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Working Paper

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CESifo Working Paper, No. 3377

Provided in Cooperation with:

Ifo Institute – Leibniz Institute for Economic Research at the University of Munich

Suggested Citation: Lerbs, Oliver; Oberst, Christian (2011) : Explaining spatial variation in homeownership rates: Results for German regions, CESifo Working Paper, No. 3377, Center for Economic Studies and ifo Institute (CESifo), Munich

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Explaining Spatial Variation in Homeownership Rates: Results for German Regions

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CESIFO WORKING PAPER NO. 3377

CATEGORY 6: FISCAL POLICY, MACROECONOMICS AND GROWTH

MARCH 2011

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Abstract

A wide range of aggregate data is used to examine the spatial variation in homeownership rates among a cross-section of 96 German planning regions. The analysis accounts for potential endogeneity of prices and affordability as well as for spatial dependence in homeownership levels. In addition to familiar demographic and socioeconomic variables, the regional price and affordability of owner-occupied housing, and the regional composition of the housing stock can be identified as important determinants of regional tenure choice patterns. At large, the above factors suffice to explain both the substantial disparities in homeownership rates between eastern and western Germany as well as between rural, urbanized and agglomerated locations. The results of this study offer some interesting implications for housing policy.

JEL-Code: R210, R310, R380.

Keywords: homeownership, German regions, housing policy.

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Revised version: March 2011

We thank U. van Suntum, G. Turati, M.C. Bramati, the participants of the CESifo Conference on Housing Taxation and Regulation, and the participants in the INFER International Workshop on Recent Issues in Economic Geography for helpful comments and suggestions.

1 Introduction

With some 43%, the German homeownership rate ranks at the bottom of highly-developed countries. In addition to cultural and historical factors, public policy and legal institutions in the housing market have contributed to this phenomenon (Voigtlander, 2009). The above factors surely help to explain why the homeownership rate is low at national average. However, they do not explain why the share of owner-occupation varies substantially across different regions. In 2006, regional homeownership rates varied between 13.6% in Berlin and 63.5% in Emsland (Lower Saxony), a difference of nearly 50 percentage points. Of course, it might be objected that Berlin is a densely populated agglomeration, while Emsland is sparsely populated and peripheral. However, striking differences not only existed across regions with varying levels of urbanization, but also across regions of similar spatial characteristics. For instance, the homeownership rate of Emsland was about 20 percentage points higher than the one of Oberland - a region contiguous to Munich - although the level of urbanization of both regions is almost identical.

The present article aims at investigating to what extent the substantial spatial variation in homeownership rates can be explained by fundamental market variables. To do so, the influence of demographic, socio-economic and regional housing market factors on the variation of homeownership rates among 96 German planning regions is empirically analyzed. The work contributes important insights to the ongoing research on homeownership in Germany. First, the use of spatially disaggregated data on house price levels, nominal affordability of owner-occupied housing and price-to-rent ratios allows to assess the partial influence of these important variables on tenure choice at the regional level. This adds valuable information over and above the role of national, primarily institutional factors. Second, identifying relative impacts of real determinants of homeownership at the regional level yields valuable informations for housing policy, given that the success of policy measures related to homeownership crucially depends on regional housing market conditions.

The results of this study indicate that differences in regional house prices and affordability levels, employment, the size and age distribution of households, recent immigration, and housing stock composition explain a large fraction of the countrywide variation in homeownership. The above factors are able to explain the substantial disparities in homeownership rates both across eastern and western Germany and across rural, urbanized and agglomerated locations. As two interesting corollary results, evidence is found that differences in relative costs of owning and renting

across regions are not sufficiently pronounced to explain differences in tenure choice patterns, while regional differences in the expected future growth in house values (indicated by the future growth in resident households) are capitalized into differences in current house prices.

The remainder of the article is arranged as follows: Section 2 briefly reviews antecedent research on spatial variation in homeownership rates. In Section 3, potential determinants of regional homeownership rates are outlined. Section 4 serves to discuss methodology and data, while the empirical results are presented in Section 5. Finally, Section 6 concludes.

2 Related research

Most studies on the determinants of tenure choice either use household level data (e.g. Clark et al. (1997), for German households) or aggregate data at the national level (Fisher and Jaffe, 2003; Earley, 2004). Studies using regional data bridge the gap between these two approaches. One of the first rigorous advances in this tradition has been provided by Eilbott and Binkowski (1985) for US regions, using data at the metropolitan level. Correcting for the endogeneity of house prices, Eilbott and Binkowski (1985) find the interregional variation in homeownership rates to be determined by differences in income levels, house price levels, the size and age distribution of households, and recent population growth. They conclude that the use of regional data yields results consistent with studies based on microeconomic data.

The study of Blackley and Follain (1988) extended the one of Eilbott and Binkowski (1985) by the use of pooled cross-sectional data and a differentiation between demographic subgroups. The results of this study partly challenge the results of Eilbott and Binkowski (1985). The econometric results confirm the validity of demographic factors, especially mobility and racial composition of the regional population, as determinants of regional levels of homeownership. However, the authors claim income and house prices to be significant determinants only for certain subgroups of the population.

The study of Coulson (2002) combines micro and aggregate data to estimate partial effects of various factors on regional homeownership levels in the US. In order to replicate regional homeownership rates, average probabilities of homeownership derived from regionally stratified samples of household data were combined with market-level variables reflecting structural differences in regional housing markets.

Coulson finds regional market-level variables such as population density, geographic location and the relative costs of owning and renting housing units to have a greater explanatory power for regional variation in homeownership than demographic or income differences. He concludes that variables related to the supply side of regional housing markets may play a much larger role for differences in regional patterns of tenure choice than assumed in previous studies.

In a recent study, Lauridsen et al. (2009) analyze the geographic and dynamic heterogeneity of homeownership rates in Denmark. They employ a rich database to assess the relative impact of regional house price levels, short- and medium-term house price changes, public regulation, demographic factors, income, and various factors related to the supply side of regional housing markets. Together with Barrios Garcia and Rodriguez Hernandez (2004) on Spain, this study is one of the first to use data from European countries to analyze regional disparities in homeownership rates. To the best of our knowledge, the authors are also the first to apply spatial econometric techniques to the problem at hand. Their results confirm the importance of house prices, the size and socio-demographic composition of households, the level of urbanization, and public regulation in regional housing markets. Moreover, considerable dynamics as well as geographic variation in the effects are found.

3 Regional-level determinants of homeownership

Households demand housing services and choose tenure in simultaneous manner, maximizing utility given their individual budget constraints and preference structures (Henderson and Ioannides, 1983; Linneman and Wachter, 1989; Haurin, 1991). Both housing demand and tenure choice are mainly influenced by the relative real costs of owning and renting, permanent household income, and demographic factors. However, an analysis of regional patterns of tenure choice should not be focused only on the demand side. Spatial variation in homeownership rates can also be the outcome of regional differences in housing stock composition, local regulation, and density (Hubert, 2006). Partly unobservable, location-specific variables like geographic conditions, history or culture may also play a role.

Following these considerations, we depict the following simple model for the regional homeownership rate:

$$HOR_j = f\left(\frac{p_j^{own}}{p_j^{rent}}, Y_j^P, DC_j, HC_j, L_j\right) \quad (1)$$

with HOR denoting the regional homeownership rate in region j , p_{own} the cost of owning and p_{rent} the cost of renting housing units, Y^P average permanent income, DC a vector of socio-demographic variables, HC a vector of variables reflecting regional housing market conditions, and L a vector of locational variables.

The arguments of the homeownership rate function are described in more detail in the following.

Cost of owner-occupied housing

Following the user cost approach of Poterba (1984, 1992), the real user cost of owner-occupied housing in region j can be expressed as a function of the nominal house price level (P^H), the weighted average net cost of capital (i^{Cap}), depreciation and maintenance costs (d), the effective property tax rate (τ), and expected nominal house price appreciation ($E(\pi^H)$):¹

$$p_j^{own} = P_j^H [i_j^{Cap} + d_j + \tau_j - E(\pi_j^H)] = P_j^H \psi_j \quad (2)$$

Given the cost of rental housing, the equilibrium share of homeowners in a region is a decreasing function of $P^H \psi$. Higher values of P^H , i^{Cap} , d and τ all decrease the probability of ownership, while higher values of $E(\pi^H)$ increase it, all else equal.

While an exact measure of the regional user cost of owning would be suited best for our analysis, empirical research has faced problems computing reliable data on this variable. In addition to methodological problems, this is due to shortcomings in the availability of disaggregated data on some of the cost components. As a practicable solution, a good proxy for interregional variation in real user costs consists in the interregional variation in nominal house price levels, P^H (Blackley and Follain, 1988). This proposition assumes that, compared to the large differences in house prices, interregional differences in the other user cost determinants (included in ψ) are negligible. We follow this assumption, including the regional level of house prices ($hprice$) as the main driving force behind regional differences in the user cost of owning. In doing so, we assume capital costs, depreciation and maintenance, and effective property tax to be equal across regions.

In the case of Germany, it indeed can be assumed that regional differences in these variables are too small to exert a decisive influence on the pattern of tenure choice:

¹The equation reflects that imputed rent of owner-occupied housing is left untaxed, while interest payments, depreciation/maintenance expenses, and property taxes are not tax deductible in Germany. If certain conditions are met, capital gains are also not taxed.

- regional differences in the cost of capital could be caused by spatial price discrimination in mortgage interest rates (Billingsley et al., 1992). Generally, these differences are hard to observe directly. However, they should be of very limited scale in Germany, given the high level of integration of the mortgage market. Furthermore, they can indirectly be accounted for by controlling for regional levels of price-to-income ratios and employment, assuming that lenders use these variables as indicators of creditworthiness.
- besides interest rates, there could be spatial variation in the costs of maintenance and depreciation. Maintenance expenses include user fees and charges for local services, while depreciation costs depend on dwelling structures. Empirical evidence on regional differences in these variables is sparse, but some existing studies indicate them to be comparatively modest and hardly following any visible taxonomy.² Generally, some variation of these variables should be captured by regional levels of urbanization and regional housing stock composition, two variables which are included in our regressions.
- due to differing municipal leverage factors, nominal property tax rates surely do vary among different locations in Germany.³ Nonetheless, these differences might not affect regional levels of user costs decisively. Due to the use of outdated assessed property values (dating back to 1964 in western and 1935 in eastern Germany) instead of market values, the effective burden of the German property tax is extraordinarily modest.⁴ A reasonable estimate of the average effective tax rate (the ratio of tax burden and market value of the house) lies within the range of only 1-2 permil (Spahn, 2004).

A frequently tackled issue is the extent to which expected house price appreciation affects tenure choice. In a study of homeownership trajectories within US metropolitan areas, Myers et al. (2005) find that house price increases in regional housing markets tend to encourage homeownership. A possible explanation is that rising asset prices trigger additional investment incentives that go beyond increased affordability concerns.⁵ We will test the linkages between expected growth in re-

²Most of these studies have been carried out by local public authorities. The results of these studies should be treated with some caution, given methodological shortcomings and lack of representivity (von der Lippe and Breuer, 2008).

³In 2006, the maximum average leverage factor on the district level was 660% in Berlin, while the minimum was 270% (Kreis Bergstrasse).

⁴To fix property tax liability, assessed property values are combined with type-of-property dependend base rates and the leverage factors.

⁵The study of Myers et al. (2005) assumes that expectations about future house price movements are based on past house price developments.

gional demand for housing, current house prices, and homeownership indirectly in our analysis by including the expected growth in the number of households between 2007 and 2025 (*hhgrowth*) in each region as an indicator of future demand pressure on house prices. The underlying assumption is that market participants expect long-run housing supply to be less than perfectly elastic. Hence, additional demand increases prices even in the long term. If future expected value gains are not fully capitalized into current house prices, expected household growth should have some explanatory power that goes beyond the explanatory power of prices alone.

Affordability of owner-occupied housing

As an alternative to regional house prices, we employ a simple measure of the nominal affordability of owner-occupied housing in each region. Affordability is defined as the ratio of regional house price levels to average annual household incomes (*hprincer*), indicating how many average annual incomes are needed to afford the purchase of a typical home in a certain region. This variable can be used as an indicator of regional borrowing constraints in terms of home purchase financing. The inclusion of this variable will yield information whether high price-to-income ratios, which are frequently cited as a major reason for the low nationwide homeownership rate (Faller et al., 2001), also act as a major barrier to homeownership at the regional level.

Cost of rental housing

Given that renting is the direct alternative to owning, the equilibrium homeownership rate in a region should not only depend on house price or affordability levels, but also on the regional cost of rental housing. The higher the cost of renting relative to the cost of owning, the higher should be the homeownership rate, all else equal. In order to account for differences in the relative cost of owner-occupied vs. rental housing, the ratio of the regional house price to the regional rent level (*hprrentnr*) is included in all models as an alternative to prices and affordability.

Permanent income

Both the demand for housing services and the creation of homeownership are likely to increase with higher levels of permanent income. Wealthier households not only demand more, but also higher-quality housing services, combined with the option of adjusting housing quality to their own preferences (Eilbott and Binkowski, 1985). As a proxy for permanent income of private households in a region, it appears reasonable to employ variables related to regional economic prosperity. While some studies use regional household income or income per capita, we follow the proposition of Barrios Garcia and Rodriguez Hernandez (2004) and use the 2002-2006 average

regional unemployment rate (*unempr*). Residents in low-unemployment regions face better employment opportunities and earn higher average wages, so unemployment highly correlates with current income. The unemployment rate also constitutes a practical indicator of expected job security, which is also closely related to the tenure choice decision (Haurin, 1991).⁶

Demographic composition

Among this variable group, we include average household size (*hhsiz*), the respective proportions of residents aged under 18 years, 18-25 years, and 50-65 years (*(prop018,prop1825,prop5065)*), and the proportion of foreigners (*propfor*). In order to account for the effect of household mobility, we also include the number of newly registered households per 1000 residents in each region, accumulated over 2002-2006 (*immigr*). We expect average household size, the proportion of children, and the proportion of older adults to be positively linked to homeownership rates. Higher proportions of young adults and foreigners are expected to reduce regional proportions of homeowners. The same holds true for higher average rates of recent in-migration.

Housing stock and land use

Depending on the type of dwelling, accommodations differ substantially regarding their economic appeal to owner-occupation. In contrast to accommodations in multi-family houses, units in one- or two-family houses are usually both maintainable and adaptable to their occupiers needs and preferences at low costs. This makes the latter forms of units highly attractive for owner-occupation. Indeed, homeownership in Germany is predominantly built in one- or two-family dwellings.⁷ In order to account for the impact of housing stock composition, we include the share of multi-family houses in regional housing stocks (*propmfh*). Additionally, we include the share of settlement area (area designated to residential and traffic use) in each region to account for the effects of land use (*propsettl*). We assume conditions for homeownership to be less favorable in regions characterized by increased land scarcity and congestion.

Type of region

In order to account for unobservable locational characteristics, we follow a twofold

⁶At 12.8%, the homeownership rate among households in which the household head was unemployed was far below the national homeownership rate in 2006.

⁷In 2006, a share of 87.9% of one-family houses owner-occupied, while this share was 44.5% for units in two-family-houses. Units in multi-family houses constituted a share of 76.4% of all units rented.

differentiation between types of regions. First, we differentiate between eastern and western regions, including a dummy variable that is unity for regions located in eastern Germany and zero otherwise (D_east). The idea is that homeownership rates in eastern regions may still structurally differ from western regions due to historical reasons.⁸ Furthermore, we differentiate between urban, rural and agglomerated regions, including a dummy variable for rural regions (D_rural) and another one for agglomerations (D_aggl). We follow the classification of the Federal Office for Building and Regional Planning (*Bundesamt für Bauwesen und Raumordnung*), which is based upon population density and the existence of central places with a certain minimum population.

4 Methodology and data

The basic empirical approach chosen to investigate the determinants of regional homeownership rates in Germany is a standard multiple linear regression model:

$$y = X\beta + u \tag{3}$$

with y denoting an N -dimensional vector of regional homeownership rates observations, X denoting a N by K dimensional matrix of explanatory variables, β a K -dimensional vector of regression coefficients, and u a vector of residuals with heteroscedastic variance, $u_j \sim N(0, \sigma_j^2 I_N)$.

Three alternative versions of the model depicted in Eq. (3) are estimated. Along with the remaining explanatory variables, the first version includes regional house price levels. The second one includes price-to-income ratios instead of prices, while the third version includes price-to-rent ratios. For each version, we carry out various estimations. First, we estimate stepwise OLS regressions, combining price-related variables with different combinations of other explanatory variables. The variables acting as the main determinants of regional homeownership rates are identified using the common criteria and tests. Second, on each version we apply two-step least squares. The underlying idea is that price-related variables may be endogenous to homeownership, given that house prices, rents and tenure choice may be determined simultaneously:

⁸Due to the general inhibition of private property, homeownership played an inferior role in the socialist GDR. Central planning policies strongly favored the development of public housing in selected cities and towns.

$$y = X\beta + z'\gamma + u \quad (4)$$

with z denoting a right-hand side endogenous variable either reflecting prices, price-to-income ratios or price-to-rent ratios. Two physical parameters are used as instruments: regional climate (measured by annual hours of sunshine) and spatial centrality (measured by the inverse of average travel time to the nearest three European agglomerations). Wooldridge (1995) robust score tests are employed to test for both the validity of instruments and the true endogeneity of instrumented regressors.⁹

In order to enhance the validity of our estimates, in a following step we account for potential spatial dependence in regional levels of homeownership. Spatial dependence in homeownership may arise from spatial interactions and spill-overs between regions as well as from spatial error processes. While spatial interactions and spill-overs can occur in the form of interregional commuter flows or spreading of certain building types across regional borders, spatial error processes relate to the modifiable areal unit problem (Openshaw and Taylor, 1983). The presence of spatial dependence between regions generally violates the assumption of stochastically independent residuals in OLS estimation. Spatial autocorrelation in the data causes the OLS estimator to be at least unefficient, at worst also biased. Consequently, statistical inference based on the standard OLS coefficients may be invalid.

Spatial dependence is commonly dealt with in regional science with allowing for a spatial lag either in the endogenous variable (spatial lag model) or in the disturbance term (spatial error model), see Anselin (1988) and Anselin et al. (2004). In many cases, the appropriate model is chosen via a Lagrange multiplier test. In this study, we use a different approach, estimating a combined form of spatial lag and spatial error model in which the information on spatial patterns is richer than in estimating and testing each model separately (Piras, 2010). We consider a linear Cliff-and-Ord-type model with a first order spatial lag of the dependent variable and a first order autoregressive disturbance term, also called cross-sectional spatial autoregressive (SARAR) model:

$$y = \lambda W y + X\beta + u, \quad (5)$$

⁹First-stage regression results are additionally shown in Tab. in the Appendix. In analogy to OLS estimations, heteroskedasticity-consistent covariance matrix estimators (White, 1980) are used in each estimation.

with

$$u = \rho W u + \epsilon \tag{6}$$

with y denoting the vector of observations on the dependent variable, X the matrix of observations on the explanatory variables, β the vector of regression parameters, W a spatial weights matrix of dimension N , and λ and ρ denoting scalar autoregressive parameters that represent the spatial dependence. Furthermore, u is the vector of regression disturbances and ϵ a vector of innovations which are assumed heteroscedastic of an unknown form, $\epsilon_j \sim N(0, \sigma_j^2 I_N)$.¹⁰

The spatial weights matrix (W) represents the nature of spatial dependence between different regions, describing patterns of interaction and diffusion. The spatial weights are usually interpreted as functions of economic or geographic distance (Anselin, 1988; Anselin et al., 2004). The results presented in this study rely on a row-standardized binary queen contiguity matrix with $w_{jk} = \frac{1}{n_j}$ if regions j, k ($j \neq k$) share a common border and 0 otherwise, n_j denoting the number of neighbors of region j .¹¹ The model is estimated using the multistep GM/IV estimation procedure proposed by Kelejian and Prucha (2010) and Arraiz et al. (2010), computationally implemented in R by Piras (2010).

For estimation purposes, we use 2006 data for a cross-section of $N = 96$ planning regions (*Raumordnungsregionen*). These are the smallest geographic units for which reliable data on homeownership rates is currently available in Germany.¹² Using cross-sectional data only has the disadvantage of not being able to control for unobserved regional effects, as would be possible with panel data. However, while regional homeownership rates are available for 1998, 2002 and 2006, data on regional house prices, price-to-income ratios, and rents is available from 2004 onwards only. We

¹⁰This model is also known as the Kelejian-Prucha model (Kelejian and Prucha, 1998, 2007). Typically, Wy is referred to as spatial lag and Wu as spatial error. If $\lambda = 0$ the model reduces to a spatial error model. If $\rho = 0$ the model reduces to a spatial lag model.

¹¹In addition to this spatial weights matrix, two other matrices were tried out: a nearest-neighbor matrix replacing all neighbors with the four nearest neighbors of region j , and an inverse distance matrix which was calculated using direct distances between the regions centroids. The results turned out to be similar to those presented in the results section.

¹²Ideally, studies of spatial disparities in homeownership rates rely on regional housing markets. Defining such areas has proved a hard challenge in Germany and other countries, so empirical studies on regional homeownership rates mainly draw on alternative geographic units like regional labor markets. This concept is warranted by the close interdependency of working and housing location decisions made by private households. The regional units chosen in this analysis are in this tradition, forming functionally delineated regional labor markets.

decided to weight the availability of this data heavier than potential heterogeneity bias caused by the presence of unobserved regional effects. In order to minimize potential omitted variable bias, all explanatory variables are included in the basic specifications.

Data on regional homeownership rates was computed from the *German Mikrozensus*. Data on prices, price-to-income ratios and price-to-rent ratios was obtained from a comprehensive dataset of regionalized house price and rent data, elaborated by the Federal Institute for Research on Building, Urban Affairs and Spatial Development (*Bundesamt für Bau-, Stadt- und Raumforschung, BBSR*). The BBSR uses print and internet offer data on typified forms of typical owner-occupied and rental housing to calculate regionally representative median prices and rents. Due to a large number of observations (> 1.4 million each year), a high spatial coverage is achieved. The observations have been of double countings and unplausible outliers (Sigismund, 2005). Although only typified forms of housing are used, comparability is not perfect because prices and rents still can contain some quality and locational differences. Given that only offer prices are observed, prices and rents could additionally be overestimated at least for contracting regional housing markets, and some housing segments may be underrepresented in the data (von der Lippe and Breuer, 2010). Despite these limitations, the data still provides sound indicators of regional rent and price levels.¹³ Data on the remaining variables was obtained from the *INKAR* database, a database on spatially disaggregated data provided by various official sources (see Tab. 5 in the Appendix for a detailed description of definitions and data sources).

Tab. 1 shows means of all included variables by type of region. All data is defined at an aggregate, regional level and refers to 2006, if not otherwise indicated. The average regional homeownership rate was 45%. As previously indicated, the share of homeowners varies between a low of 13.6% and a maximum of 63.5%, a span of 50 percentage points. The average homeownership of western regions exceeds that of eastern ones by more than 10 percentage points. Substantial differences also become apparent among rural, urban and agglomerated regions. About 50% of all households owned their homes in rural and urban regions. Meanwhile, this share was only 36.5% in agglomerated locations.

The map depicted in Fig. 1 shows the geographic distribution of homeownership across all 96 regions included. Regions characterized by high homeownership rates

¹³Because data on prices and rents are available at the district level only, they were aggregated to the level of planning regions (which consist of one or more districts) using the number of households in each district as a weighting factor.

Variable	Overall	East	West	Rural	Urban	Aggl.
Homeownership rate	45.0	35.6	47.8	47.5	48.0	36.5
House price	1550.89	1174.10	1662.91	1501.51	1441.96	1839.58
Price-to-income ratio	4.94	4.56	5.05	4.55	4.70	5.81
Price-to-rent ratio	23.40	19.49	24.56	22.31	23.10	25.14
Av. unemployment 2002-06	12.0	20.2	9.6	13.6	11.2	11.7
Household size	2.15	2.06	2.17	2.19	2.18	2.04
Prop. aged 0-18	17.4	13.7	18.5	17.0	17.9	17.0
Prop. aged 18-25	8.4	9.4	8.1	8.6	8.4	8.2
Prop. aged 50-65	18.4	20.0	17.9	18.7	18.2	18.3
Prop. foreigners	7.1	2.9	8.4	4.4	6.5	11.4
Cum. in-migration 2002-06	39.4	32.0	41.7	34.3	40.6	42.8
Household growth 2007-25	3.3	-7.9	6.6	0.6	4.0	4.9
Prop. multi-family houses	15.7	19.8	14.5	12.1	13.6	23.5
Prop. settlement area	15.2	12.1	16.1	9.1	12.4	27.1
No. of observations	96	22	74	26	46	24

Table 1: Table of means, by type of region

are mostly located in north-western and southern Germany. Low levels are found in entire eastern Germany as well as in agglomerations like Hamburg, Munich and the Rhein-Ruhr area. In analogy to homeownership rates, house prices and housing affordability vary substantially among different regions and tend to cluster in space (see Figs. 2 and 3). Both prices and affordability increase with higher levels of urbanization. Generally, a close correlation can be observed between prices and price-to-income ratios. The nominal affordability of owner-occupied housing is typically lower in regions characterized by high house price levels, indicating that interregional income differentials are not pronounced enough to offset price differentials.

The descriptive statistics show that capitalization of rents into prices is strong and mostly uniform across the country. The bivariate correlation between these two variables is strongly positive (+0.855) and significant. As a consequence, spatial variation in price-to-rent ratios is much lower than spatial variation in prices.¹⁴ In addition to homeownership, house prices and affordability, noteworthy regional differences also exist concerning employment levels, demographical composition, and population development. Agglomerated regions not only experience the highest levels of in-migration, but also expect the highest levels of population growth, mostly at expense of high unemployment, rural regions in eastern Germany.

Turning to housing stock and land use, both the proportion of multi-family houses in the housing stock and the share of settlement area generally increase with higher

¹⁴For bivariate scatterplots for prices and affordability/rents, see Figs. 4 and 5 in the Appendix.

levels of urbanization. Expectedly, the highest shares of apartment blocks and settlement area is found in agglomerated regions. Furthermore, both housing stock and land use pattern strongly differ between eastern and western regions on average. The average share of apartment blocks of eastern regions exceeds the one of western regions by more than five percentage points.¹⁵

5 Results

Tab. 2 reports OLS regression results for two baseline specifications of the OLS model depicted by Eq. 3. Each specification is estimated under three different versions, alternatively using house price levels, price-to-income ratios and price-to-rent ratios. In addition to one price-related variable, the first specification (OLS 1) only includes the dummy variables. The second specification (OLS 2) includes the full set of explanatory variables. The dependent variable in all regressions is percentage levels of homeownership. Proportion variables are expressed in level form, while house prices are expressed as natural logarithms.

Within the first specification, house prices levels and price-to-income ratios are found to be statistically significant, while price-to-rent levels are found to be insignificant. The latter result may be explained by the low interregional variation for this variable, which is caused by the close correlation between prices and rents. As expected, the signs of all variables are negative. The dummy variables also carry the expected signs. The strong significance of some dummy variables indicates that the price-related variables alone do not suffice to explain the substantial disparities in homeownership across different types of regions. Some 65% of the spatial variation in homeownership rates can be explained by the combination of price-related variables with region dummies, with the best estimation results provided by the price-to-income ratio.

Once the entire set of covariates is included under the second specification, all region dummies straightly lose statistical significance. House price levels and price-to-income ratios retain their negative signs and significance, while price-to-rent ratios remain insignificantly different from zero. Three other potential determinants are found to be significant in all three versions: the proportion of children (*prop018*), the proportion of older adults (*prop5065*), and the proportion of multi-family dwellings

¹⁵Altogether, the housing stock composition in Germany differs remarkably from the stock composition of other countries. In 2006, 21.25 out of a total of 39.55 million housing units were located in multi-family houses (a share of nearly 54%).

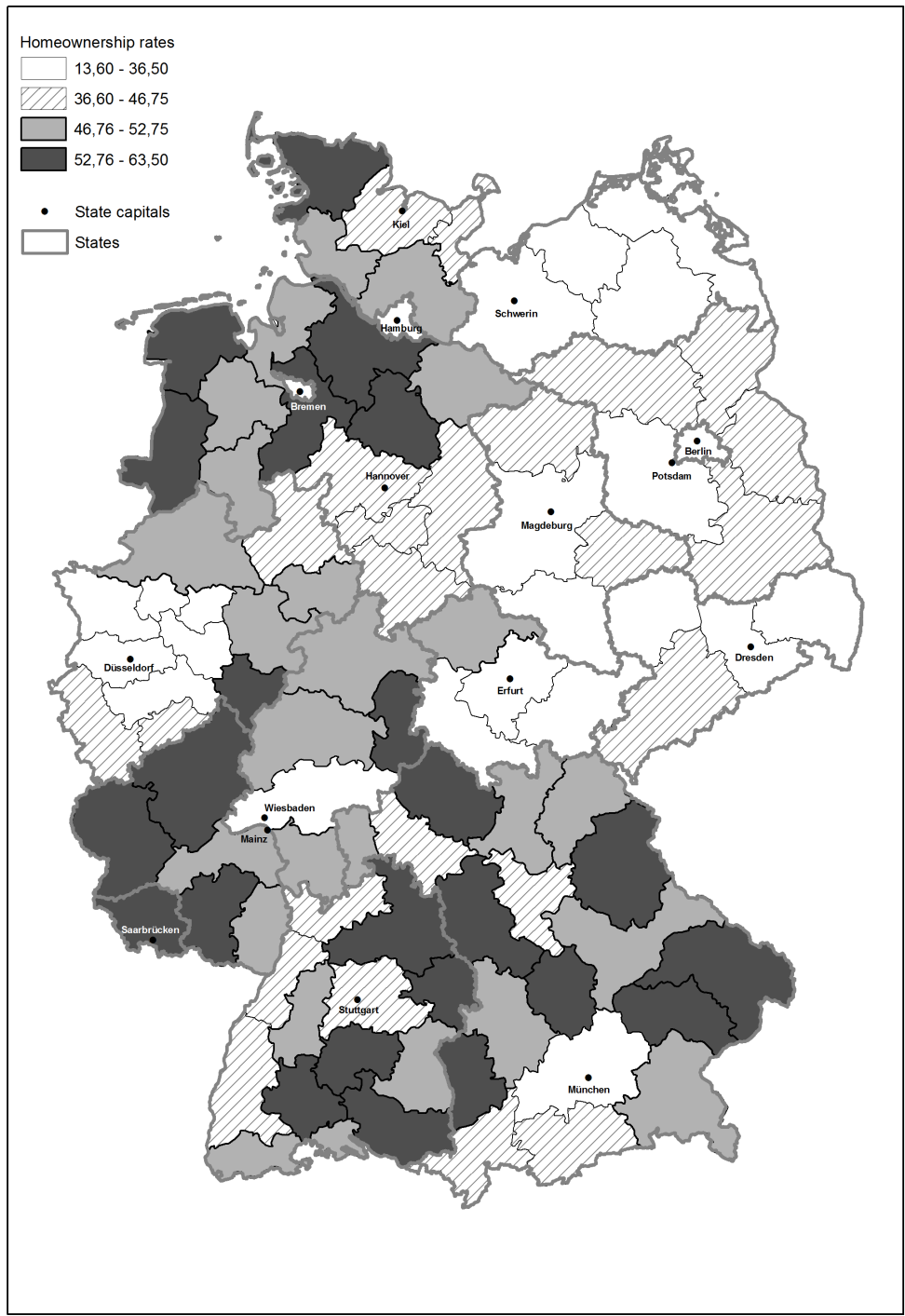


Figure 1: Spatial distribution of homeownership rates, 2006

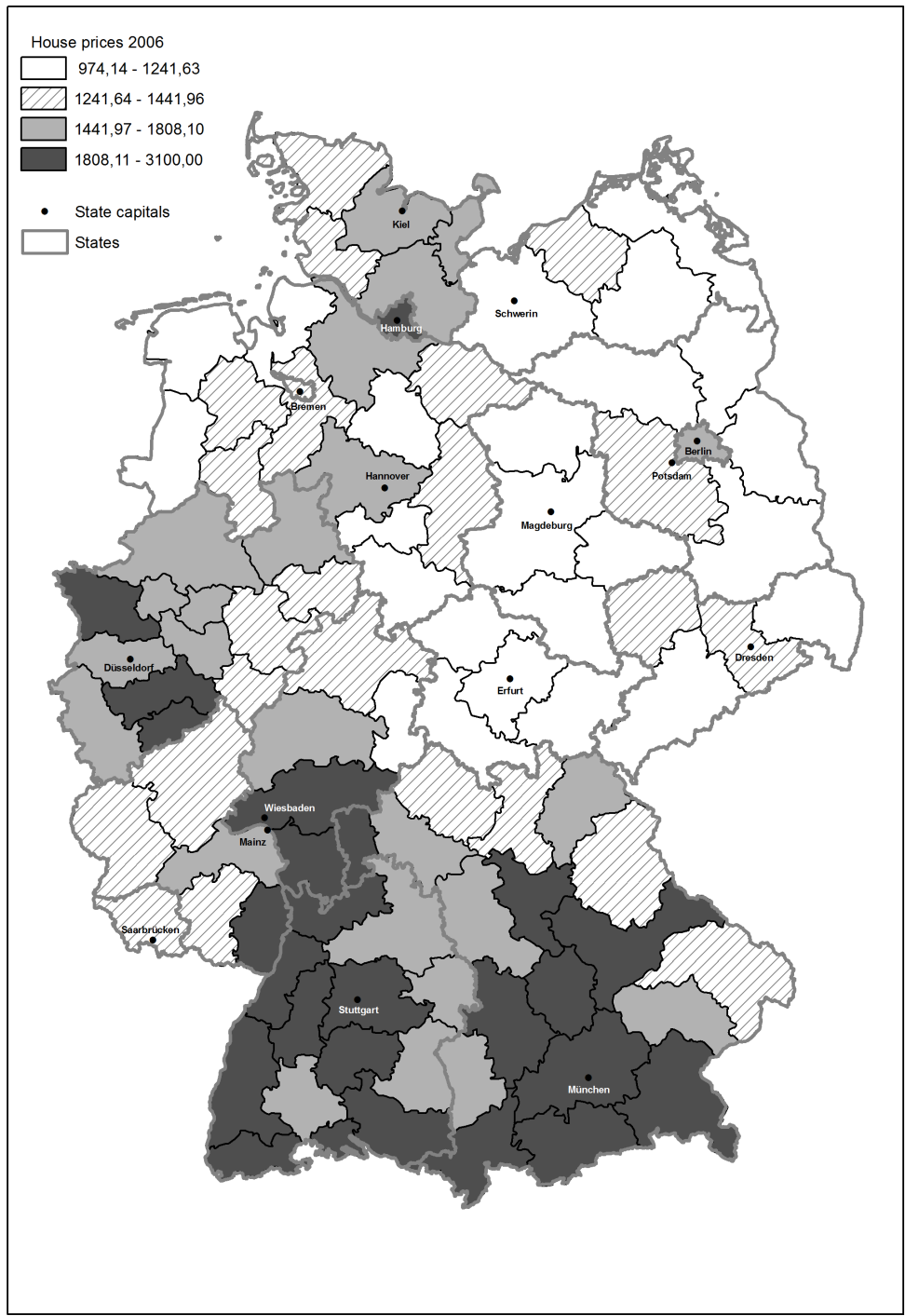


Figure 2: Spatial distribution of house price levels, 2006

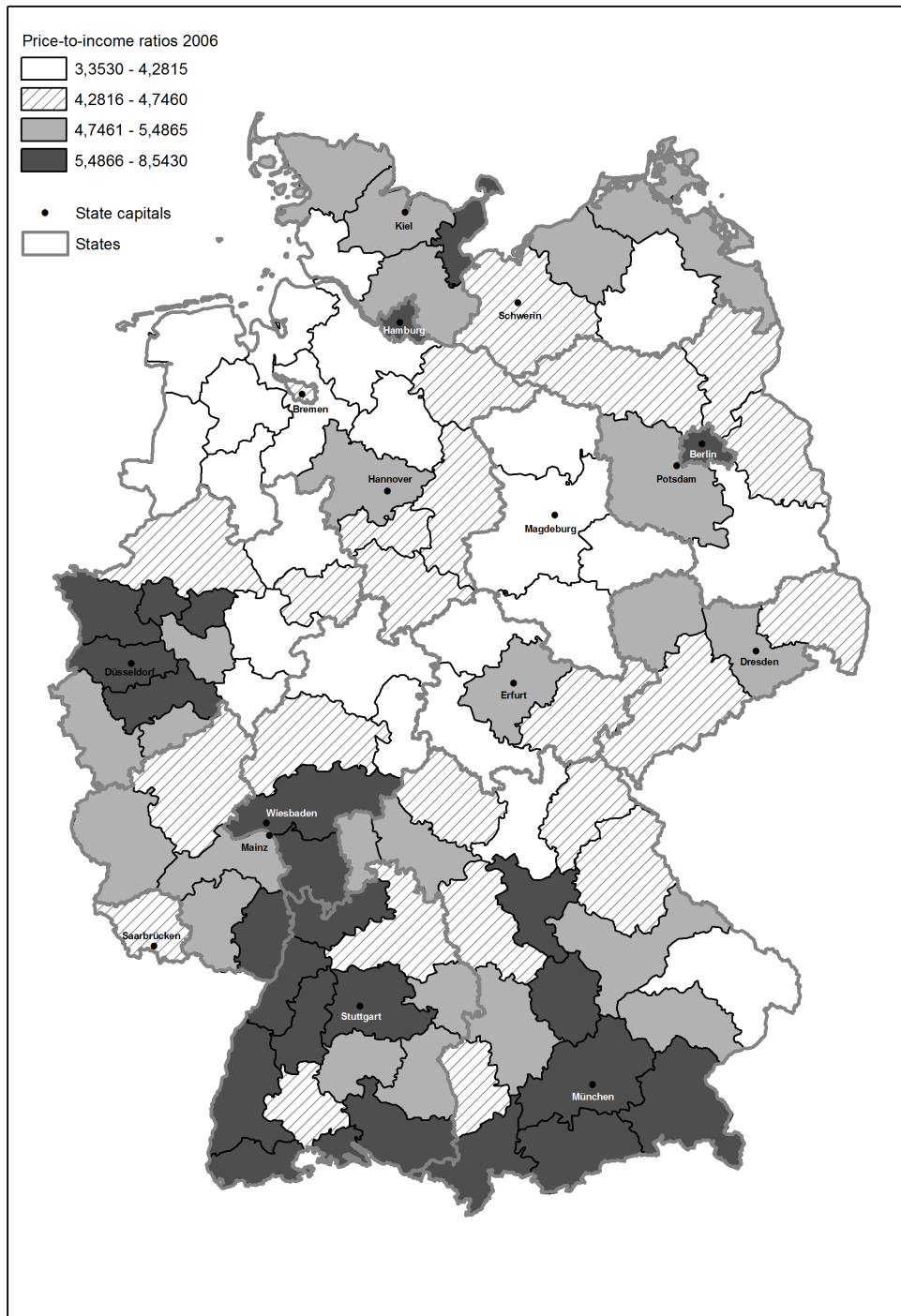


Figure 3: Spatial distribution of price-to-income ratios, 2006

Variable	OLS 1(a)	OLS 1(b)	OLS 1(c)	OLS 2(a)	OLS 2(b)	OLS 2(c)
<i>loghprice</i>	-6.5978* (3.5741)			-11.1081** (4.3606)		
<i>hprincr</i>		-2.6050*** (0.5937)			-1.5013* (0.7631)	
<i>hprrentr</i>			-0.1496 (0.2470)			-0.0475 (0.2070)
<i>unempr</i>				-0.7144 (0.4498)	-0.5563** (0.2096)	-0.5227** (0.2288)
<i>hhsiz</i>				12.1465** (5.1724)	7.0418 (6.5716)	8.7279 (7.1359)
<i>prop018</i>				1.5308*** (0.5201)	2.0108*** (0.7265)	2.2324*** (0.7373)
<i>prop1825</i>				0.2114 (0.8805)	0.4727 (1.1414)	0.5569 (1.1725)
<i>prop5065</i>				2.5306** (1.1206)	2.8566*** (1.0443)	2.8963*** (1.0700)
<i>propfor</i>				0.3581 (0.2442)	0.3049 (0.2657)	0.1005 (0.2531)
<i>inmigr</i>				-0.0407* (0.0221)	-0.0378 (0.0336)	-0.0418 (0.0344)
<i>hhgrowth</i>				0.0700 (0.1031)	0.0045 (0.1172)	-0.1086 (0.1044)
<i>propmfh</i>				-0.5946*** (0.1838)	-0.6567*** (0.1268)	-0.7744*** (0.1295)
<i>propsettl</i>				-0.0311 (0.0586)	-0.0108 (0.0658)	0.0443 (0.0609)
<i>D_east</i>	-16.5208*** (3.5741)	-15.3560*** (1.1866)	-15.2900*** (1.8878)	0.2654 (3.6616)	1.3794 (3.4057)	0.7767 (3.5840)
<i>D_rural</i>	1.9130 (1.2010)	1.9968* (1.1082)	2.2427* (1.2510)	-0.3185 (0.8626)	-0.0373 (0.9273)	-0.5339 (0.9185)
<i>D_aggl</i>	-11.3339*** (1.8787)	-9.6637*** (1.8527)	-12.2547*** (1.8251)	-1.4035 (1.0614)	-1.5234 (1.3718)	-1.2312 (1.4163)
No. of obs.	96	96	96	96	96	96
F-Statistic	50.28***	69.26***	45.53***	172.84***	54.43***	51.72***
R^2	0.6456	0.6799	0.6329	0.9076	0.9039	0.8994
Akaike IC	618.9434	609.1963	622.3317	509.8936	513.6618	518.0802

Table 2: OLS results (robust standard errors in parentheses)

in regional housing stocks (*propmfh*). Higher proportions of children and older adults in the population clearly increase the proportion of households living in owner-occupied homes, holding other factors constant. Meanwhile, higher proportions of apartment blocks significantly reduce regional homeownership rates. Unemployment, average household size and in-migration also have the expected signs, but are not significant in all estimations, likely due to multicollinearity. The remaining variables

hardly exert any influence, as their coefficients are not significantly different from zero. Notably, this also holds true for expected population growth (*hhgrowth*). In fact, the variable carries the expected positive sign. However, there is no statistical evidence that it possesses any distinct influence on homeownership rate variation that exceeds the influence of other variables, notably prices. As a result, it is reasonable to assume that current prices already include most of the information yielded by future population growth.¹⁶

Including the full set of potential determinants substantially increases the fraction of explained variance, but there still remain insignificant variables not adding to the fit of the model. Furthermore, the estimations so far do not account for potential endogeneity of house price-related variables. In order to overcome these limitations, a parsimonious specification of the model was estimated. With the exception of the dummy variables, always insignificant variables were stepwisely omitted. The results are reported in Tab. 3. The first specification (OLS 3) shows results for the parsimonious model estimated by OLS, while the second specification (2SLS) shows results derived from two-stage least squares.

The estimations of the parsimonious model reinforce the impression of previous results. As shown by Akaike's information criterion, the parsimonious OLS model outranges the full model in terms of efficiency. With exception of the region dummies, all variables remaining in the model are statistically significant and have the expected signs. The negative effects of house price levels and nominal affordability of owner-occupation are confirmed. According to the coefficients, ten percent higher house price levels go along with roughly 0.8 percentage point lower homeownership rates.¹⁷ In relative terms, increases in the price-to-income ratio by one additional annual income decrease homeownership by some 1.2 percentage points, all else equal. In analogy to prices, regional levels of unemployment and recent in-migration are negatively related to homeownership. The same holds true for regional proportions of apartment blocks. On the other hand, average household size, the proportion of children, and the proportion of older adults all exert a positive effect on regional homeownership.

The results for the demographic variables clearly meet our expectations. The positive effect of household size is easily explained by the fact that owner-occupied housing meets the preferences of larger households far better than rental housing.

¹⁶For a bivariate scatter plot for house price levels and expected growth in the number of households, see Tab. 6 in the Appendix.

¹⁷Note that for explanatory variables appearing in log form, it holds that $\Delta y \approx (\frac{\beta}{100})\% \Delta x$.

Variable	OLS 3(a)	OLS 3(b)	OLS 3(c)	2SLS(a)	2SLS(b)	2SLS(c)
<i>loghprice</i>	-7.7201* (4.0466)			-2.3306 (5.6419)		
<i>hprincr</i>		-1.1754* (0.6975)			-0.5196 (1.0661)	
<i>hprreentr</i>			-0.0798 (0.2005)			0.6184 (0.6198)
<i>unempr</i>	-0.7319* (0.4275)	-0.5706** (0.3095)	-0.3947** (0.1872)	-0.4723 (0.4487)	-0.4531 (0.3766)	-0.0914 (0.4349)
<i>hhsiz</i>	12.9866*** (4.5439)	10.0149* (5.1932)	10.0149* (6.2791)	10.0149* (4.9948)	10.5124** (5.0360)	3.6235 (9.2638)
<i>prop018</i>	1.6459*** (0.4457)	1.7951*** (0.4764)	1.6965*** (0.5703)	1.7009*** (0.4497)	1.7558*** (0.4338)	1.9430*** (0.5401)
<i>prop5065</i>	2.4090*** (0.8884)	2.4922** (0.9502)	2.3915*** (0.6706)	2.3970*** (0.8863)	2.4362*** (0.9164)	2.3944** (0.9487)
<i>inmigr</i>	-0.0298* (0.0177)	-0.0324 (0.0234)	-0.0537* (0.0307)	-0.0469 (0.0314)	-0.0446 (0.0321)	-0.0593 (0.0378)
<i>propmfh</i>	-0.6012*** (0.1300)	-0.6266*** (0.1338)	-0.6994*** (0.0995)	-0.6848*** (0.1350)	-0.6792*** (0.1332)	-0.8880*** (0.2125)
<i>D_east</i>	0.2215 (2.5717)	0.7341 (2.8433)	-0.8113 (2.6837)	-0.3765 (2.4837)	-0.0298 (2.8914)	0.7317 (2.3802)
<i>D_rural</i>	-0.5776 (0.8114)	-0.3626 (0.8732)	-0.6943 (0.8839)	-0.6971 (0.7993)	-0.5781 (0.9332)	-1.1714 (0.9915)
<i>D_aggl</i>	-0.4699 (1.1863)	-0.7635 (1.1869)	-1.1801 (1.1727)	-1.0051 (1.2914)	-1.0274 (1.2614)	-1.6747 (1.2797)
No. of obs.	96	96	96	96	96	96
F-Statistic	174.33***	134.51***	74.02***			
R^2	0.9047	0.9019	0.8970	0.9009	0.9003	0.8823
Akaike IC	504.8507	507.6503	512.3354			
Wald χ^2				1439.53***	1360.26***	1361.87***
χ^2 Score				3.1336	0.9781	1.8301

Table 3: Parsimonious model results (robust standard errors in parentheses)

The coefficients magnitude is large, indicating that an increase of average household size by one more person would increase homeownership rates by 10-13 percentage points. The positive partial impact of the children variable can be explained by the trigger effect of family formation (Deurloo et al., 1994; Mulder, 2006). After controlling for household size and other age proportions, higher proportions of people under 18 years indicate larger proportions of households with children, predominantly being homeowners. In analogy, the proportion of people aged 50-65 years is indicative of households situated in an advanced stage of their life-cycle. These households have accumulated some wealth, which also increases the probability of homeownership. Recent in-migration levels partially decrease regional homeownership, what

can be explained by trickle-down effects of migration. Because they lack experience in the destination regional housing market, many moving households tend to choose renting over owning until their knowledge of prices and quality reaches sufficiently high levels. Stated differently, the rental market absorbs the majority of housing demand from recent movers.

Turning to the unemployment variable, the results support the hypothesis that higher regional unemployment rates go along with lower levels of permanent income, which relates inversely to regional homeownership levels.¹⁸ Interestingly, the magnitude of the unemployment coefficient absolutely decreases when price-to-income ratios are used instead of absolute price levels. A possible explanation is that the income effects reflected in unemployment levels are partly captured by price-to-income ratios, once this variable is used instead of prices.

Turning to the effects of housing stock composition, the results indicate that higher shares of apartment blocks in the housing stock clearly diminish homeownership. The estimations indicate that ten percentage point higher proportions of apartment blocks go along with homeownership rates some six to seven percentage points lower, all else equal. Given a standard deviation of around seven percentage points for this variable, this result implicates that housing stock composition contributes to a substantial part of interregional variation in homeownership rates, even after average price levels are controlled for. As previously indicated, a reasonable explanation is that housing units in multi-family houses do not match the needs and preferences of potential homeowners. Additionally, Linneman (1986) states that the high production efficiency of landlords in high-density areas crowds out homeownership in favor of rental housing.

Estimating the parsimonious model by two-stage least squares according to Eq. 4, using regional climate and proximity to agglomerations as instruments for price-related variables, slightly alters the results.¹⁹ In contrary to OLS estimations, the coefficients of prices and price-to-income ratios decrease in absolute magnitude and lose statistical significance, as do the coefficients for unemployment and in-migration. Importantly, however, insignificant robust χ^2 scores (Wooldridge, 1995) show endogenous regressors in the model to be in fact exogenous. Consequently, the OLS

¹⁸It is important to note that this analysis uses regional unemployment levels as a control variable for permanent income, rather than focusing on the direct interaction between homeownership and unemployment levels as such. For a recent overview of the literature covering the complex link between these two variables, see Coulson and Fisher (2009).

¹⁹First-stage regression results and tests for overidentifying restrictions showed the instruments to be relevant and really exogenous. See Tab. 6 in the Appendix.

results must be strongly preferred to the 2SLS results.

Summarizing the results provided by the estimations of non-spatial models, it can be assumed that the price and affordability level of owner-occupied housing, the size and age distribution of households, the level of recent in-migration, the regional employment situation and the housing stock composition act as primary determinants of regional homeownership levels. Given the insignificance of the dummy variables reflecting different types of regions, the above variables are able to explain the striking regional variation in homeownership rates among eastern and western German regions as well as among rural, urbanized and agglomerated regions. However, we not yet addressed the problem of spatial autocorrelation typically arising in spatial econometric analysis.

A commonly used test statistic for the presence of spatial autocorrelation is *Morans I* (Cliff and Ord, 1981; Anselin et al., 1996):

$$I = \frac{N}{S_0} \frac{\sum_{j=1}^N \sum_{k=1}^N w_{jk} (x_i - \bar{x})(x_j - \bar{x})}{\sum_{j=1}^N (x_i - \bar{x})} \quad (7)$$

where w_{jk} is the weight between region j and k , and S_0 is the sum of all w_{jk} over N .

A calculation of Morans I based on the binary queen contiguity matrix revealed that positive spatial autocorrelation in homeownership levels is indeed present and statistically significant at the 1%-level, independent of which price variable was used. Consequently, spatial dependence among regional homeownership rates was accounted for using the spatial model outlined in Eq. 5 and 6. The SARAR model was estimated using the parsimonious form of previous estimations. Like the other models, it was estimated under three different versions, alternatively using house prices, price-to-income ratios and price-to-rent ratios.

Each estimation of the SARAR model showed the spatial error component to be highly significant (as indicated by a significant coefficient for *rho*), while the spatial lag component (represented by the coefficient for *lambda*) turned out to be generally insignificant. Based on this general result, a spatial error model without spatial lag of the dependent variable was estimated in addition to the SARAR model. Tab. 4 reports estimation results for both models.

Both spatial models widely confirm the results derived from non-spatial analysis. However, the partial influence of price-related variables and unemployment turns out

Variable	SARAR(a)	SARAR(b)	SARAR(c)	SE(a)	SE(b)	SE(c)
<i>loghprice</i>	-6.4097* (3.7697)			-6.2682 (5.2861)		
<i>hprincr</i>		-0.6805 (0.6601)			-0.6839 (0.8640)	
<i>hprrentr</i>			-0.0737 (0.2330)			-0.0767 (0.2537)
<i>unempr</i>	-0.2984 (0.3390)	-0.1620 (0.3095)	-0.1215 (0.3007)	-0.2939 (0.4762)	-0.1623 (0.4092)	-0.1229 (0.3882)
<i>hhsiz</i>	16.5964*** (6.0571)	14.5682** (6.9801)	16.6014*** (6.2697)	16.8492* (8.8009)	14.5258 (9.2739)	16.0595* (8.7218)
<i>prop018</i>	1.6064*** (0.5480)	1.7925*** (0.5768)	1.7467*** (0.5888)	1.6114** (0.8106)	1.7925** (0.7919)	1.7425** (0.7868)
<i>prop5065</i>	2.8667*** (0.7502)	3.0168*** (0.7582)	3.0687*** (0.8109)	2.9040*** (0.7481)	3.0122*** (0.7880)	2.9986*** (0.7931)
<i>inmigr</i>	-0.0354** (0.0161)	-0.0382** (0.0191)	-0.0432* (0.0226)	-0.0357** (0.0165)	-0.0381* (0.0207)	-0.0428 (0.0268)
<i>propmfh</i>	-0.5166*** (0.1281)	-0.5296*** (0.1427)	-0.5543*** (0.1418)	-0.5162*** (0.1679)	-0.5296*** (0.1726)	-0.5570*** (0.1664)
<i>D_east</i>	-5.4605 (3.4591)	-4.6881 (3.5756)	-5.2115 (3.4345)	-5.4708 (3.4717)	-4.6838 (3.7178)	-5.1764 (3.4775)
<i>D_rural</i>	1.0684 (0.7185)	1.4506** (0.7025)	1.5128** (0.6820)	1.0696 (0.8666)	1.4513* (0.8721)	1.5313* (0.8672)
<i>D_aggl</i>	-0.6619 (1.1952)	-1.2109 (1.1174)	-1.4325 (1.2974)	0.7034 (1.2116)	-1.2064 (1.1575)	-1.3807 (1.3373)
No. of obs.	96	96	96	96	96	96
<i>lambda</i>	-0.0195	0.0026	0.0389			
<i>rho</i>	0.6150***	0.6294***	0.6056***	0.5947***	0.6226***	0.6240***
<i>W</i>	Queen	Queen	Queen	Queen	Queen	Queen
Wald χ^2	11.012***	12.979***	12.854***			

Table 4: Spatial models results (robust standard errors in parentheses)

to be generally weaker than suggested by non-spatial models. Regional house price levels are significant in the SARAR model, but turn out to be insignificant in the spatial error model. The absolute magnitude of the house price coefficient is slightly smaller than in the OLS estimations of the parsimonious model. Surprisingly, the price-to-income variable is shown to be generally insignificant. While its standard error remains about the same, the estimated coefficient is nearly cut in half in comparison to non-spatial analysis. Even larger is the decrease in absolute magnitude of the unemployment variable, which also turns out to be generally insignificant.

The partial influence of the remaining explanatory variables on homeownership found in non-spatial estimations is supported both in direction and magnitude. The positive effects of average household size, proportion of children, and proportion of

older adults on homeownership remain strong and highly significant. The partial influence of household size and proportion of 50-65 year olds turns out to be slightly stronger than in non-spatial models. In analogy to previous estimations, both spatial models suggest the familiar negative effect of recent in-migration on homeownership. The absolute magnitude of the in-migration coefficient turns out to be almost unchanged. The coefficient for the proportion of multi-family houses also keeps its negative sign and significance. Its absolute magnitude slightly falls short of the one estimated in non-spatial models.

Generally, the consideration of spatial dependencies in homeownership rates assigns a larger fraction of the spatial variance in homeownership rates to structural, partly unobserved level effects. At least in terms of magnitude, the results for the region type dummy variables prove to be much more pronounced both in the SARAR and the spatial error model. In contrast to previous estimations, each dummy variable carries the expected sign and is fairly different from zero. The rural dummy turns out to be significant at least in the versions which employ price-to-income ratios and price-to-rent ratios as explanatory variables, indicating structurally higher homeownership rates in rural regions by some 1.5 percentage points. Nonetheless, the insignificance of most dummy variables suggests that the other explanatory variables still capture a large fraction of the homeownership variation between different types of spatial entities.

Summarizing the main findings, our estimations reveal that the prevailing form of tenure choice in a certain region is predominantly determined by familiar demographic and economic factors determining demand for homeownership. The size and age composition of households living in a region, recent influx of migrants, and the price and affordability of owner-occupied housing prove to play a substantial role in explaining spatial variation in homeownership. At least in non-spatial models, the unemployment level in a region also turns out to be an important determinant. However, our results suggest that even if demographics, house price levels, and economic prosperity were equally distributed across space, homeownership rates would not. According to our estimations, there also is a role for the composition of regional housing stock - which can be seen as exogenously given in the short run - in determining regional homeownership levels. As two corollary results, we find regional rent levels and expected house price gains, as indicated by future growth in the number of households demanding housing services in the region, to be capitalized into current house prices.

6 Conclusions

Although the promotion of homeownership has been an integral part of German housing policy for many years (Harlander, 1999), the German homeownership rate ranks at the lower end of highly-developed countries. At the same time, pronounced regional differences in homeownership exist, but empirical evidence on the determinants of these differences is very sparse. This study has extended the existing body of research on homeownership in Germany by analyzing its spatial structure. The empirical findings suggest that the regional homeownership rate is determined by demographic factors, employment levels, and regional housing market variables like regional house price and affordability levels and housing stock compositions. The combination of all determinants identified explains both why homeownership rates differ significantly between eastern and western German regions as well as between rural, urbanized, and agglomerated regions. The results have to be seen in the context of a relatively high level of aggregation, but yield further insights in the causes of the low nationwide homeownership rate in Germany. Furthermore, they provide interesting implications for regional housing policy.

The importance of regional house prices and affordability levels, as well as housing stock compositions in explaining spatial variation in homeownership supports the view that, while the majority of German households aspires to live in owner-occupied property, restricted availability and affordability of adequate housing may deter them from entering the property ladder. Economically, limited supply and high prices are two sides of the same medal. As a consequence of land constraints and high regulatory standards, prices of one- or two-family homes generally reach higher values than in most other highly-developed countries, even in less densely populated regions. Despite moderate income growth, the affordability of these forms of housing has not significantly improved in the past. At the same time, condominium ownership in multi-family dwellings is still less prevalent than in other highly urbanized countries. In terms of housing policy, our results suggest that the creation of homeownership could be efficiently facilitated by improving supply conditions in the homeownership market. From an economists perspective, this may be achieved by reducing factors that artificially push up the price of adequate forms of housing, including acquisition taxes, excessive rationing of land, and building regulations.

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Appendix

Variable	Definition	Data source
Homeownership rate	Proportion of households living in owner-occupied dwellings of all households in region j	BBSR Wohnungsmarktbeobachtung, Mikrozensus
House price	Median price of typical one-family home (Euro per m^2) in region j	BBSR Wohnungsmarktbeobachtung, IDN ImmoDaten
Price-to-income ratio	Ratio of median house price (absolute value) to average net household income in region j	BBSR Wohnungsmarktbeobachtung, IDN ImmoDaten, Federal Income Accounting
Price-to-rent ratio	Ratio of median house price (Euro/ m^2) to median net rent (Euro/ m^2) in region j	BBSR Wohnungsmarktbeobachtung, IDN ImmoDaten
Household growth	Expected growth rate of total number of households in region, 2007-2025 j	Raumordnungsprognose BBSR 2025
Unemployment rate	Average proportion of unemployed labor force as a percentage of total labor force in region i , 2002-06	Federal Employment Agency
Household size 0-18 year	Average household size in region j	Population statistics of the Bund and the Laender
18-25 year	Proportion of population aged 0 to 18 years as a percentage of total population in region j	Population statistics of the Bund and the Laender
50-65 year	Proportion of population aged 18 to 25 years as a percentage of total population in region j	Population statistics of the Bund and the Laender
Foreign population	Proportion of population with foreign nationality in per cent of total population in region j	Population statistics of the Bund and the Laender
Immigration	Average number of new registrations per 1000 residents in region j , 2002-2006	Migration statistics of the Bund and the Laender
Apartment blocks	Proportion of apartment blocks as a percentage of total housing stock in region j	Housing statistics of the Bund and the Laender
Congestion	Proportion of residential and traffic area as a percentage of total land area of region j , 2004	Federal Bureau of Statistics
Region type	Classification of regions in rural, urbanized and agglomerated regions (type 1,2,3 regions)	BBR
Sunshine	Annual hours of sunshine in region j in 2006	National Meteorological Service
Centrality	Inverse of average travel time (hours) to the 3 nearest 6 of 36 European agglomeration centers j	BBR

Table 5: Data descriptions and sources.

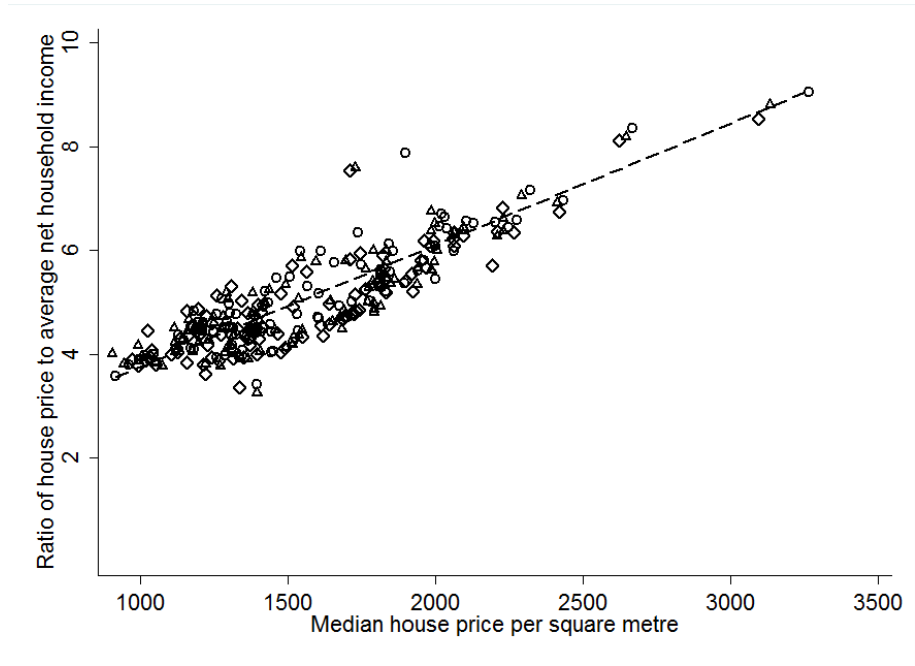


Figure 4: House prices and price-to-income ratios in German regions (2004-2006 data)

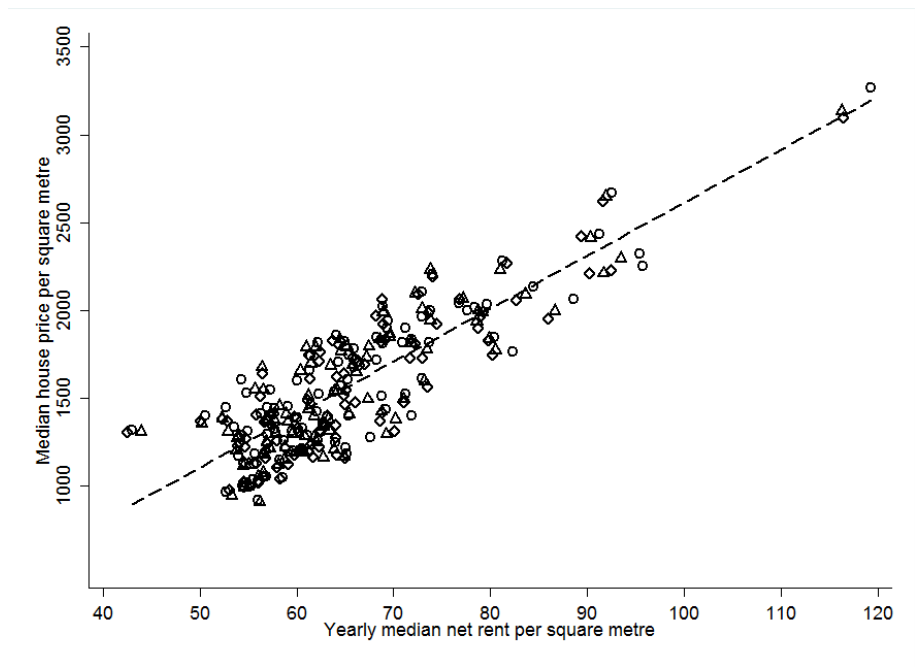


Figure 5: House prices and rents in German regions (2004-2006 data)

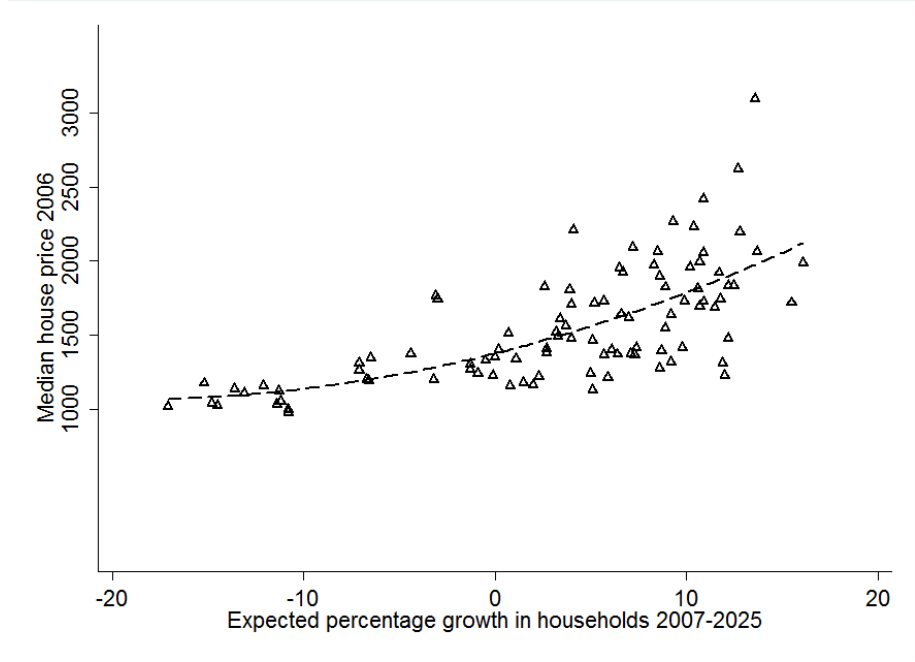


Figure 6: House prices and price-to-income ratios in German regions (2004-2006 data)

Variable	<i>loghprice</i>	<i>hprincr</i>	<i>hprent</i>
<i>unempr</i>	-0.0271*** (0.0062)	-0.0714** (0.0349)	-0.2768*** (0.0935)
<i>hysize</i>	0.2509 (0.1803)	-0.8665 (1.0128)	11.9700*** (2.9059)
<i>prop018</i>	-0.0204 (0.0155)	0.0001 (0.0883)	-0.2374 (0.3182)
<i>prop5065</i>	0.0018 (0.0198)	0.0889 (0.1089)	-0.1593 (0.3489)
<i>inmigr</i>	0.0014 (0.0014)	0.0092** (0.0044)	0.0069 (0.1037)
<i>propmfh</i>	0.0189*** (0.0022)	0.0990*** (0.0127)	0.2687*** (0.0596)
<i>D_east</i>	-0.1411* (0.0758)	-0.1610 (0.4521)	-3.1476** (1.3668)
<i>D_rural</i>	-0.0009 (0.0322)	0.2082 (0.1774)	0.5749 (0.4792)
<i>D_aggl</i>	0.0589* (0.0301)	0.1833 (0.1703)	0.7257 (0.7131)
<i>logsunshine</i>	0.6635*** (0.1092)	3.2843*** (0.5710)	7.7274*** (1.8838)
<i>centrality</i>	0.0275*** (0.0038)	0.1490*** (0.0192)	-0.0557 (0.0567)
No. of obs.	96	96	96
F-Statistic	81.38***	47.68***	39.03***
R^2	0.8790	0.7927	0.7690
F (logsunshine=0, centrality=0)	48.97***	63.55***	8.55***
Score χ^2	4.7311	4.0285	1.6379

Table 6: First-stage results for 2SLS estimations

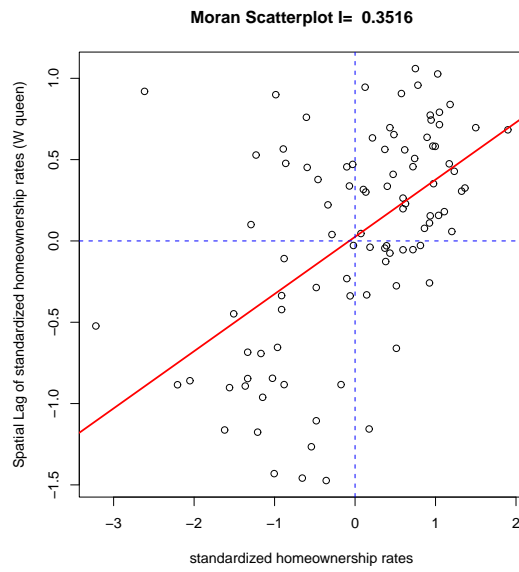


Figure 7: Moran scatterplot for regional homeownership rates (2006)

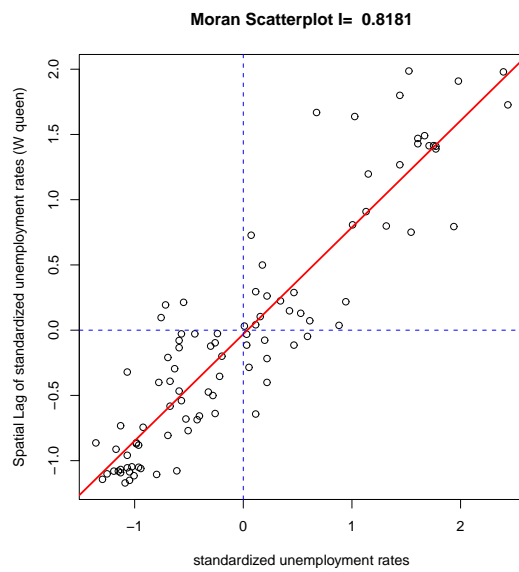


Figure 8: Moran scatterplot for regional unemployment rates (2006)

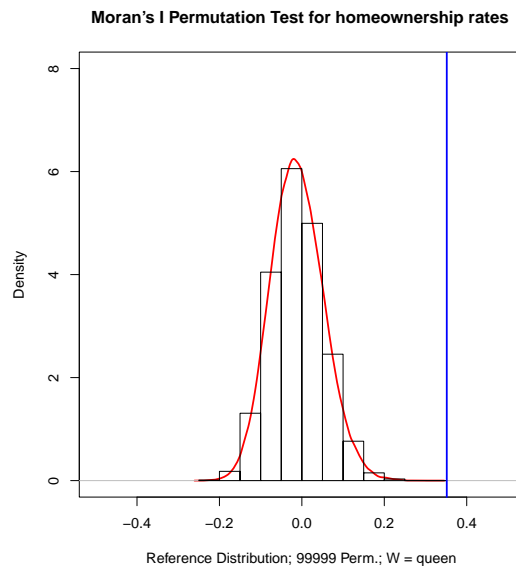


Figure 9: Moran permutation test for regional homeownership rates (2006)

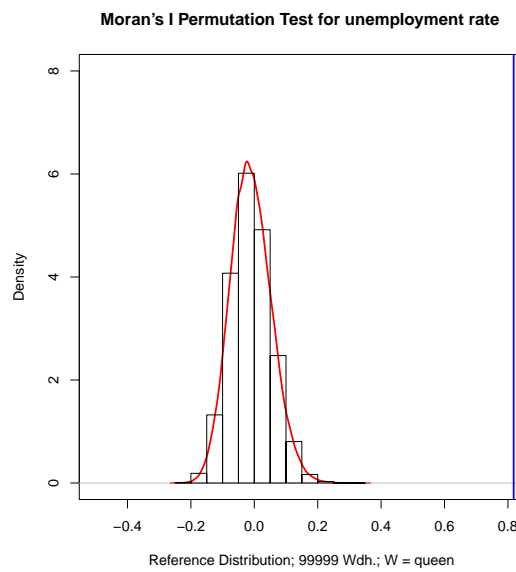


Figure 10: Moran permutation test for regional unemployment rates (2006)