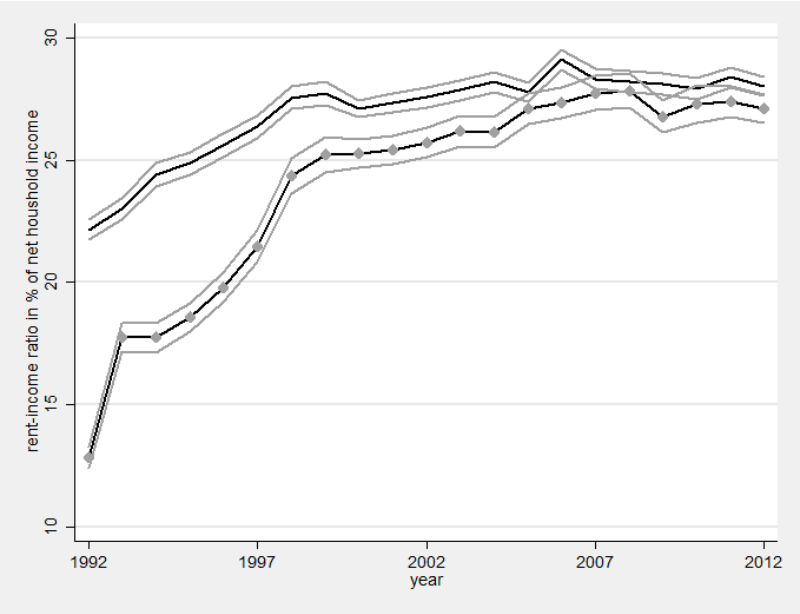
3.1 Descriptive analysis

Particularly in the early years after reunification, housing markets and income levels in the new and old Laender differed substantially. I.e., in the 1990s, both disposable incomes and rents per square meter were markedly lower in the new than in the old Laender.

Figure 1 plots average rent-income ratios over time. In this and all subsequent figures, solid lines refer to the old Laender and lines with diamonds to the new Laender. Particularly during the period immediately following German reunification, there was a substantial regional difference in rent-

[2] For more information see description of $SAMPREG under:
https://www.diw.de/documents/dokumentenarchiv/17/diw_01.c.60054.de/hpfad.pdf

income ratios. As an example, the 1992 average rent-income ratio level in the old Laender was approximately 22% and thus about 10 percentage points higher than in the new Laender. Since then, the average rent-income ratio in the new Laender first increased sharply, by about 13 percentage points, up to the late 1990s and then increased by another two percentage points up to 2012. The ratio in the old Laender increased too, but at a much lower pace: from about 22 percent in 1992 to about 27-28% in the 2000s. As a result, the regional divide vanished in the last few years of the observation period.

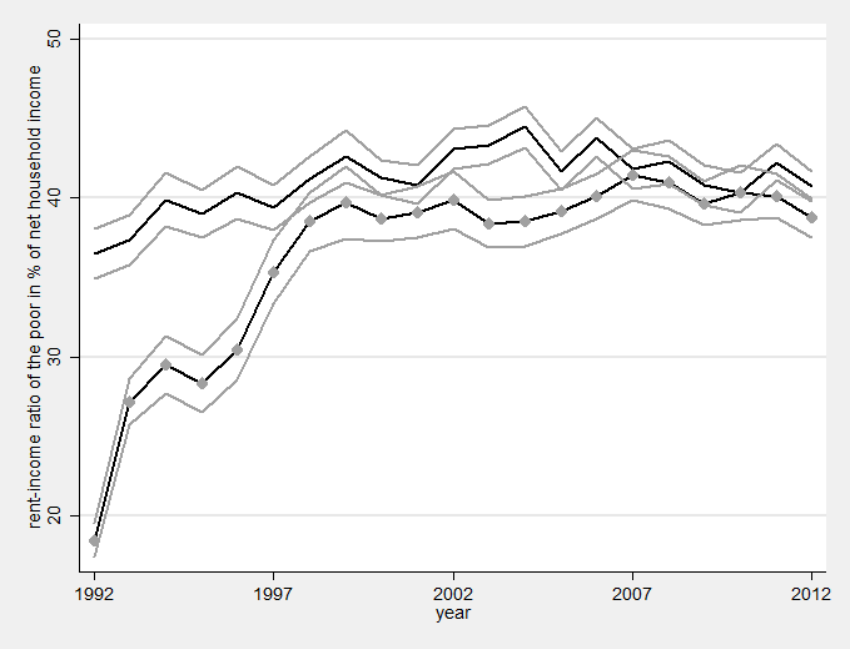


Note. The solid line refers to western Germany and diamonds to eastern Germany. 95% confidence bands are colored in grey. Data source: SOEP v29.

Figure 1 – Rent-income ratio since reunification

Low-income households often face particular difficulty paying their rent. To gain an impression of their rent burdens, Figure 2 provides rent-income ratios for poor households, defined as households with a needs-adjusted household income (equivalent income) below the poverty line (60% percent of the median adjusted household income). The poverty line is derived from the overall population – including both tenants and owners. Compared to the overall population of tenants, poor households spend a substantially larger share of their income on rent, suggesting that housing has features of a necessity good with a minimum consumption requirement. The rent-income ratios of poor households exhibit the same pattern as the ratios for the entire tenant population. However, the level of the ratios is by far higher. For poor households in the old Laender, the rent-income ratio increases from about 38% in 1992 to around 40-42% in the 2000s. For the same time period, the ratio more than doubles for poor households in the new Laender, from about 20% in 1992 to about

40% since the late 1990s. Hence, nowadays, irrespective of whether households reside in the new or old Laender, poor households share a similarly high burden for rent.[3]



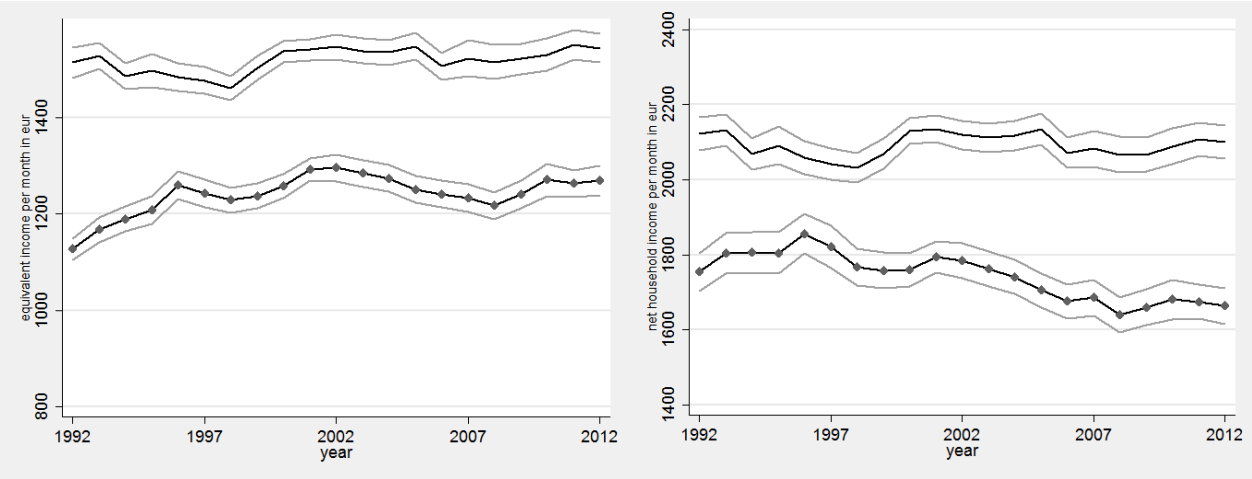
Note: The solid line refers to western Germany and diamonds to eastern Germany. 95% confidence bands are colored in grey. Data source: SOEP v29.

Figure 2 – Rent-income ratios of poor households

In order to better understand the inter-temporal rise of rent-income ratios we now turn to its defining variables: net household income and rent (rent per square meter times the size of the home).

Figure 3 provides the inter-temporal trends of the averages of two income concepts for tenants: net household income, the denominator of rent-income ratios, and equivalent income. Average net household incomes of tenants have decreased slightly in the new Laender (right panel), while it has remained about constant in the old Laender. There is a substantial regional gap in income levels that has widened over time: from about €300 in the early 1990s to more than €500 in 2012. The decline in income in the new Laender is one of the drivers of the rise in rent-income ratios in this area. For the second income concept, equivalent income, trends are different. While we find again stability in the old Laender, average equivalent income has increased in the new Laender. This is because of a decline in the average number of family members as we shall see below.

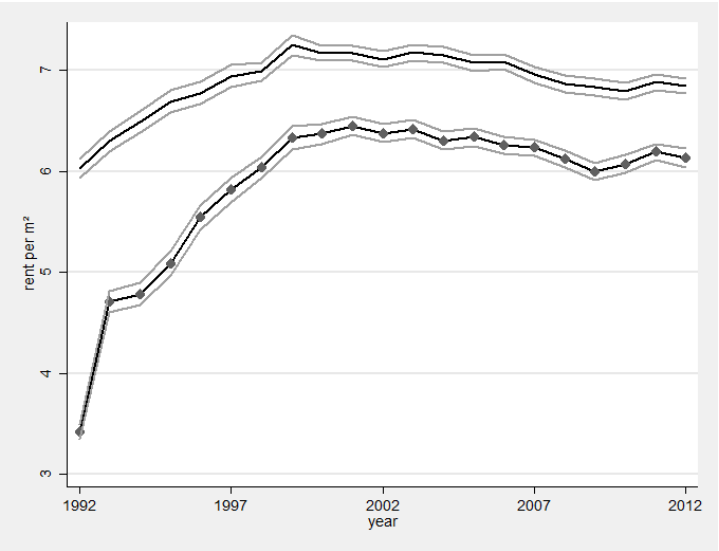
[3] The rising rent-income shares at the beginning of the observed period are in line with the findings of Frick and Grimm (2009).



Note: Left panel: average equivalent income. Right panel: average net household income. Solid line refers to western Germany and lines with diamonds to eastern Germany. 95% confidence bands are colored in grey. Data source: SOEP v29.

Figure 3 – Equivalent and net incomes

We now turn to the first element of the numerator of rent-income ratios: rent per square meter. Figure 4 shows how its averages have evolved over time. In the old Laender, the average rent per square meter has increased from about €6 in the early 1990s to about €7 since the late 1990s.Then, it stagnated. Households in the new Laender have experienced a much stronger rise from about €3.5 in 1992 to slightly above €6 in the 2000s.[4] The increase in square meters prices is the main driver of the rise in rent-income ratios during the 1990s.

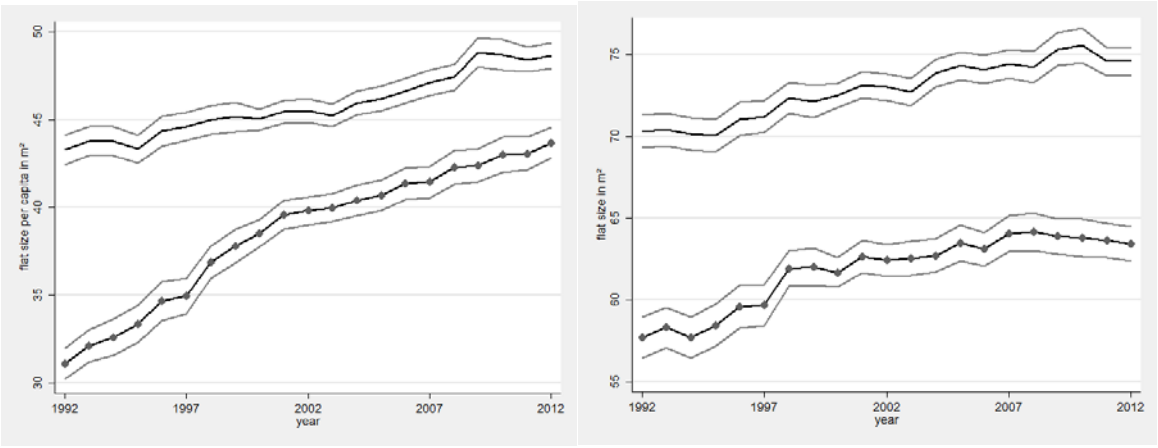


Note: The solid line relates to western Germany and diamonds to eastern Germany. 95% confidence bands are colored in grey. Data source: SOEP v29.

Figure 4 – Rent per square meter

[4] The patterns are similar in urban areas and rural areas as can be seen in Figure A1, and also for households below the poverty line (Figure A2).

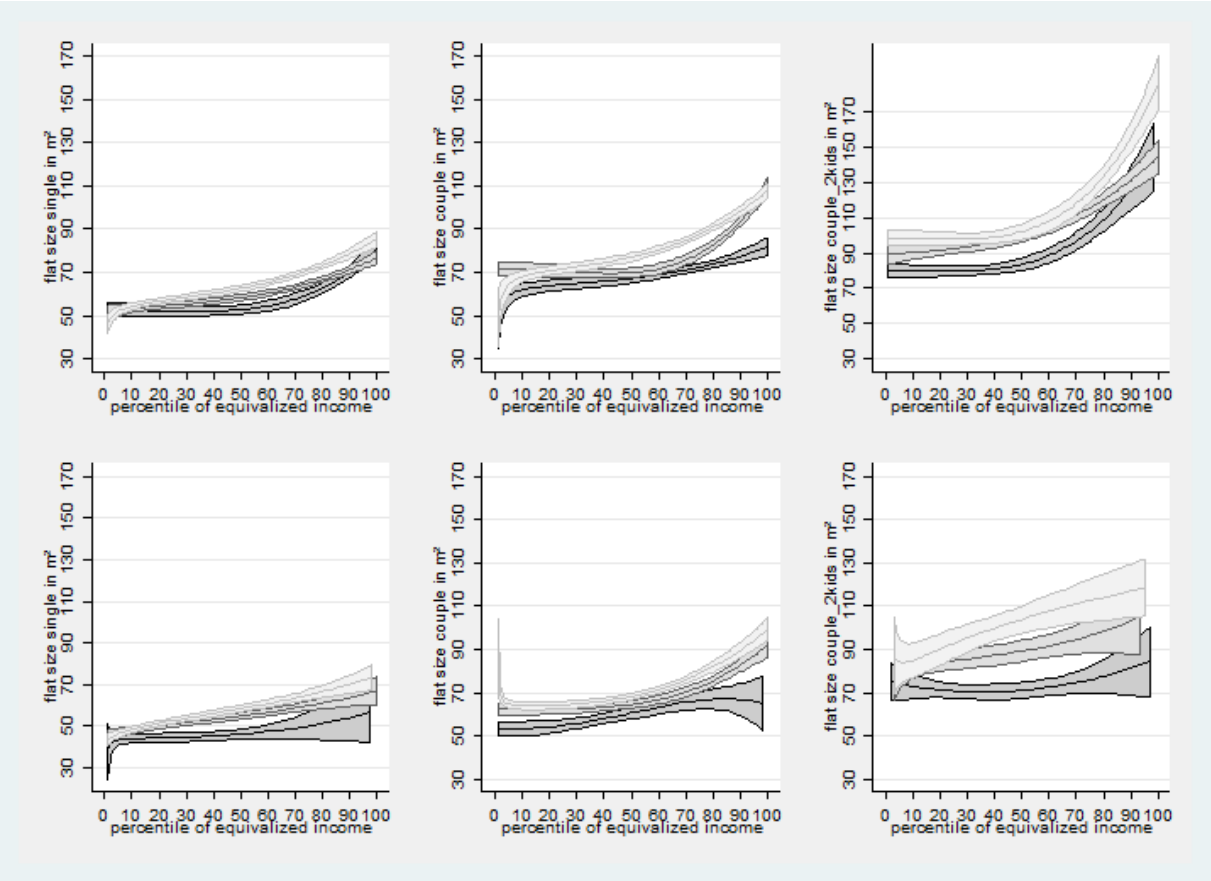
Another potential driver of the rise of rent-income ratios is the change in demand for living space. Figure 5 provides two central indicators of this demand: average home size and home size per household member (per capita). Over the observation period, average home sizes have increased in both German regions: from about 58 to about 64 m² in the new Laender; from about 70 to 75 m² in the old Laender (right panel of Figure 5). Also the per capita demand has increased: from about 44 m² to 48 m² in the old Laender, and—at a much faster pace from about 31 to 43 m²—in the new Laender.



Note. The solid line relates to western Germany and diamonds to eastern Germany. 95% confidence bands are colored in grey. Data source: SOEP v29.

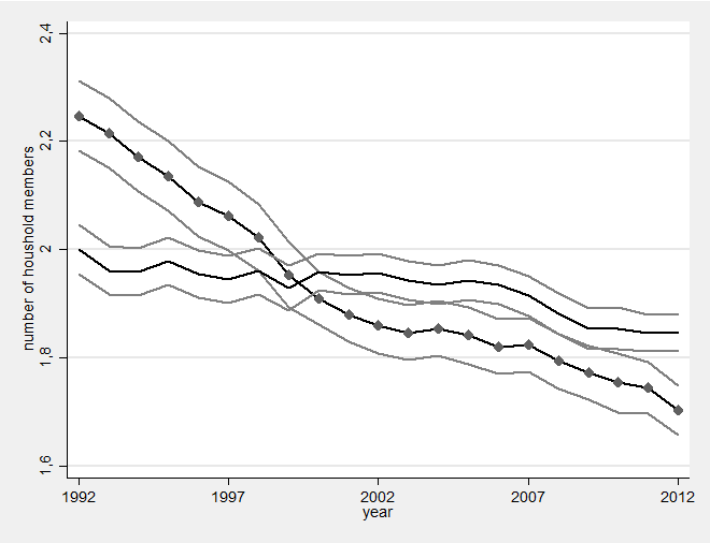
Figure 5 – Flat size and flat size per capita and total flat size in square meter

A more detailed look at average home size by percentiles and household composition reveals that only a small increase in average home size occurred at the bottom of the distribution, which is driven by the new Laender (see Figure 6 and also Figure A4 in the Appendix). This matches with the fact that poor households in the old Laender experienced only a small increase in the rent-income ratio. The largest increase in average home size between 2002 and 2012 occurred among middle-income couples and high-income couples with children in the old Laender. For all household compositions, we observe a slightly convex relationship. In other words: below a certain income level, households do not utilize income gains to increase living space.



Note. First (second) row Germany's old (new) Laender, first column singles, second column couples with no children, third column couples with two or more children. The darkest shade represents 1992 and the lightest 2012 with 95% confidence bands. For eastern German couples with children there are only a few observations (e.g., the group above the 50th percentile contains only 25 observations in 2012). Data source: SOEP v29.
Figure 6 – Flat size in m² by percentiles of equivalent income (selected years)

The rapid increase in flat size per capita, particularly in the new Laender, is a result of a marked decrease in the average number of household members (see Figure 7). Since 1992, the average number of household members has decreased in the old Laender from about 2.0 to 1.85. The decrease is more pronounced in the new Laender, where we find that the average number of household members has dropped from 2.2 to 1.7.



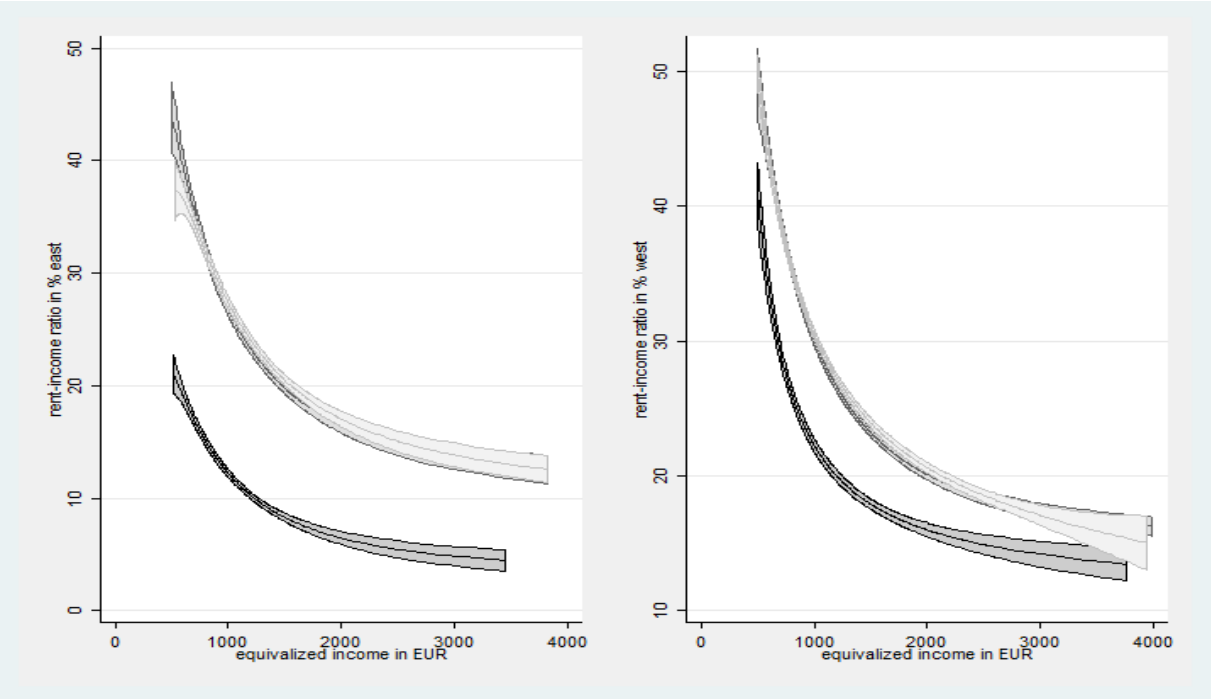
Note. The solid line relates to western Germany and diamonds to eastern Germany. 95% confidence bands are colored in grey. Data source: SOEP v29.

Figure 7 – Average number of household members

Most important for our understanding of housing affordability is the relationship between rent-income ratios and equivalent net income. The higher the ratios are at the bottom of the equivalent-income distribution, the more difficult is it for low-income households to meet their housing needs. Figure 8 provides rent-income ratios along the distribution of equivalent incomes for three years (1992, 2002, 2012). Lighter shades of gray represent more recent years. We restrict the sample to households with an equivalent income higher than €500 and lower than €4,000 to avoid wide confidence bands at both tails of the income distribution due to too few observations.

The share of household income spent on rent decreases in equivalent income. This pattern is present in Germany in general irrespective of region or household composition. The analysis is performed not only for new and old Laender independently but also on different regions (rural, undergoing urbanization and cities) and living arrangements. We can also see that the curves of 2002 and 2012 lie almost on top of each other (Figure 8). This means that the rent-income ratio across the entire income distribution has hardly changed during this period. However, there was a significant increase between 1992 and 2002, especially in the new Laender. As the shift of the curves is almost parallel up to an income of €2,500 in both parts of Germany, we can conclude that the increase has been equally distributed across these households.[5]

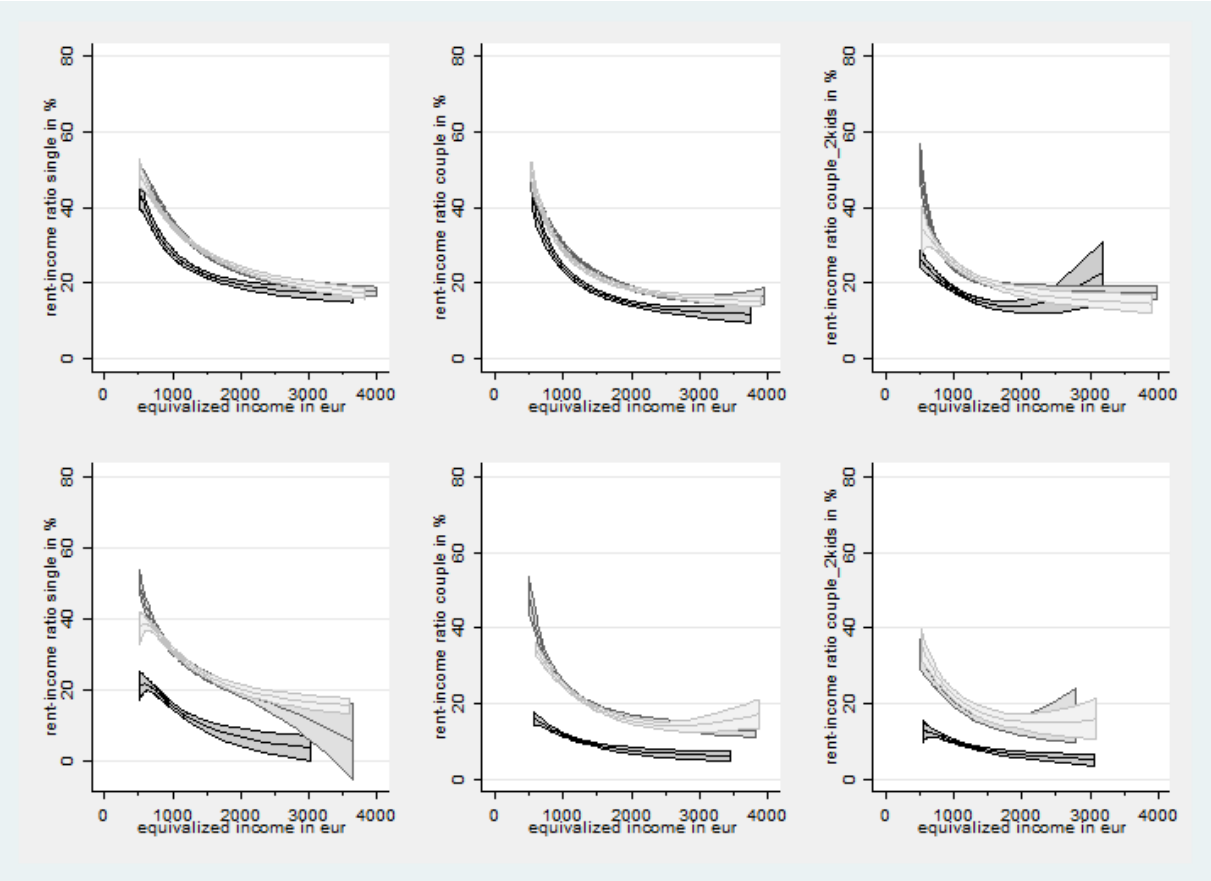
[5] Figure A5 provides rent-income ratios for urban and rural regions in the new and old Laender. The rent-income ratio in cities in the old Laender is slightly higher than in the new Laender for incomes above €2,000. For rural regions, the increase between 1992 and 2002 was largest in the new Laender – about 100%. In rural regions in the old Laender, this change has been rather low. Figure A6 shows rent-income ratios of households who recently moved into new homes (up to five years ago). The patterns are similar to those for the entire population of tenants. Therefore the results from Figure 8 cannot be driven entirely by old tenancy agreements.



Note: Left (right) graph refers to Germany's new (old) Laender. The darkest shade represents 1992 and the lightest 2012 with 95% confidence bands. Data source: SOEPv29.

Figure 8 – Rent-income ratio by equivalent income (selected years)

Figure 9 provides the rent-income ratio by equivalent income, distinguished by household compositions and region of residence. For all household types, we find the aforementioned negative relationship between rent-income ratio and equivalent income. However, the strength of the relationship hinges on the household type. It is stronger for couples (with or without children) than for singles, suggesting that housing demand is more income-elastic for singles than for families. For small low-income families the elasticity is rather low, most likely because their opportunities to further downsize living space are limited. This is in line with our previous result that the demand for living space of low-income households has changed little over time. For equivalent incomes above €1,000, rent-income ratios are slightly lower for couples and families than for singles, indicating that multi-person households spend relatively less on rent and more often make use of economies of scale in living space. In the new Laender, these patterns are similar in recent years, but we observe lower levels for families with two or more children. However, in the new Laender, we obtain large confidence bands due to the small number of observations.



Note: First (second) row Germany's old (new) Laender, first column singles, second column couples without children, third column couples with two or more children. The darkest shade represents 1992 and the lightest 2012 with 95% confidence bands. Data source: SOEP v29.
Figure 9 – Rent-income ratios by equivalent income for different household compositions (selected years)

3.2 Regression analysis

3.2.1 Regression model

We econometrically investigate rent burdens by a standard OLS fixed effects model (3) with robust standard errors:

$$(3)\ y_{it} = \alpha_i + \beta_1 \mathrm{x}_{it} + \beta_2 t + \beta_3 t^2 + \varepsilon_{it},$$

where y_{it} denotes the dependent variable, t and t^2 denote years since 1992 and years since 1992 squared as a continuous variables, α_i the fixed effect of household i and ε_{it} the error terms. Vector x_{it} denotes a vector of explanatory variables on the household's region, household composition, and income in units of 1000 Euro in our baseline regression.

The two most common methods to model the individual effects in linear panel data models are random or fixed effects. We have implemented a Hausman test, which indicates that the random-effects estimation is not a valid alternative.[6]

In order to further control for changing effects of the explanatory variables over time we later extend the baseline regression model by interaction terms of the indicating variables and a continuous time variable,

$$(4)\ y_{it} = \alpha_i + \beta_1 \mathrm{x}_{it} + \beta_2 t + \beta_3 t^2 + \beta_4\, \mathrm{x}_{it} t + \varepsilon_{it},$$

In order to identify effects of housing characteristics we perform a third specification including housing characteristics but excluding household compositions. Included housing characteristics are building type, flat size, and the existence of a balcony or garden and their interaction terms with time.

3.2.2 Regression results

Table 1 summarizes the regression results according to equation (3). The first column provides the results for Germany as a whole, the second column for the old Laender, the third for the new Laender. Explanatory variables are:

1. Spatial dummies – *city* and regions undergoing *urbanization* (base category: *rural* area)
2. Household-type specific dummies (base category: single)
3. *Household income in €1,000*
4. *Period-1992* – continuous time variable (with values 0 in 1992 and 20 in 2012)
5. *(Period-1992)²* – time variable squared
6. *Years since moving* – number of years household has lived in recent home
7. *New Laender* – dummy distinguishes between old and new Laender (base category: old Laender)

All included explanatory variables except urbanization are highly significant for all three populations. We first comment on the results for the overall sample of tenants. Ceteris paribus, rents of households in cities are about €30.5 higher compared to households living in villages. Compared to the one-member benchmark household type in our regression, larger households have higher expenditures for rent. However, household-type specific coefficients are always smaller than the regression constant, which can be interpreted as the minimum expenditure for the one-member household, suggesting that multi-member households benefit from economies of scale in housing.

[6] However, for completeness we provide the results from random effects estimations in the Appendix (Table A6).

The coefficient for household income indicates that housing is inelastic with respect to income: increasing household net income by €1,000 increases rent expenditure by a moderate €31. This relationship is consistent with the declining rent-income ratio in income from the descriptive analysis.[7] Over time, expenditures on rent increase at a decreasing rate. A regression with year dummies confirms this pattern and shows that it peaks in 2005 (see Table A5). The coefficient for years since moving indicates that households that spend more years in the same flat pay lower rent.

The region-specific estimations reveal some regional peculiarities. Consistent with the descriptive analysis, we find higher expenditures on rent in the old Laender (see regression constant) and a stronger sensitivity of the expenditures with regard to living area (city) and household composition. However, the income elasticity and also the inter-temporal rise in expenditures are stronger in the new Laender.[8]

Table 1 – Determinants of rent burdens (OLS fixed effects)

	Germany		Old Laender		New Laender	
City	30.51**	(2.41)	60.05***	(3.36)	-38.21	(-1.45)
Urbanization	-8.740	(-0.65)	9.727	(0.55)	-56.07	(-1.57)
Single parent	84.31***	(13.42)	99.39***	(12.37)	56.28***	(6.32)
Couple no children	64.03***	(15.32)	74.73***	(14.37)	33.64***	(6.25)
Couple 1 child	108.8***	(19.80)	131.4***	(19.29)	54.93***	(7.32)
Couple 2(+) children	138.2***	(22.21)	164.7***	(21.90)	72.48***	(7.97)
Other household comp	92.99***	(18.12)	112.4***	(17.56)	46.09***	(7.10)
Household income in €1,000	31.08***	(13.21)	29.13***	(11.06)	32.74***	(10.65)
Period-1992	22.71***	(39.44)	18.27***	(24.89)	30.85***	(37.45)
(Period-1992)²	-0.756***	(-31.09)	-0.603***	(-19.72)	-1.063***	(-29.97)
Years since moving	-3.596***	(-15.64)	-3.412***	(-10.36)	-3.304***	(-11.31)
New Laender	-70.37***	(-5.92)				
Constant	256.0***	(20.61)	256.5***	(16.01)	178.3***	(10.87)
Number observations	102431		73731		28700	
R^2 overall	0.297		0.249		0.265	
R^2 within	0.168		0.145		0.256	
R^2 between	0.318		0.278		0.282	

Note: t statistics in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Rent in Euro per month.
Data source SOEP v29.

The inclusion of interaction terms of the covariates with the time variable (equation 4) does not change the general findings from Table 1. The time interaction of the region-specific city dummy and also some interactions with household-type dummies are insignificant, suggesting that the relationships of these variables and rent expenditures did not change over the observation period

[7] Table A4 shows that this extra amount spent for rent with every 1,000€ household income decreases across the income distribution. This is due to the fact that high income households already have satisfied their demand for proper living space.
[8] The latter confirms the observed convergence of levels between new and old Laender.

(Table 2). Those coefficients of household composition which are significant are positive, implying that the relationship has intensified over time. The interaction term of living in a city is negative for Germany as a whole which implies that this fact becomes less important over time.[9]

Table 2 – Determinants of rent burdens (OLS fixed effects) with interaction terms

	Germany		Old Laender		New Laender	
City	37.54***	(2.78)	29.66	(1.51)	-34.97	(-1.26)
Urbanization	11.45	(0.77)	3.570	(0.18)	-40.63	(-1.11)
Single parent	59.04***	(5.28)	85.82***	(5.81)	7.201	(0.48)
Couple no children	63.92***	(9.91)	82.50***	(10.18)	27.41***	(3.25)
Couple 1 child	85.02***	(9.54)	120.2***	(10.95)	17.61	(1.39)
Couple 2(+) children	99.80***	(11.19)	135.6***	(12.74)	26.30**	(1.98)
Other household comp.	100.8***	(12.35)	128.6***	(12.66)	42.64***	(3.99)
Household income in €1,000	19.57***	(6.31)	18.70***	(5.31)	10.19**	(2.20)
Period-1992	19.91***	(26.82)	13.63***	(13.38)	25.31***	(26.77)
(Period-1992)²	-0.754***	(-30.51)	-0.609***	(-19.40)	-1.019***	(-28.83)
Years since moving	-4.332***	(-14.31)	-4.204***	(-9.39)	-3.406***	(-9.18)
City #c.t	-1.793***	(-3.39)	0.637	(0.78)	-0.806	(-1.28)
Urbanization #c.t	-0.547	(-1.17)	2.874***	(4.00)	0.00138	(0.00)
Single parent #c.t	2.077**	(2.42)	0.983	(0.87)	4.318***	(3.81)
Couple no children #c.t	0.0245	(0.05)	-0.633	(-1.04)	0.166	(0.29)
Couple 1 child #c.t	2.561***	(3.53)	1.315	(1.47)	4.073***	(4.12)
Couple 2(+) children #c.t	3.957***	(5.52)	2.992***	(3.54)	5.199***	(5.04)
Other household comp. #c.t	-1.231**	(-1.98)	-1.936**	(-2.53)	-0.454	(-0.54)
Household income in 1000#c.t	0.997***	(3.80)	0.904***	(3.04)	1.953***	(5.49)
Years since moving #c.t	0.0600***	(3.90)	0.0607***	(2.82)	0.00340	(0.17)
New Laender	-69.97***	(-5.95)				
Constant	288.2***	(22.19)	310.0***	(17.51)	236.0***	(13.63)
Number observations	102431		73731		28700	
R^2 overall	0.302		0.254		0.271	
R^2 within	0.173		0.150		0.270	
R^2 between	0.324		0.282		0.295	

Note: t statistics in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Rent in euros. Data source SOEP v29.

In order to see whether rent varies systematically with certain household amenities, we include such amenities as explanatory variables. Particularly, we extend the set of explanatory variables from equation (3) by:

1. Building-type-specific dummies (base category: detached house)
2. *Terrace/balcony* dummy
3. *Garden* dummy
4. *Home size* in m²

[9] However, inference for spatial differences is limited for the fixed effects model due to little within-household variation in the variable.

All additional explanatory variables are significant except from the garden dummy and dummies for large and unspecified building types (Table 3). Again, we first focus on the sample for all tenants. The inclusion of housing characteristics instead of household compositions does not change general patterns for time, level of urbanization, and income. The coefficient for home size indicates that square meters alone account for less than 50% of the rent prices: increasing the home size by one m² increases the price only by €3.7, which is far below the average rent per square meter depicted in Figure 4. Flats with a terrace or a balcony are about €43 more expensive on average, suggesting that these are typical features of more valuable living space. Compared to a detached house, all other building types except high-rises translate into a higher rent-income ratio notwithstanding the controls for region undergoing urbanization and city. The region-specific estimations show that home size, terrace/balcony, and large building types have a larger effect on the rent in the old Laender, suggesting that rent prices in the new Laender are set more heterogeneously.

Table 3 – Determinants of rent burdens (OLS fixed effects) including housing characteristics

	(1) Germany		(2) Old Laender		(3) New Laender	
City	48.58***	(4.07)	74.84***	(4.25)	-19.40	(-1.01)
Urbanization	0.0904	(0.01)	16.87	(0.96)	-17.80	(-0.70)
Household income €1,000	20.95***	(12.45)	20.06***	(10.53)	20.98***	(8.84)
Row house	59.94***	(7.13)	60.25***	(6.55)	61.61***	(2.77)
3-4 apartments	23.40***	(3.96)	24.25***	(3.68)	26.59**	(1.99)
5-8 apartments	32.65***	(5.53)	36.53***	(5.42)	17.95	(1.39)
9 or more apartments	25.38***	(3.85)	37.45***	(4.64)	2.330	(0.18)
High-rise	-5.773	(-0.49)	-5.882	(-0.34)	-3.816	(-0.22)
Other building type	-28.72	(-1.50)	-36.22	(-1.44)	-15.73	(-0.84)
Terrace/balcony	42.83***	(14.73)	48.42***	(13.57)	32.16***	(6.73)
Garden	-1.990	(-0.81)	0.940	(0.32)	-6.682	(-1.57)
Home size	3.734***	(29.35)	3.767***	(25.26)	3.527***	(14.86)
Period-1992	17.89***	(35.07)	13.84***	(21.44)	26.35***	(35.66)
(Period-1992)²	-0.692***	(-32.37)	-0.561***	(-20.88)	-0.976***	(-31.04)
Years since moving	-2.857***	(-14.46)	-2.476***	(-9.01)	-3.034***	(-11.52)
New Laender	-49.83***	(-4.65)				
Constant	28.78**	(1.96)	19.49	(1.02)	-10.28	(-0.46)
Number observations	100292		72420		27872	
R^2 overall	0.518		0.501		0.491	
R^2 within	0.322		0.299		0.402	
R^2 between	0.559		0.548		0.531	

Note: t statistics in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Rent in euros. Data source SOEP v29.

Robustness checks

One may argue that controlling for household income in the regression analysis biases the coefficients for household compositions downward: for a single, €2,000 net household income provides a quite comfortable financial situation, allowing the single to invest in a larger or more luxurious apartment, whereas for a couple, €2,000 might not result in the same situation. To account for this fact, we replace the household income by equivalent household incomes (Table A7). As expected, coefficients for household compositions become larger.

4 Conclusion

After a rapid increase during the 1990s, the average rent-income ratio has remained relatively stable at a level of about 27% during the last decade. Only in the new Laender has there been a slight increase of about two percentage points. Also for poor households, the ratio stabilized but on a significantly higher level of approximately 40%. At the same time, we observe a decreasing number of household members and increasing trend in home size, both in absolute terms and per capita. This increase in demand for living space is concentrated in the middle of the income distribution. Poor households in western Germany do not show an increasing demand for living space, which can explain the stable rent-income ratio for those households. In the new Laender, the demand for living space increased for poor households as well. However, we still observe a stabilization of the rent-income ratio for these households because prices per square meter decreased.

By analyzing the determinants we find that the rent-income ratio is negatively correlated with income. The relationship between rent-income ratio and equivalent income is convex. In other words, the share of income spent for rent decreases at a decreasing rate with rising income. For non-single households the curve is steeper than for singles, indicating that non-single households need more space in the first place but then profit from economies of scale and are able and willing to spend less on shelter. In our regression on housing characteristics, we find that the effect of home size on total rent payments lies far below the average price per square meter. This implies that there are other ways of saving on rent besides cutting back on size such as making sacrifices in regard to comfort or neighborhood.

Urbanization has different effects on the rent-income ratios in eastern and western Germany: Living in cities or regions undergoing urbanization compared to rural areas is more expensive in western Germany and less expensive in eastern Germany, where the difference is only significant for western German cities.

Overall we cannot conclude that housing has become less affordable in Germany during the last decade. Trends were driven by an increasing demand for living space. However, poor households already need to spend a remarkably high share of their income on rent and do not seem to be able to spend more. The rent-income ratio does not reveal whether poor households had to move to cheaper, more affordable, but less attractive places. Moreover, rising energy costs add to the stable rent-income ratio and therefore may have caused rising shelter-related cost ratios for those households. Both of these topics may be object to further research.

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Appendix A

Table A1 – Number of Observations in overall population (Sample 0)

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Germany	6430	6365	6530	6617	6554	6530	7231	7030	12302	11274	11993	11378	11170	10854	11687	11096	10451	11105	10092	11645	11676
New Laender	1914	1843	1814	1772	1792	1790	1900	1882	2938	2782	2801	2754	2700	2633	2820	2703	2585	2761	2467	2825	2844
Old Laender	4516	4522	4716	4845	4762	4740	5331	5148	9364	8492	9192	8624	8470	8221	8867	8393	7866	8344	7625	8820	8832

Note: Sample 0 includes all observations with non-missing information on income and household size. It is used to determine the poverty line. Data source SOEP v29.

Table A2 – Number of Observations in working sample (Sample 1)

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Germany	3922	3916	4043	4101	3997	3913	4209	4010	6526	5927	5894	5607	5465	5305	5671	5332	4945	5285	4708	5585	5677
New Laender	1256	1247	1209	1166	1158	1132	1166	1137	1733	1602	1591	1564	1513	1453	1550	1477	1403	1466	1302	1564	1605
Old Laender	2666	2669	2834	2935	2839	2781	3043	2873	4793	4325	4303	4043	3952	3852	4121	3855	3542	3819	3406	4021	4072

Note: Sample 1 is our working sample. It includes only observations of private households with data on their rent and is subject to restrictions as described above. Private households with missing information on gross rent, household net income, region, size of flat, household composition are excluded in the year where either of the variables is missing. The additional requirement that data on region, size of flat and household composition is non-missing reduces the sample size by 128 observations. The development of tenants' income, the home size, and rent-income ratio rely on this sample. Data source: SOEP v29.

Table A3 – Number of Observations in Sample 1

	Household composition						Region		
Year	Singles	Couple w/o children	Couple with 1 child	Couple with 2 or more children	Single parents	Others w/o children	City	Undergoing urbanisation	Rural
1992	942	1004	470	719	160	60	1994	1061	867
2002	1934	1725	539	739	311	39	3067	1576	1251
2012	2281	1705	361	493	352	26	2762	1590	1325

Note: Sample 1 is our working sample. This table presents a more detailed description of the number of observations. Data source: SOEP v29.

Table A4 – Determinants of rent burdens (OLS fixed effects)

	(1) Germany		(2) Old Laender		(3) New Laender	
City	30.81**	(2.43)	59.95***	(3.35)	-37.44	(-1.41)
Urbanization	-8.394	(-0.62)	9.991	(0.57)	-57.18	(-1.61)
Single parent	76.82***	(11.13)	94.36***	(10.94)	36.13***	(3.72)
Couple	58.62***	(12.39)	70.48***	(12.34)	20.00***	(3.30)
Couple 1 child	98.86***	(14.57)	124.3***	(15.23)	28.90***	(3.31)
Couple 2 children	123.8***	(15.11)	154.7***	(16.08)	34.62***	(3.20)
Other hhc	81.72***	(12.53)	104.2***	(13.35)	17.47**	(2.16)
Household income in €1,000	50.34***	(6.37)	39.86***	(4.42)	87.48***	(8.66)
inc_1000*d2	-3.483	(-1.46)	0.229	(0.08)	-15.36***	(-4.44)
inc_1000*d3	-7.328**	(-2.32)	-2.487	(-0.68)	-23.53***	(-5.15)
inc_1000*d4	-9.472**	(-2.57)	-4.364	(-1.02)	-27.21***	(-5.26)
inc_1000*d5	-10.15**	(-2.50)	-4.430	(-0.95)	-31.89***	(-5.57)
inc_1000*d6	-11.34***	(-2.59)	-5.437	(-1.08)	-34.98***	(-5.61)
inc_1000*d7	-10.81**	(-2.30)	-3.661	(-0.68)	-38.91***	(-5.92)
inc_1000*d8	-12.38**	(-2.47)	-5.879	(-1.02)	-40.03***	(-5.87)
inc_1000*d9	-10.37*	(-1.90)	-2.540	(-0.40)	-43.26***	(-5.84)
inc_1000*d10	-18.49***	(-3.20)	-10.80	(-1.61)	-45.81***	(-5.52)
Period-1992	22.63***	(39.16)	18.27***	(24.87)	30.45***	(37.17)
(Period-1992)²	-0.753***	(-30.93)	-0.604***	(-19.78)	-1.044***	(-29.63)
Years since moving	-3.606***	(-15.69)	-3.415***	(-10.40)	-3.344***	(-11.41)
New Laender	-70.17***	(-5.92)				
Constant	243.3***	(18.47)	247.8***	(14.84)	148.2***	(8.50)
Number of observations	102431		73731		28700	
R^2 overall	0.294		0.246		0.267	
R^2 within	0.169		0.147		0.260	
R^2 between	0.313		0.273		0.286	

Note: t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Rent in Euro per month. Included interaction terms, e.g. *inc_1000*d2,* are defined as net household income(in 1000€) times the decile of the equivalent income distribution, with first decile as base category. Data source SOEP v29.

Table A5 – Determinants of rent burdens (OLS fixed effects)

	(1) Germany		(2) Old Laender		(3) New Laender	
City	30.74**	(2.43)	60.11***	(3.36)	-38.50	(-1.45)
Urbanization	-8.690	(-0.64)	9.905	(0.56)	-57.40	(-1.60)
Single parent	84.16***	(13.39)	99.31***	(12.36)	55.63***	(6.22)
Couple	63.85***	(15.26)	74.46***	(14.30)	33.68***	(6.26)
Couple 1 child	108.8***	(19.79)	131.2***	(19.23)	55.46***	(7.43)
Couple 2 children	138.0***	(22.17)	164.3***	(21.82)	73.19***	(8.04)
Other hh composition	93.25***	(18.16)	112.4***	(17.54)	47.20***	(7.28)
Household income in €1,000	31.04***	(13.15)	29.13***	(11.01)	32.26***	(10.43)
1993	39.20***	(17.99)	21.44***	(7.69)	74.27***	(29.12)
1994	58.60***	(23.02)	44.30***	(13.40)	80.54***	(26.09)
1995	72.78***	(24.24)	55.33***	(14.31)	99.00***	(25.78)
1996	90.68***	(29.27)	68.29***	(17.19)	128.0***	(31.26)
1997	112.1***	(33.06)	86.45***	(19.95)	156.7***	(34.48)
1998	134.6***	(38.26)	103.4***	(23.18)	191.9***	(38.48)
1999	146.4***	(39.12)	112.0***	(23.55)	210.4***	(39.93)
2000	154.8***	(40.96)	119.0***	(24.41)	219.1***	(43.12)
2001	162.8***	(41.80)	125.6***	(24.97)	228.2***	(44.16)
2002	163.2***	(40.21)	127.0***	(23.97)	225.1***	(43.06)
2003	168.5***	(40.69)	131.4***	(24.32)	232.2***	(42.77)
2004	176.6***	(41.55)	141.0***	(25.17)	236.3***	(42.96)
2005	178.9***	(41.52)	142.4***	(24.98)	240.3***	(42.83)
2006	177.2***	(40.34)	141.5***	(24.05)	235.0***	(42.09)
2007	179.1***	(39.33)	143.0***	(23.43)	237.8***	(42.06)
2008	173.2***	(36.62)	134.1***	(21.11)	238.6***	(40.68)
2009	172.4***	(35.52)	134.3***	(20.39)	233.5***	(39.98)
2010	179.7***	(35.98)	142.3***	(21.04)	239.4***	(39.16)
2011	181.4***	(35.55)	144.3***	(20.78)	238.8***	(38.40)
2012	178.5***	(34.16)	140.3***	(19.72)	236.7***	(36.96)
Years since moving	-3.618***	(-15.75)	-3.431***	(-10.42)	-3.324***	(-11.38)
New Laender	-70.36***	(-5.93)				
Constant	241.7***	(19.51)	249.5***	(15.57)	153.4***	(9.48)
Number of observations	102431		73731		28700	
R^2 overall	0.298		0.249		0.270	
R^2 within	0.171		0.147		0.269	
R^2 between	0.315		0.276		0.282	

Note: t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Data source SOEP* v29.

Table A6 – Determinants of rent burdens (OLS random effects)

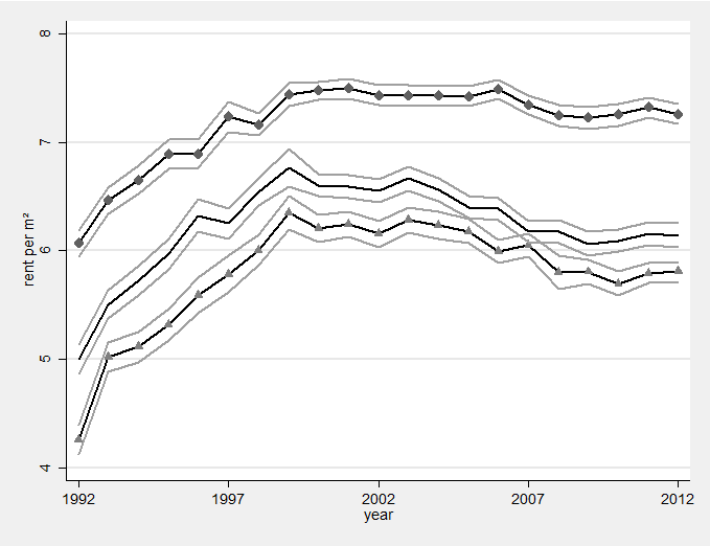
	(1) Germany		(2) Old Laender		(3) New Laender	
City	57.71***	(11.12)	80.95***	(11.87)	20.74***	(3.07)
Urbanization	8.968*	(1.69)	27.86***	(3.93)	-12.31**	(-2.14)
Single parent	77.93***	(15.53)	89.73***	(14.22)	58.88***	(8.44)
Couple no children	56.02***	(14.54)	64.19***	(13.51)	35.42***	(7.77)
Couple 1 child	96.59***	(19.49)	116.2***	(19.26)	52.54***	(8.35)
Couple 2(+) children	125.9***	(22.66)	149.2***	(22.60)	69.97***	(9.39)
Other household comp	79.51***	(16.57)	95.14***	(16.14)	43.70***	(7.68)
Household income in €1,000	45.61***	(17.04)	44.50***	(14.56)	47.23***	(15.93)
Period-1992	22.38***	(42.59)	17.92***	(27.30)	30.98***	(40.97)
(Period-1992)²	-0.777***	(-34.56)	-0.623***	(-22.25)	-1.090***	(-32.95)
Years since moving	-2.687***	(-19.37)	-2.588***	(-13.90)	-2.377***	(-13.21)
New Laender	-80.90***	(-19.41)				
Constant	210.5***	(31.37)	210.8***	(25.64)	110.8***	(17.13)
Number of observations	102431		73731		28700	
R^2 overall	0.342		0.297		0.345	
R^2 within	0.162		0.139		0.249	
R^2 between	0.384		0.348		0.400	

Note: t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Data source SOEP* v29.

Table A7 – Determinants of rent burdens (OLS fixed effects)

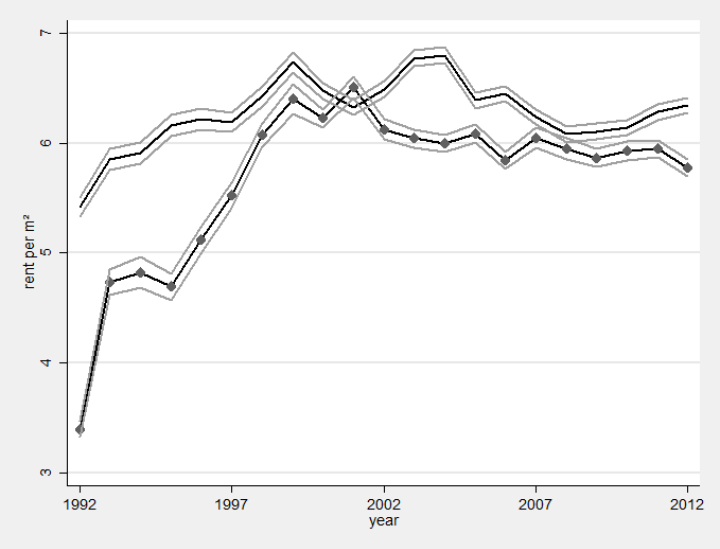
	(1) Germany		(2) Old Laender		(3) New Laender	
City	29.71**	(2.32)	60.27***	(3.34)	-39.53	(-1.50)
Urbanization	-9.737	(-0.71)	9.534	(0.53)	-57.30	(-1.58)
Single parent	109.5***	(16.90)	124.3***	(14.97)	79.14***	(8.73)
Couple no children	87.59***	(22.78)	98.49***	(20.50)	53.11***	(10.20)
Couple 1 child	145.7***	(28.03)	167.6***	(25.75)	88.26***	(12.17)
Couple 2(+) children	186.3***	(31.49)	211.7***	(29.19)	116.7***	(13.50)
Other household comp	134.0***	(28.52)	152.8***	(25.74)	83.59***	(13.14)
Equiv. income in €1,000	36.76***	(10.06)	34.21***	(8.51)	41.38***	(9.27)
Period-1992	22.80***	(39.00)	18.31***	(24.59)	30.92***	(37.27)
(Period-1992)²	-0.758***	(-30.68)	-0.601***	(-19.39)	-1.068***	(-29.91)
Years since moving	-3.589***	(-15.58)	-3.399***	(-10.29)	-3.295***	(-11.30)
New Laender	-71.75***	(-5.92)				
Constant	248.7***	(18.80)	248.3***	(14.65)	169.9***	(9.97)
Number of observations	102431		73731		28700	
R^2 overall	0.269		0.218		0.247	
R^2 within	0.158		0.135		0.250	
R^2 between	0.282		0.240		0.261	

Note: t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Dependent variable is rent; robust standard errors. *Data source SOEP* v29.



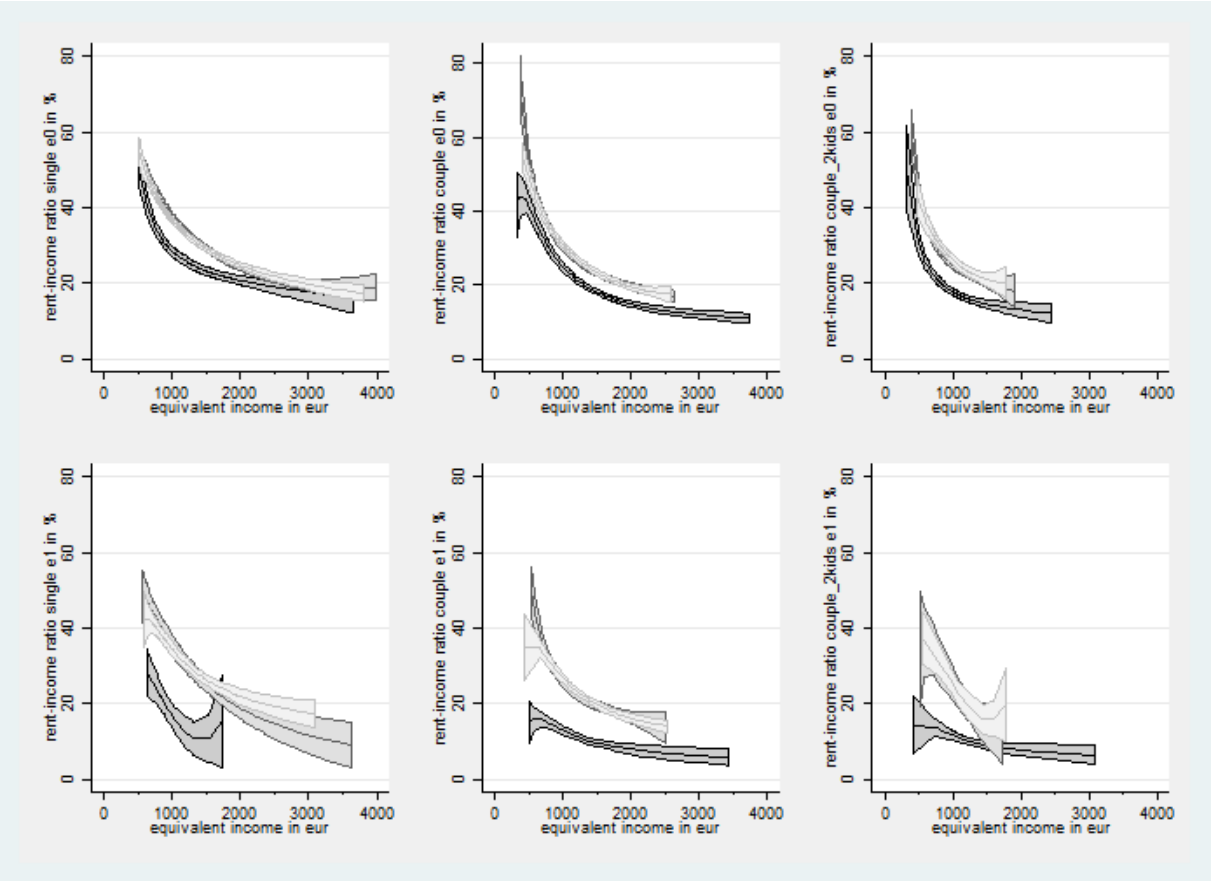
Note: Triangles refer to rural regions, solid line to regions undergoing urbanization, diamonds to cities. 95% confidence bands are colored in grey. Data source: SOEP v29.

Figure A1 – Rent per square meter in rural and urbanized regions



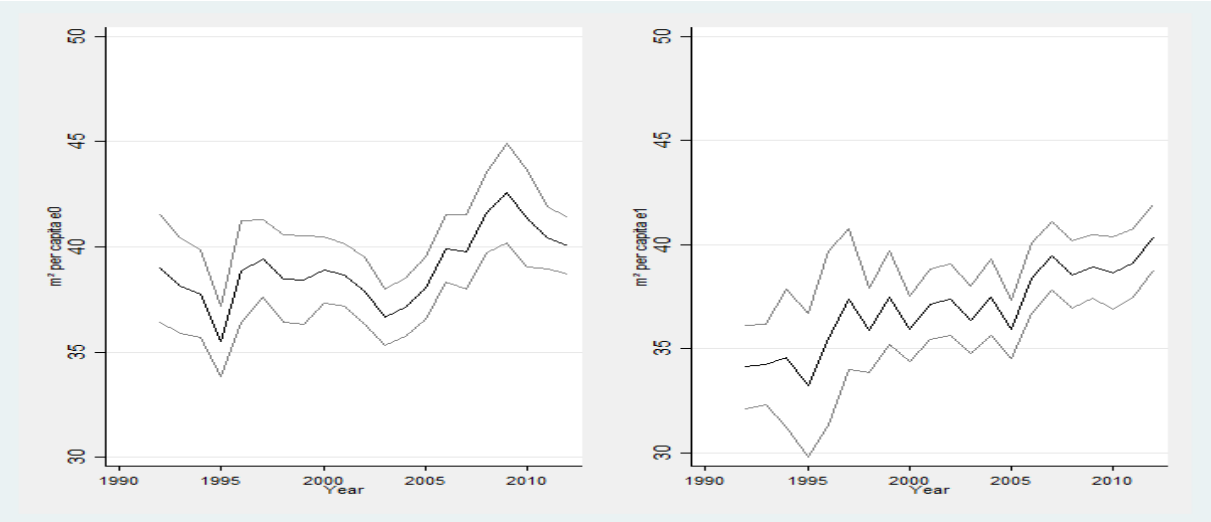
Note: The solid line refers to western Germany and diamonds to eastern Germany. 95% confidence bands are colored in grey. Data source SOEP v29.

Figure A2 – Rent per square meter for poor households



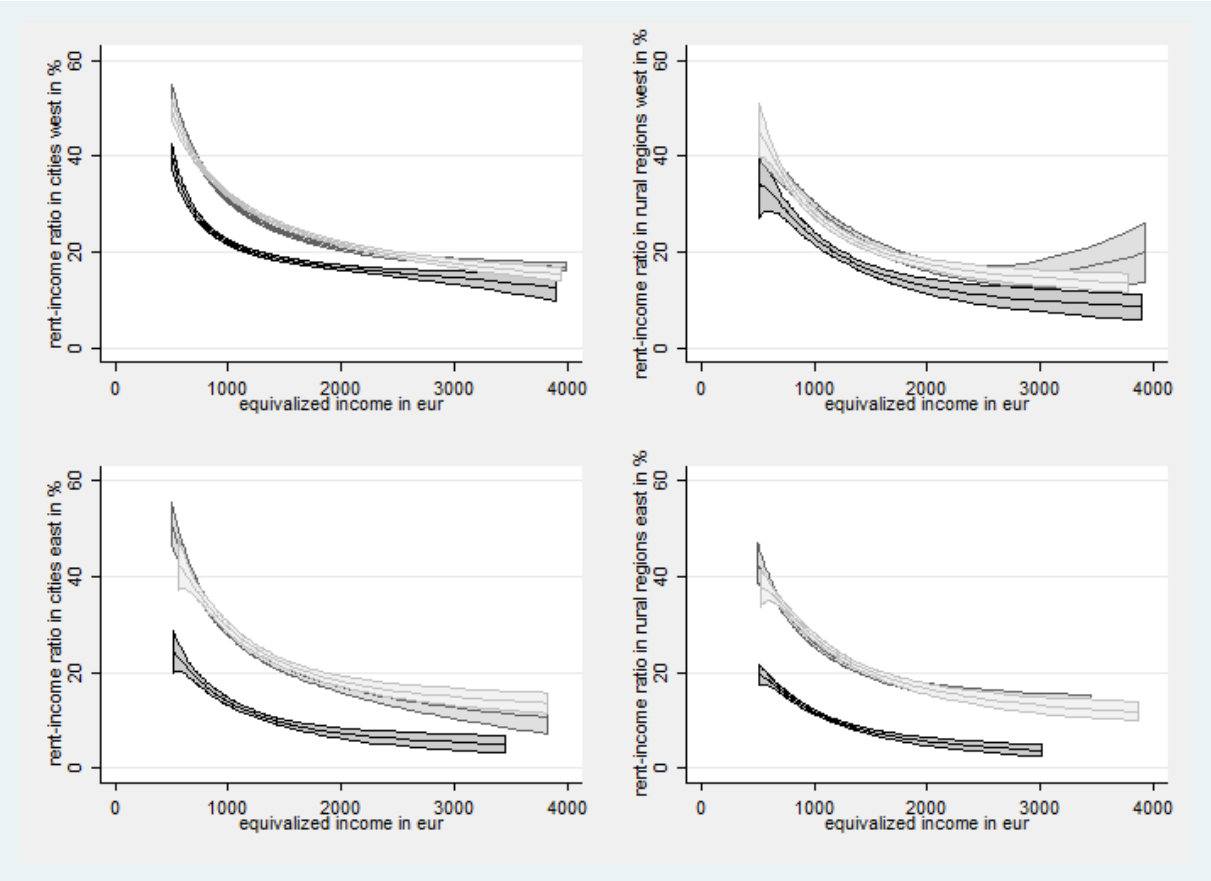
Note: First (second) row Germany's old (new) Laender, , first column singles, second column couples without children, third column couples with 2 or more children. The darkest shade represents 1992 and the lightest 2012 with 95% confidence bands. Data source: SOEP v29.

Figure A3 – Rent-income ratio in cities by equivalent income and household compositions (1992, 2002, 2012)



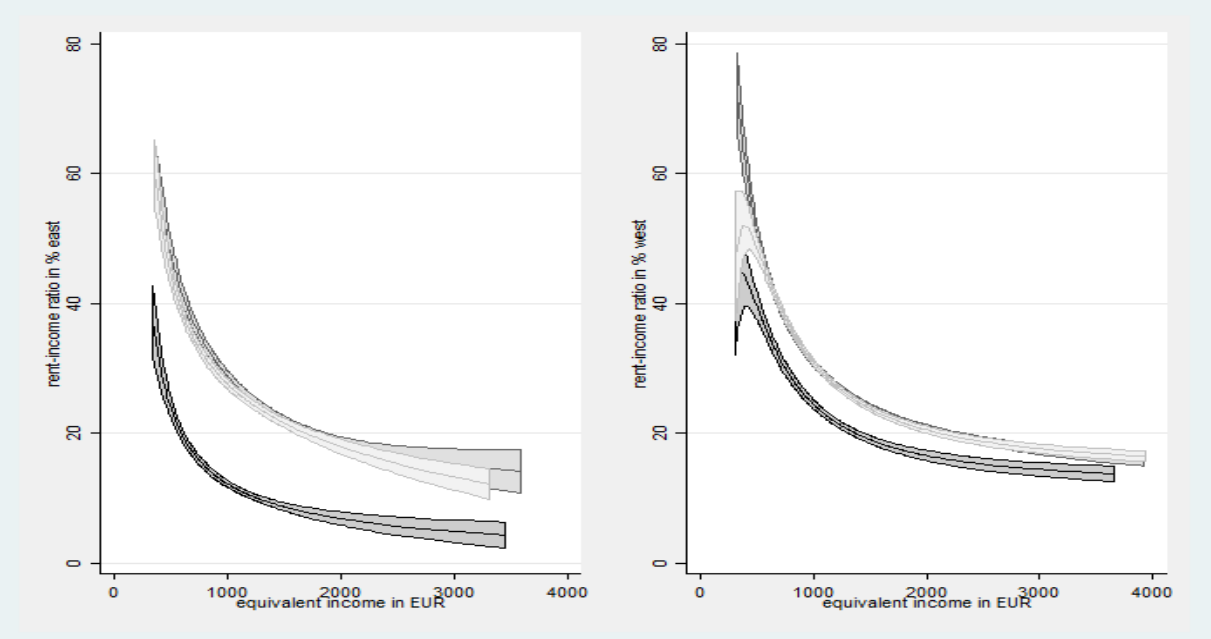
Note: Left (right) graph shows Germany's old (new) Laender, with 95% confidence bands. Data source: SOEP v29.

Figure A4 – Home size per capita poor households



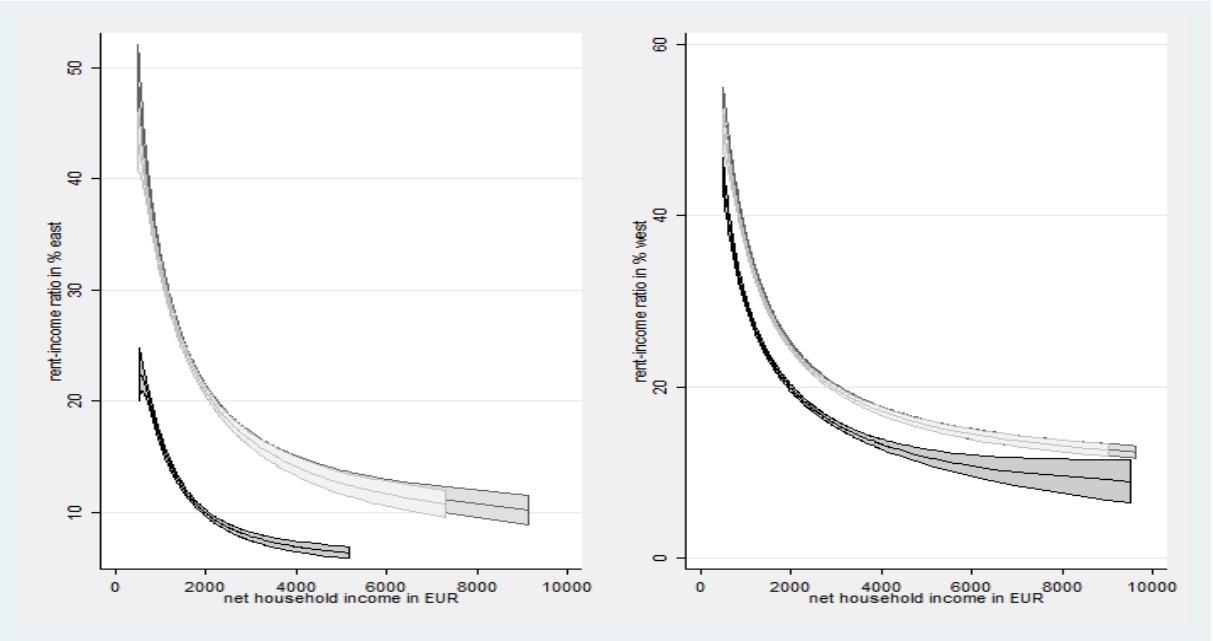
Note: First (second) row Germany's old (new) Laender, first column cities, second column rural regions. The darkest shade represents 1992 and the lightest 2012 with 95% confidence bands. Data source: SOEP v29.

Figure A5 – Rent-income ratios by equivalent income: cities vs. rural regions in Germany's old and new Laender (selected years).



Note: Left (right) graph refers to Germany's new (old) Laender. The darkest (medium/lightest) shade refers to the rent to income ratios of households in 1992 (2002/2012) who moved in 1987 (1997/2007) or later, medium shade refers to the rent and the lightest 2012 with 95% confidence bands. Data source: SOEP v29.

Figure A6 – Rent-income ratio of households who recently moved in (up to 5 years ago)



Note: Left (right) graph refers to Germany's new (old) Laender. The darkest shade represents 1992 and the lightest 2012 with 95% confidence bands. Data source: SOEPv29.

Figure A7 – Rent-income ratio by net household income (selected years)