RESEARCH ARTICLE

https://doi.org/10.17059/ekon.reg.2023-3-23
UDC: 332.6
JEL: C51, C33, O18, R32

Elena V. Semerikova [a)], *Anastasia O. Blokhina* [b)], *Andreas Nastansky* [c)]
[a, b)] HSE University, Moscow, Russian Federation
[a, b)] Humboldt University of Berlin, Berlin, Germany
[b)] Vattenfall GmbH, Berlin, Germany
[c)] Berlin School of Economics and Law, Berlin, Germany

Determinants of Regional Disparities in Housing Prices: A Spatial Analysis of German Regions[1]

Abstract. Germany is characterised by heterogeneous regional development in various economic spheres, including housing markets. Differences in housing prices persist during decades, causing undesirable inequality, affecting migration and employment patterns. The purpose of this work is to identify regional factors which affect regional housing prices in Germany. The peculiarity of the study is the consideration of the spatial location of regions for analysing the influence of the characteristics of neighbouring regions. Based on data from 397 German regions for 2004-2019, spatial econometric panel data models are built, which consider both selling and rental prices. The following factors that affect demand in the housing market are used as determinants of housing prices: the unemployment rate, the balance of pendulum migration at the place of work and living, the share of employment, wages, the number of employees, gross regional product. The analysis findings revealed that factors that raise income for the population trigger an upsurge in demand and prices for housing. Conversely, opposite effects result in a decline in prices due to a decrease in demand. Moreover, it was verified that neighbouring regions mutually affect housing markets through pendulum migration and the creation of economic clusters with similar living standards and prices. Furthermore, changes in labour market metrics are crucial; unemployment, wages, and the number of workers in nearby regions have a significant influence on real estate prices in the area under examination. The study's practical importance lies in the possibility of using its outcomes to develop regional and migration policies[2].

Keywords: spatial econometrics, German regions, housing market, housing costs, rental costs, determinants of housing costs, panel data spatial econometric models, weighting matrix, unemployment rate, migration

For citation: Semerikova, E. V., Blokhina, A. O. & Nastansky, A. (2023). Determinants of Regional Disparities in Housing Prices: A Spatial Analysis of German Regions. *Ekonomika regiona / Economy of regions, 19(3)*, 919-933. https://doi.org/10.17059/ekon.reg.2023-3-23

[1] © Semerikova E. V., Blokhina A. O., Nastansky A. Text. 2023.

[2] The first draft results of the study were presented previously by Semerikova and Blokhina (2020) in: Semerikova, E. & Blokhina, A. (2020). Determinants of Regional Differences in Housing Prices: Spatial Analysis of German Regions. In: Sistemnoe modelirovanie sotsialno-ekonomicheskikh protsessov: trudy 43-y Mezhdunarodnoy nauchnoy shkoly-seminara [System modeling of social-economic processes: The Material 43-d International scientific school-seminar] (pp. 463-468). Voronezh: Istoki. (In Russ.)

ИССЛЕДОВАТЕЛЬСКАЯ СТАТЬЯ

Е. В. Семерикова [а)], *А. О. Блохина* [б)], *А. Настанский* [в)]
[а, б)] Национальный исследовательский университет «Высшая школа экономики», г. Москва, Российская Федерация
[а, б)] Берлинский университет имени Гумбольдта, г. Берлин, Германия
[б)] Vattenfall GmbH, г. Берлин, Германия
[в)] Berlin School of Economics and Law, г. Берлин, Германия

Факторы, определяющие региональные различия цен на жилье: пространственный анализ регионов Германии

Аннотация. Неоднородность развития регионов Германии проявляется в различных отраслях экономики, включая рынок недвижимости. Различия в ценах на жилье привели к возникновению неравенства в структуре миграции и занятости. Цель работы — выявить региональные факторы, которые влияют на цены на жилье в Германии. Особенностью исследования является рассмотрение пространственного расположения регионов для анализа влияния на них характеристик соседних регионов. На основе панельных данных по 397 регионам Германии за период 2004-2019 гг. построены пространственные эконометрические модели, учитывающие как цены на продажу, так и цены на аренду жилья. В качестве факторов, определяющих цены на жилье, используются показатели спроса на рынке недвижимости: уровень безработицы, сальдо маятниковой миграции по месту работы и жительства, доля занятых, заработная плата, число сотрудников, валовой региональный продукт. Результаты анализа показали, что факторы, способствующие повышению доходов населения, вызывают рост спроса и цен на жилье. Противоположные эффекты приводят к снижению цен из-за уменьшения спроса. Кроме того, было подтверждено взаимное влияние соседних регионов на рынки жилья посредством маятниковой миграции и создания экономических кластеров, характеризующихся сходным уровнем жизни и ценами. Такие показатели рынка труда, как безработица, заработная плата и количество сотрудников в близлежащих регионах, оказывают существенное влияние на цены на недвижимость. Полученные выводы могут быть использованы на практике для разработки региональной и миграционной политики.

Ключевые слова: пространственная эконометрика, регионы Германии, рынок недвижимости, стоимость жилья, стоимость аренды, детерминанты стоимости жилья, пространственные эконометрические модели панельных данных, матрица весовых коэффициентов, уровень безработицы, миграция

Для цитирования: Семерикова Е. В., Блохина А. О., Настанский А. (2023). Факторы, определяющие региональные различия цен на жилье: пространственный анализ регионов Германии. *Экономика региона, 19(3)*, 919-933. https://doi.org/10.17059/ekon.reg.2023-3-23

Introduction

Germany's housing market is relatively expensive yet remarkably stable. Due to the country's high standard of living, real estate prices remain within reach of the population, although there is a prevalent inclination for long-term or even lifelong housing rentals. The German housing market differs significantly from the Russian one. In Russia, it is more common for individuals to rent a house at a young age, particularly when they are separating from their families and do not have the means to buy an apartment or a house. However, in the coming years, the Russian people aim to acquire their own homes as soon as possible. Conversely, in Germany, housing expenses and property taxes are comparatively higher, leading many individuals to choose not to purchase a house.

The housing market in Germany is quite heterogeneous. Differences between German regions are observed in the level of prices, attractiveness for investment and migration. Basically, the differences are caused by historical factors that shape not only the physical housing itself, but also the demographic and economic situation in the region. The problem of the East falling behind the West is still quite acute, although the gap has been decreasing over the years. Situations in the regions are gradually becoming more alike, but it will take several more decades for these differences to level out.

The purpose of this work is to identify the factors that influence differences in the cost of housing in the regions of Germany, taking into account the relative locations of the regions, as well as to analyse the influence of the characteristics of neighbouring regions using spatial econometric models. We use panel data for 397 German regions for 2004–2019, both selling and rental prices are considered. As determinants of housing prices, the following factors that determine demand in the real estate market are used: unemployment rate, pendulum migration, employment, wages, Gross Regional Product (GRP).

Determinants of Prices in the Housing Market

First of all, housing demand is definitely influenced by demographic factors and labour market indicators. The higher the population density, the higher the demand for housing.

Sunde and Muzindutsi (2017) note the particular impact of population growth on housing prices in the long run. They also connect this phenomenon with the process of urbanisation and migration. In addition, authors find that when unemployment is high, people are willing to spend less due to a temporary lack of income, so the demand for new housing is reduced. Moreover, when unemployment rates surge in specific regions, there is a noticeable reduction in the migration flow, potentially resulting in a population exodus. Consequently, this leads to a decrease in demand, ultimately causing a decline in prices.

Conversely, as stated by Cohen and Karpavičiūtė (2017), a decline in unemployment rates triggers an increase in housing prices. This occurs because individuals experience a boost in their disposable incomes and consequently look for more affordable housing alternatives, which in turn drives up the demand for such properties. An increase in unemployment leads to uncertainty about future income and thus to an unwillingness to enter into financial obligations. Belke and Keil (2017) and Lin Lee (2009) also show negative correlation between unemployment and housing prices.

Clearly, an increase in migration flow towards a particular region directly boosts the demand for housing in that area. Consequently, regions that are considered desirable for relocation witness a rise in housing prices. However, Cohen and Karpavičiūtė (2017) shed light on the divergent impact of migration on different regions within a country. While some regions experience a decrease in demand and housing prices due to population outflows, receiving regions encounter a surge in real estate transactions and an upward trajectory in property prices as a result of migration.

Belke and Keil (2017) and Geng (2018) have observed a noteworthy correlation between migration, regional population, and housing price levels. Moreover, de Bruyne and van Hove (2013) have found that the presence of foreign residents in a region significantly contributes to the escalation of housing prices. This phenomenon can be attributed to the increased population density resulting from migration, which further intensifies the demand for housing in those areas. Next factors correlating with demand for housing are average life expectancy as well as the age structure. Borowiecki (2009) notes that a 1 % climb in the population aged 18–64 leads to a 2 % rise in housing prices, since it is this social group that mainly determines the number of households. Belke and Keil (2017) also note a positive correlation between the share of working population and demand for housing in Germany. Since people accumulate savings and tend to invest more with ageing, the increase in life expectancy also leads to higher investments to real estate.

De Bruyne and van Hove (2013) confirm that income is positively correlated with prices, as the budget of households that they are willing to spend on housing increases. A climb in regional income by 1 % leads to an increase in prices by 0.3 %. The level of income does not only show how affordable is housing for local buyers, but also predicts whether the price can rise in future periods (Wang et al., 2017). Moreover, the competitiveness of wages in a region indicates how likely it is that the rate of population migration to or from the region will go up.

The demand for housing is undoubtedly influenced by both the income levels of the population and the overall economic growth of the country. Gross Domestic Product (GDP) serves as a crucial indicator of the population's income. The research by Égert and Mihaljek (2007) demonstrates a positive correlation between GDP per capita, general price levels, and real estate values. Likewise, Sunde and Muzindutsi (2017) also show that sustainable economic growth fosters increased household consumption, purchasing power, and confidence in meeting financial obligations, thereby leading to a surge in demand for real estate.

In addition, Lin Lee (2009) highlights that historical income volatility plays a significant role in shaping house prices. However, the strength of this relationship varies depending on the sensitivity to income shocks in different regions. In essence, the interplay between income levels, economic growth, and income volatility contributes to the dynamics of housing demand and influences real estate values across various areas.

An increase in taxes, due to a direct impact on disposable income, reduces demand. Belke and Keil (2017) consider the negative impact of taxes on demand, while the opposite phenomenon is observed when subsidies for the population are introduced. Tax breaks for homeowners and mortgage borrowers drive up home prices by increasing the demand for housing due to its lower cost (Geng, 2018).

Regional infrastructure also affects the prices. The proximity of social institutions such as hospitals, educational centres, etc., cultural opportunities, museums, monuments of architecture and nature, career opportunities (jobs), all this posi-

tively affects the demand for housing in such attractive regions. A favourable environmental situation is equally included in this list. Proximity to all this increases the demand for housing, and thus the price of it.

Belke and Keil (2017) describe the impact of the region's infrastructure on demand and prices. The transport network, schools and hospitals increase the usefulness of these areas for the population, raise demand and thereby prices. Urbanisation, which is mentioned in the work of Tripathi (2020), can also be attributed to this phenomenon. The higher the proportion of the urban population, the higher the prices and demand for housing. Due to the developed infrastructure and higher number of vacancies, migration to the region is increasing. Wang et al. (2017) use the indicator "urban level". It characterises the number of employees in the service sector of a region. The higher this indicator, the greater the share of their income people are willing to spend on consumption, including real estate.

The real interest rate has a direct impact on demand in the real estate market. Égert and Mihaljek (2007) note a negative correlation between the interest rate and house prices. The elasticity of the real interest rate in developed countries, and in Germany in particular, is much lower than in transition economies. Sunde and Muzindutsi (2017) explain the relationship between housing prices and interest rates by the fact that a large amount of real estate is financed by mortgages, which are very sensitive to changes in interests. When the real interest rate rises, the price of new loans rises and the demand for mortgages falls. According to Cohen and Karpavičiūtė's findings in 2017, when interest rates are raised over an extended period, it creates a more favourable scenario for investing in other fixed income assets like bonds. Consequently, this causes a notable change in demand, as investors shift their focus from real estate to these alternative forms of investment.

Tripathi (2020) presents an opposite correlation to the one observed by Cohen and Karpavičiūtė (2017). According to Tripathi's research, when the real interest rate rises, it leads to an increase in the money supply. As a result, the real cost of housing for buyers decreases, while the nominal price of housing increases. The impact of interest rates on housing prices is a highly contentious aspect in macroeconomics, as it can have both increasing and decreasing effects on demand. This outcome is contingent on various model features under consideration, such as monetary policy and business cycle characteristics. The contradiction in the effects of interest rates on housing prices is a topic of discussion explored by Belke and Keil (2017).

Tripathi (2020) highlights that the impact of inflation on the housing market can be both positive and negative. In one scenario, an increase in inflation may result in a decrease in the real price of housing, thereby stimulating demand for housing. However, in another scenario, high inflation can have detrimental effects on the economy, leading to instability and ultimately reducing the purchasing power of the population in the long term.

Lin Lee (2009) also points out that the increase in the price level, often driven by inflation, can have a similar effect on housing prices. Inflation's influence on the housing market is further compounded by the argument that it is one of the main factors contributing to real estate price volatility. Higher levels of inflation tend to lead to more significant fluctuations in housing prices, making the market more unpredictable and uncertain for buyers and sellers alike.

Equity prices can also become a reason for the housing prices change. Égert and Mihaljek (2007) determine a negative correlation between stock prices and housing prices, which indicates the existence of a substitution effect. This situation is typical for the OECD countries, which include Germany, and for developing countries, the income effect prevails, and the correlation is positive.

Qualitative indicators, such as the equipment of the house, the presence of a personal garden plot, good repairs or a swimming pool near the house, allow the developer or seller to increase the price (see, for example, Borowiecki, 2009). The building age has a contradictory effect on the price.

Another factor playing a key role for the value of the house or apartment is the location. Different regions can have various price levels dependent on the local economic situation, which determines, among other things, the housing prices. Rental prices are usually higher in good, prosperous areas (Hackelberg & Hennig 2019). Belke and Keil (2017) show that good infrastructure and its availability increase the demand and therefore housing prices. Furthermore, prices differ depending on the type of the city for both urban and rural areas. In smaller towns or cities, they are usually lower due to poorer infrastructure. De Bruyne and van Hove (2013) indicate also the influence of the "level of happiness", the availability of shops, parks and transport accessibility.

The availability of potential new developments significantly impacts housing prices. In areas with

high building density, companies may encounter challenges in identifying suitable sites for new projects, leading to increased costs and opportunity costs. As a result, the final price of housing rises to accommodate these factors.

Belke and Keil's research in 2017 emphasizes the importance of housing stock affordability as a crucial factor influencing supply, especially in markets where the housing stock is relatively inflexible. When the supply of housing cannot easily adjust to changes in demand, the affordability of the existing housing plays a pivotal role in determining the amount of supply that can be brought to the market, thereby influencing housing prices accordingly.

An increase in the interest rate is negatively correlated with the supply of new housing, since in such a situation, the costs of construction increase. Borowiecki (2009) provides data on a 1.8 % decrease in construction activity with a 1 % increase in the real interest rate. Sunde and Muzindutsi (2017) state that the fall in the real interest rate makes loans more affordable for companies, so construction activity increases and supply increases.

Construction costs are negatively correlated with supply and positively correlated with price. The article concludes that high construction costs, including labour, materials and maintenance of an existing building, or a high price of land lead to a decrease in new construction, which leads to a decrease in supply and an increase in the price level (see, for example, Sunde and Muzindutsi, 2017; Wang et al., 2017).

Government policies could also have an impact on housing supply. Institutional factors such as building codes and regulations, rent controls, can, if tightened, complicate the construction regime, increase costs and positively affect prices (Belke & Keil, 2017; Geng, 2018).

Lisitskaya and Yurkina (2016) note the speculative opportunity as one of the determinants of prices in the housing market. In the conditions of volatility and instability of the economy, typical for the Russian market as a whole, the motive to buy a flat is often the desire to invest and resell in the future, since, in stochastic conditions, real estate becomes the most profitable investment being riskless and with a moderate profit. Consequently, it can be deduced that market fluctuations and other types of economic instability within the region contribute to the escalation of real estate prices.

Bataleva (2005) describes that the specificity of papers devoted to the analysis of the real estate market in Russia is that the authors use offer prices, rather than actual ones, which makes the results inaccurate. However, the author, analysing the effect of the equipment of an apartment on its price using a hedonic model, notices that the offer prices received from the same party exceed the transaction prices, that is, the equipment of the apartment is not as overestimated by buyers as by sellers.

Glushchenko and Bataleva (1999) studied the prices on the secondary housing market in Novosibirsk. They also used the hedonic prices theory, according to which the price of a heterogeneous product is influenced by a set of homogeneous individual market aspects of its value to the consumer. Based on their research, it becomes evident that the price of an apartment is influenced by a multitude of factors, which include internal infrastructure parameters and territorial location, particularly the proximity to transport stations. Decreasing utility of the number of rooms in an apartment is noted, that is, the correlation with the price, other things being equal, becomes negative at some point.

Kholodilin et al. (2010) explain the low growth rates of real property prices in Germany and Canada in 1975–2005. The housing market was influenced by real per capita income, real interest rate, population growth rate and urbanisation rate. It is noted that Germany is characterised by slow growth in disposable income and high interest rates, so housing prices were declining in a long time period.

Kholodilin et al. (2018) study bubbles in the real estate market. When analysing panel data for large cities in Germany for 1990–2013, the authors came to the conclusion that in some regions the real price differs from the market price, but this problem is not nationwide.

Thus, population growth, population density, average life expectancy, migration, incomes, developed infrastructure of the region and the number of tenants have a positive effect on the demand and housing prices. Taxes and high unemployment repel buyers, therefore reducing demand and prices. Contradictory influence on demand and prices is exerted by the real interest rate and inflation, which can either increase or decrease demand and prices. Factors such as home equipment, size, favourable location, existence of a financial bubble in the region, construction costs, and some elements of public policy that increase costs for construction companies are positively correlated with housing prices. At the same time, factors such as building age, a large number of apartments, low building density and a large living area per capita reduce housing prices.

Literature Review

Paying attention to the determinants chosen by the authors for analysing the housing market in different countries is essential. In their research on European countries, Égert and Mihaljek (2007) examined the influences on housing prices. Employing a panel data analysis, they discovered that changes in housing prices could be explained by several factors, such as GDP per capita, real interest rates on loans/deposits, demographic indicators, and the level of institutional development of the economy.

Algieri (2013) examined the determinants of housing prices in Europe, the United Kingdom and the United States over the period 1970–2010. The author used the Harvey model, which shows significant influence of such determinants as real income, inflation, and changes in the population.

Vizek (2010) considers short-term and long-term periods separately and shows the differences between Western and Eastern Europe. Using the VECM model, the relationship between real income, interest rate and house prices is demonstrated. In most considered countries, price changes are explained by the interest rate in the long run.

Key determinants of housing prices are often suggested to be demand-side factors, as indicated in much of the literature. Some literature on various countries have already adopted a spatial approach to analyse house prices. In their study, Hanink et al. (2010) examined the impact of various economic factors on housing prices. They discovered that the level of internal migration and other economic characteristics significantly influence housing prices, but this impact varies depending on the local regional context. To reach these conclusions, the authors employed a two-level hedonic model that integrated global data estimated using a spatial error model and local effects estimated using geographically weighted regression. In a study focusing on Russian regions, Lunkov (2015) also observed a spatial correlation between housing prices.

O'Donovan and Rae (1997) conducted a study on housing price determinants in New Zealand, considering both aggregate and regional levels. They took into account housing demand, supply, and consumption. Furthermore, they found that housing prices in geographically close regions were more likely to be correlated, indicating a spatial spillover effect.

Likewise, Ge (2009) employed a multiple regression analysis to investigate the New Zealand housing market and identified migration, investment expectations, unemployment, mortgage rates, and building permits as significant factors influencing price fluctuations.

Hort (1998) looked at the determinants of housing prices in Sweden. The author uses a restricted error correction model for real house prices, which is estimated for Swedish panel data. In the long-run equation, changes in income and construction costs have a significant impact on real housing prices. Dynamic equation estimates show an autoregressive structure of real house prices.

Conducting a study on agglomerations, Miller et al. (2005) explored the definition of temporary fluctuations in nominal housing prices through nominal income, nominal interest rates, and employment. Their findings revealed that housing prices in coastal markets tend to display higher volatility compared to cities situated in central regions of the country. Additionally, certain markets prove to be more responsive to changes in interest rates than others, with limited supply potentially contributing to the explanation of these disparities.

All in all, authors usually analyse demand-side determinants of housing prices. The most frequently observed factors in literature are unemployment, migration, population density. Often the authors examine income factors, such as GDP and the income of households, interest rates.

Data & Methodology

We use panel data for 397 regions for the period 2004–2019. This study includes data from BulwienGesa (RIWIS), which offers information on regional markets for all NUTS 3 (Nomenclature of territorial units for statistics) regions of Germany. The data for migration is collected from Regional Statistik Genesis. Explaining their approach, Kauffmann and Nastansky (2007) obtained migration data from Regional Statistik Genesis and detailed the methodology used for calculating property data. When examining rental prices, the authors employed net cold rent, while selling prices of owner-occupied apartments were considered without incidental costs.

The determinants of housing prices were chosen based on supply and demand factors and their dynamics, as outlined by Case and Mayer (1996). The analysis encompassed various factors affecting demand, such as interest rates, population growth, and positive migration flows. On the other hand, high unemployment rates were found to decrease the demand for housing. Additionally, the region's Gross Regional Product (GRP) was taken into account, reflecting the overall economic state of the area. GRP showed a positive correla-

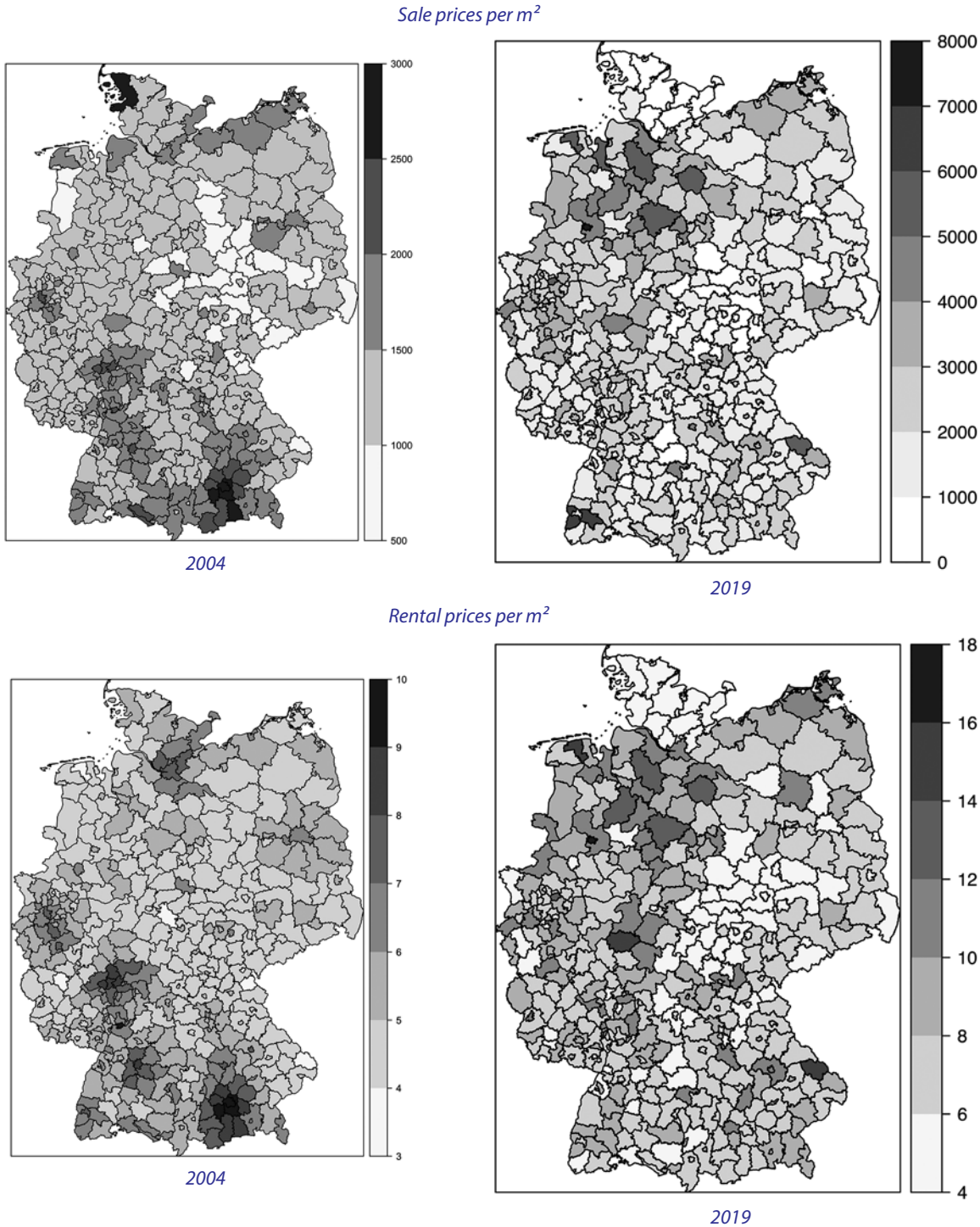

Fig. 1. *Sale prices per m² for German regions (2004–2019, first row) and rental prices per m² for German regions (2004–2019, second row)*

tion with housing prices due to the increase in the price level and higher demand for housing.

The dependent variables are the sale price and the apartment rental price €/m². Figure 1 shows the presence of spatial clusters in real estate prices. The regions with the highest prices are Munich and Frankfurt am Main. From the information presented in these figures, one can notice the division of the country into economic clusters. Due to historical differences, the proximity of large industrial centres and transport accessibility, the regions of Germany have different levels of economic development. Although we observe some convergence on regional housing markets (Semerikova et al., 2022), differences still persist. Let us consider the first two maps, representing the price level for home sales. One can notice that agents will incur the greatest costs when

buying real estate in the traditionally expensive Munich in Bavaria. In this region, there is such a thing as a financial bubble, so prices continue to rise. Housing prices in Schleswig-Holstein are comparable to those in Bavaria, potentially influenced by its close proximity to economically developed Denmark. Furthermore, it becomes evident that pricier regions are primarily located in the western part of the country. This phenomenon might be connected to the historical division of the nation into East and West, with the former German Democratic Republic (GDR) still undergoing an industrial lag. However, in the second map in the first row, which belongs to a later period, the gap is noticeably reduced due to the convergence of living standards and prices. In the Eastern part, Berlin is highlighted since prices there are higher than in neighbouring regions.

Approximately similar results are obtained by the analysis of data for the rental prices. Bavaria still stands out, as well as Berlin stands out among the Eastern regions. Persistently, higher housing prices continue to prevail in the Western regions, influenced by their proximity to cities of significant industrial, transportation, and scientific importance. Among these cities, Frankfurt am Main, Düsseldorf, Cologne, Bremen, and Berlin stand out as the most expensive places to purchase or rent an apartment. Moreover, the suburbs and border regions of these cities also exhibit a higher price level compared to other areas.

The Moran's I (Table 1) checks if there is a clustering of objects (spatial correlation) or if they are randomly distributed. In this case, there is a significant spatial correlation between regions in terms of the sale price and rental price of apartments.

After 2009, real estate prices in Germany experienced a significant surge, particularly in metropolitan areas and their surroundings, according to a study by Kauffmann and Nastansky (2019). However, notable disparities in real estate prices were evident between the old federal states and the former GDR. The study highlighted a clear upward trend solely in Berlin (including its surrounding area) and the Baltic region, while other regions, including most independent cities, did not follow suit. Interestingly, some regions away from major agglomerations witnessed substantial price increases, primarily in the coastal regions along the North Sea and Baltic Sea.

Regarding rental agreements, Germany boasts a relatively high proportion of rented apartments, with about half of all apartments occupied by tenants. Rental agreements are subject to limitations imposed by legislation and case law to prevent excessive rent hikes. Kauffman and Nastansky (2022) conducted another study on regional rental prices in Germany since 2004, revealing rising rents in nearly all independent cities and districts. The top positions for rent levels were occupied by the centres of Hamburg, Cologne, Frankfurt am Maine, Stuttgart, and Munich, with Berlin, Nuremberg, and Freiburg following closely behind. Furthermore, high rent levels were also observed in numerous districts situated on the Baltic Sea and in the North Frisia district.

The primary explanatory variables for these trends were found to be demand factors, including the unemployment rate, pendulum migration, disposable income, share of employees, wages, number of employees, and gross regional income (Table 2).

Table 1

Global Moran's I

Year	Selling price	Rental price
2004	0.175***	0.172***
2005	0.192***	0.179***
2006	0.202***	0.179***
2007	0.211***	0.189***
2008	0.210***	0.191***
2009	0.208***	0.190***
2010	0.201***	0.187***
2011	0.195***	0.181***
2012	0.199***	0.180***
2013	0.207***	0.181***
2014	0.215***	0.199***
2015	0.213***	0.213***
2016	0.229***	0.229***
2017	0.241***	0.242***
2018	0.254***	0.260***
2019	0.262***	0.268***

*** — significance 1 %.

Table 2

Dependent and independent variables

Dependent variable:	
Selling prices	Sale prices of existing apartments in €/m²
Rental prices	Rent prices of existing apartments in €/m²
Independent variables:	
Inverse unemployment rate	1/ Unemployment rate, (inverse) (in %)
Pendulum migration rate (by the place of residence/work)	Number of pendulum migrants divided by population
Share of employment (by the place of residence/work)	Number of employees divided by population
Wages	€, in current prices, per employee
Gross Regional Income	€, per capita

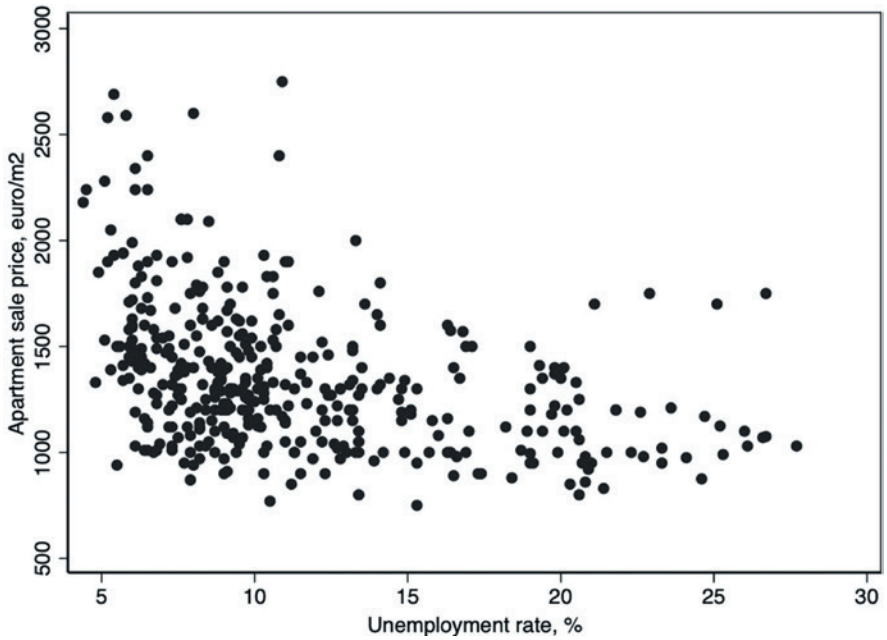

Fig. 2. *Scatterplot of apartment sale price and unemployment rate (2004)*

The listed factors are included in the model linearly, with the exception of the unemployment rate, for which an inverse indicator was included:

$$X_{it} = \frac{1}{Unemp_{it}}.$$

The decision to include an inverse functional relationship was made on the basis of the scatterplot (see Figure 2), which shows an inverse relationship between price and unemployment rate. The econometric analysis consists of building four panel data models: one without taking into account spatial effects, and three others taking into account the spatial relationship between regions.

Analysis without spatial correlation

Initially, the panel data model with fixed individual and time effects is estimated without taking into account spatial effects:

$$P_{it} = \alpha_0 + \alpha_1 X_{it} + \eta_t + \mu_i + \varepsilon_{it}, \quad (1)$$

where P_{it} is the sale or rental price of an apartment (€ per sq. m), X_{it} is a set of explanatory variables, η_t are time effects, μ_i are fixed individual effects. Based on the results of the Hausman test, fixed rather than random effects were selected for the model. The test statistic is 126.9 for rental price models and 126.7 for sale price models.

Spatial Analysis

Based on the general nesting spatial (GNS) specification, the model specifications encompass the spatial lag of both the dependent and independent variables, as well as the spatial structure in the residuals, all simultaneously. It requires the evaluation of a large number of parameters. The specification is as follows:

$$\mathbf{P}_t = \alpha_0 + \alpha_1 \mathbf{X}_t + \alpha_2 \mathbf{W}\mathbf{P}_t + \alpha_3 \mathbf{W}\mathbf{X}_t + \eta_t + \boldsymbol{\mu} + \boldsymbol{\varepsilon}_t,$$
$$\boldsymbol{\varepsilon}_t = \rho \mathbf{W}\boldsymbol{\varepsilon}_t + \mathbf{u}_t,$$

Due to the large number of parameters, the following models were considered:

Spatial Autoregressive Model (SAR)

$$\mathbf{P}_t = \alpha_0 + \alpha_1 \mathbf{X}_t + \alpha_2 \mathbf{W}\mathbf{P}_t + \eta_t + \boldsymbol{\mu} + \boldsymbol{\varepsilon}_t, \quad (2)$$

Spatial Durbin Model (SDM)

$$\mathbf{P}_t = \alpha_0 + \alpha_1 \mathbf{X}_t + \alpha_2 \mathbf{W}\mathbf{P}_t + \alpha_3 \mathbf{W}\mathbf{X}_t + \eta_t + \boldsymbol{\mu} + \boldsymbol{\varepsilon}_t, \quad (3)$$

Spatial Error Model (SEM)

$$\mathbf{P}_t = \alpha_0 + \alpha_1 \mathbf{X}_t + \eta_t + \boldsymbol{\mu} + \boldsymbol{\varepsilon}_t, \ \boldsymbol{\varepsilon}_t = \rho \mathbf{W}\boldsymbol{\varepsilon}_t + \mathbf{u}_t, \quad (4)$$

where $\mathbf{P}_t$ is the vector of the sale or rental prices of an apartment (€ per sq. meter) for all regions in period t, $\mathbf{X}_t$ is a matrix of explanatory variables for all regions in period t, η_t are time effects, μ are fixed individual effects. $\mathbf{W}$ is a spatial weighting matrix of dimension 397×397. Nonzero elements of the matrix $\mathbf{W}$ denote that region j is adjacent to region i. The diagonal elements of the matrix are zeros. The matrices are row-standardised, so that the weights of all neighbouring regions are 1. In the analysis, we use a matrix based on regional common boundaries (boundary matrix). This type of matrix $\mathbf{W}$ is often used in spatial regional analysis, as it provides a suitable match for the relationship between regions. The weighted structure of the matrix provides a weighted value of house price or other indicators of neighbouring regions, which is denoted as $\mathbf{WP}_t$, the spatial lag of the dependent variable, or $\mathbf{WX}_t$, the spatial lag of the explanatory variables.

The models are estimated by the maximum likelihood method. For each model, residuals were tested for heteroscedasticity, normality, and autocorrelation (level of significance 5 %). With the exception of outliers (regions with high and low rental and sale prices), the normality hypothesis is not rejected. There is heteroscedasticity and autocorrelation in the models, and therefore robust standard errors are used to eliminate them.

Equation (2) is a spatial autoregressive (SAR) model that accounts for spatial correlation in housing prices. By introducing the spatial autoregressive lag $\mathbf{WP}_t$, it reflects global spatial correlation: a change in the price of a house in one region affects the price in a neighbouring region, which in turn affects its neighbour, and so on.

Equation (3) displays a spatial Durbin model that includes spatial lags of the explanatory variables. This allows us to distinguish shocks in one region from shocks in other regions. The SDM specification makes it possible to directly assess the impact of a shock in *X* on a neighbouring region. Equation (4), which is a spatial error model, takes into account the spatial correlation in deviations, which makes it possible to increase the efficiency of estimates.

The choice between models was carried out using diagnostic tests. To choose between the SAR and SDM models, the $\alpha_3 = 0$ hypothesis was tested, which was rejected for both the sale price models and the rental price models. When choosing between SEM and SDM, SDM is also preferred due to the rejection of the $\alpha_3 = -\rho_0\alpha_1$ hypothesis. Thus, the preferred model is the SDM, which takes into account the influence of the explanatory characteristics of neighbouring regions.

Results

Table 3 presents the estimated models that reflect the influence of various factors on the price of rental housing. In each of them, the price of rental housing in € per square meter is considered as a dependent variable. The first model FE is linear and does not take into account spatial correlation, while SAR and SEM include the influence of the spatial factor. The SDM model shows not only the relationship between price and factors, taking into account spatial correla-

Table 3

Results of rental prices models estimations

Variables	FE	SAR	SDM		SEM
	Rent	Rent	Rent	Wx	Rent
1/Unemployment	1.870***	1.403***	1.194***	1.601***	1.180***
	(0.138)	(0.264)	(0.265)	(0.517)	(0.272)
Pendulum migration rate by the place of work	–0.00169**	–0.00219	–0.00235	0.00101	–0.00224
	(0.000695)	(0.00182)	(0.00178)	(0.00426)	(0.00177)
Pendulum migration rate by the place of residence	0.00475***	0.00492***	0.00495***	0.000536	0.00463***
	(0.000630)	(0.00188)	(0.00185)	(0.00398)	(0.00180)
Share of employment	2.20e–06***	2.10e–06***	2.19e–06***	1.11e–07	1.97e–06***
	(1.25e–07)	(5.06e–07)	(5.11e–07)	(6.03e–07)	(4.96e–07)
Wages	3.85e–06	4.77e–06	5.31e–06	–5.85e–06	5.25e–06
	(2.60e–06)	(4.33e–06)	(4.24e–06)	(6.18e–06)	(4.21e–06)
GRP	6.58e–06***	6.74e–06**	6.36e–06**	–5.86e–06	7.30e–06***
	(9.67e–07)	(2.80e–06)	(2.85e–06)	(3.85e–06)	(2.80e–06)
ρ		0.406***	0.383***		
		(0.0385)	(0.0367)		
Time effects	Yes	Yes	Yes	Yes	Yes
σ^2		0.123***	0.122***		0.124***
		(0.00874)	(0.00867)		(0.00869)
λ					0.408***
					(0.0394)
Constant	4.782***				
	(0.0555)				
Observations	6,352	6,352	6,352	6,352	6,352
Number of names	397	397	397	397	397
AIC		4967	4918	4918	5021
BIC		5123	5114	5114	5176

Source: authors' estimations. Robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Calculated Direct, Indirect and Total Impacts are presented in Table 5.

Table 4

Estimation results for selling price models

Variables	FE	SAR	SDM		SEM
	Sell	Sell	Sell	Wx	Sell
1/Unemployment	1,617***	1,354***	1,214***	770.0**	1,247***
	(215.0)	(196.7)	(198.6)	(329.0)	(200.1)
Pendulum migration rate by the place of work	–2.059*	–2.280*	–2.430**	0.0874	–2.244*
	(1.219)	(1.191)	(1.190)	(2.852)	(1.171)
Pendulum migration rate by the place of residence	3.722***	3.789***	3.848***	0.539	3.607***
	(1.104)	(1.064)	(1.059)	(2.455)	(1.022)
Share of employment	0.00158***	0.00155***	0.00159***	–0.000218	0.00150***
	(0.000524)	(0.000456)	(0.000471)	(0.000353)	(0.000456)
Wages	0.00354	0.00376	0.00363	0.000480	0.00309
	(0.00302)	(0.00272)	(0.00277)	(0.00441)	(0.00270)
GRP	0.00370	0.00351	0.00353	–0.00105	0.00371
	(0.00255)	(0.00224)	(0.00232)	(0.00284)	(0.00227)
ρ		0.371***		0.356***	
		(0.0471)		(0.0471)	
Time effects	Yes	Yes	Yes	Yes	Yes
σ^2		50,317***		50,158***	50,705***
		–4,387		–4,391	–4,474
λ					0.376***
					(0.0491)
Constant	951.1***				
	(136.3)				
Observations	6,352	6,352	6,352	6,352	6,352
Number of names	397	397	397	397	397
AIC		87 020	86 994	86 994	87 073
BIC		87 168	87 176	87 176	87 222

Source: authors' estimations. Robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Calculated Direct, Indirect and Total Impacts are presented in Table 6.

tion, but also considers the impact of neighbouring regions effects.

As a result of the evaluation of the model without spatial effects (FE), the following conclusions were obtained. An increase in the unemployment rate lowers the rental prices. This inverse relationship was confirmed earlier in studies by Cohen and Karpavičiūtė (2017), Belke and Keil (2017) and Lin Lee (2009).

Pendulum migration by the place of work is significant only in FE non-spatial model and negatively affects the rental prices. This effect is surprising in its direction and can be explained by the bias in estimations, as we do not include spatial effects in FE model. Pendulum migration by the place of residence is positively correlated with rents, because high migration usually indicates good economic development. Commuting increases the price along with the economic condition. High pendulum migration flows reinforce the agglomeration and allocation effect.

The employment has a significant positive impact on the rental price. Working people receive income that they spend on consumption, including the purchase of housing. Borowiecki (2009) and Belke and Keil (2017) came to similar conclusions in their papers.

Wages and GRP have positive effects on rental prices. The income factors not only increase the purchasing power of the customers and so the demand, but illustrate the high development of the region's economy. Existing literature shows the same effect of income variables (Algieri, 2013; Égert & Mihaljek, 2007).

In regional analysis, it is important to take into account the relationship between regions. According to Tobler's First Law of Geography, the relationship between nearby points will be greater than between distant ones, so local changes in one region primarily affect neighbouring ones (Miller, 2004). The SAR, SDM and SEM models allow to consider spatial correlation.

The results of spatial models evaluation (equations 2, 3 and 4) are generally similar to the results of the fixed effects model. All models reveal a pos-

itive spatial correlation: the coefficients ρ and λ are significant and positive.

The Durbin Spatial Model (SDM, Equation 3) additionally makes it possible to estimate the impact of changing the characteristics of neighbouring regions. However, most factors are insignificant, so the economic situation in neighbouring regions is not really significant, according to the considered data. Only the impact of unemployment is significant and negative. It can be explained by the allocation effect. High unemployment in neighbouring region is a mark of its economic weakness, which can transfer to the considered ones via ripple effect.

Let us consider the results of the same models for the selling price of housing, shown in Table 4. The dependent variable is the selling price of an apartment in € per square meter.

The results of model estimation for the sale price of housing are similar to the results for the rental price of housing. The negative impact of unemployment on the sale price is smaller than the impact on the rental price. This is explained by the fact that rental prices correspond to the changes more rapidly. Pendulum migration by the place of work has a negative effect, but is significant in SAR and SDM for the considered regions. The effects of wages are not significant for selling prices. Housing is usually bought with savings, which are not so strongly affected by current wage changes. The effect of GRP is positive and is significant only in SEM model.

Thus, the considered models basically correspond to the data obtained earlier from the literature and our own research, and also show the relationship between sale and rental prices and factors for the region and neighbouring regions by taking into account spatial correlation.

Conclusion

The aim of this study is to identify the main determinants of housing prices in different regions of Germany, taking into account their location relative to each other. We analysed the spatial econometric models and estimated the effects of neighbouring regions.

We used data for 397 German regions for 2004–2019. The determinants chosen are the unemployment rate, the balance of migration by the place of work, the balance of migration by the place of residence, the share of employees, wages, the number of employees, Gross Regional Product.

The prices for sale and rent are considered separately, for which models FE, SAR, SEM, SDM are estimated. With the help of different models, it was possible not only to consider the effect of determinants on the price, but also to take into account the relative position of regions and the characteristics of neighbouring regions. The results of the calculations correspond to the results obtained in the literature review and our own empirical real estate market research given earlier.

In summary, our findings indicate that higher income factors, like a significant share of employ-

Table 5

Impacts for rental price model specifications

Variables	SAR Direct	SAR Indirect	SAR Total	SDM Direct	SDM Indirect	SDM Total
1/Unemployment	1.467***	0.915***	2.382***	1.381***	3.154***	4.535***
	(0.281)	(0.218)	(0.472)	(0.278)	(0.843)	(0.943)
Pendulum migration rate by the place of work	–0.00235	–0.00146	–0.00381	–0.00244	–0.000226	–0.00267
	(0.00182)	(0.00116)	(0.00296)	(0.00180)	(0.00639)	(0.00718)
Pendulum migration rate by the place of residence	0.00526***	0.00328***	0.00854***	0.00534***	0.00413	0.00946
	(0.00189)	(0.00126)	(0.00309)	(0.00188)	(0.00603)	(0.00689)
Share of employment	2.18e–06***	1.37e–06***	3.55e–06***	2.28e–06***	1.53e–06	3.80e–06***
	(5.15e–07)	(4.17e–07)	(9.01e–07)	(5.14e–07)	(9.95e–07)	(1.25e–06)
Wages	4.89e–06	3.11e–06	8.00e–06	4.95e–06	–5.30e–06	–3.56e–07
	(4.35e–06)	(2.83e–06)	(7.13e–06)	(4.28e–06)	(1.01e–05)	(1.25e–05)
GRP	7.09e–06**	4.39e–06**	1.15e–05**	6.16e–06**	–5.42e–06	7.46e–07
	(2.87e–06)	(1.84e–06)	(4.62e–06)	(2.90e–06)	(5.81e–06)	(7.14e–06)
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,352	6,352	6,352	6,352	6,352	6,352
R-squared	0.343	0.343	0.343	0.340	0.340	0.340
Number of names	397	397	397	397	397	397
AIC	4967	4967	4967	4918	4918	4918
BIC	5123	5123	5123	5114	5114	5114

Source: authors' estimations. Robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6

Impacts for selling price model specifications

Variables	SAR Direct	SAR Indirect	SAR Total	SDM Direct	SDM Indirect	SDM Total
1/Unemployment	1,404***	776.2***	2,180***	1,317***	1,780***	3,097***
	(210.1)	(203.6)	(380.6)	(212.1)	(530.0)	(629.4)
Pendulum migration rate by the place of work	−2.399**	−1.328*	−3.727**	−2.541**	−1.300	−3.842
	(1.185)	(0.733)	(1.884)	(1.198)	(4.132)	(4.654)
Pendulum migration rate by the place of residence	3.998***	2.212***	6.210***	4.089***	2.958	7.047*
	(1.065)	(0.771)	(1.758)	(1.079)	(3.591)	(4.109)
Share of employment	0.00159***	0.000886***	0.00248***	0.00162***	0.000565	0.00219**
	(0.000460)	(0.000332)	(0.000765)	(0.000470)	(0.000568)	(0.000859)
Wages	0.00386	0.00219	0.00605	0.00376	0.00315	0.00691
	(0.00272)	(0.00168)	(0.00436)	(0.00277)	(0.00676)	(0.00810)
GRP	0.00375	0.00203	0.00579	0.00368	0.000238	0.00391
	(0.00229)	(0.00130)	(0.00354)	(0.00233)	(0.00392)	(0.00484)
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,352	6,352	6,352	6,352	6,352	6,352
R-squared	0.407	0.407	0.407	0.413	0.413	0.413
Number of names	397	397	397	397	397	397
AIC	87 020	87 020	87 020	86 994	86 994	86 994
BIC	87 168	87 168	87 168	87 176	87 176	87 176

Source: authors' estimations. Robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

ees, tend to drive housing prices up by increasing demand. Conversely, high unemployment rates usually result in lower prices due to decreased demand. Moreover, our analysis revealed that neighbouring regions influence each other's housing markets through population movements and economic clustering, showing similar standards of living and prices.

References

Algieri, B. (2013). House Price Determinants: Fundamentals and Underlying Factors. *Comparative Economic Studies, 55(2),* 315–341. DOI: https://doi.org/10.1057/ces.2013.3

Bataleva, A. (2005). Apartment Price Structure: Prices of Supply and Prices of Deals. *Trudi NGU, 22,* 67–69. (In Russ.)

Belke, A. & Jonas, K. (2017). *Fundamental Determinants of Real Estate Prices: A Panel Study of German Regions*. Ruhr Economic Papers No. 731.

Borowiecki, K. J. (2009). The Determinants of House Prices and Construction: An Empirical Investigation of the Swiss Housing Economy. *International Real Estate Review, 12(3),* 193–220.

De Bruyne, K. & Van Hove, J. (2013). Explaining the spatial variation in housing prices: an economic geography approach. *Applied Economics, 45(13),* 1673–1689. DOI: https://doi.org/10.1080/00036846.2011.636021

Case, K. E. & Mayer, C. J. (1996). Housing Price Dynamics within a Metropolitan Area. *Regional Science and Urban Economics, 26(3-4),* 387–407.

Cohen, V. & Karpavičiūtė, L. (2017). The Analysis of the Determinants of Housing Prices. *Independent Journal of Management & Production, 8(1),* 49–63. DOI: https://doi.org/10.14807/ijmp.v8i1.521

Égert, B. & Mihaljek, D. (2007). Determinants of House Prices in Central and Eastern Europe. *Comparative Economic Studies, 49(3),* 367–388. DOI: https://doi.org/10.1057/palgrave.ces.8100221

Ge, X. J. (2009). Determinants of House Prices in New Zealand. Pacific Rim *Property Research Journal, 15(1),* 90–121. DOI: https://doi.org/10.1080/14445921.2009.11104273

Geng, N. (2018). *Fundamental Drivers of House Prices in Advanced Economies*. IMF Working Papers 2018/164. DOI: https://doi.org/10.5089/9781484367629.001

Glushchenko, K. & Bataleva, A. (1999). The Structure of Prices on Secondary Housing Market in Novosibirsk. *Region: ekonomika i sotsiologiya [Region: Economics and Sociology], 4,* 111–129. (In Russ.)

Hackelberg, F. & Hennig, D. (2019). *Investing in German Real Estate*. PricewaterhouseCooper GmbH, 58. Retrieved from: https://www.pwc.de/de/real-estate/studie-investing-in-german-real-estate-2018.pdf.

Hanink, D. M., Cromley, R. G. & Ebenstein, A. Y. (2010). Spatial Variation in the Determinants of House Prices and Apartment Rents in China. *The Journal of Real Estate Finance and Economics, 45(2),* 347–363. DOI: https://doi.org/10.1007/s11146-010-9262-3

Hort, K. (1998). The Determinants of Urban House Price Fluctuations in Sweden 1968–1994. *Journal of Housing Economics, 7(2),* 93–120. DOI: https://doi.org/10.1006/jhec.1998.0225

Kauffmann, A. & Nastansky, A. (2007). Property market indices for periods below one year in Germany. *Zeitschrift Für Immobilienökonomie [German Journal of Property Research], 2,* 55–74. (In Germ.)

Kauffmann, A. & Nastansky, A. (2019). *Explorative Analyse Der Preise von Einfamilienhäusern Und Eigentumswohnungen in Deutschland [Exploratory analysis of the prices of single-family houses and condominiums in Germany]*. Statistische Diskussionsbeiträge No. 52. (In Germ.)

Kauffmann, A. & Nastansky, A. (2022). *Regionale Mieten in Deutschland: Explorative Analyse Der Mieten in Der Wiedervermietung [Regional rents in Germany: exploratory analysis of rents in re-letting]*. Statistische Diskussionsbeiträge 54. (In Germ.)

Kholodilin, K. A., Michelsen, C. & Ulbricht, D. (2018). Speculative Price Bubbles in Urban Housing Markets. *Empirical Economics, 55(4),* 1957–1983.

Kholodilin, K., Menz, J.-O. & Siliverstovs, B. (2010). What Drives Housing Prices Down? Evidence from an International Panel. *Journal of Economics and Statistics, 230(1),* 59–76.

Lin Lee, C. (2009). Housing price volatility and its determinants. *International Journal of Housing Markets and Analysis, 2(3),* 293–308. DOI: https://doi.org/10.1108/17538270910977572

Lisitskaya, T. S. & Yurkina, E. A. (2016). The Irrational Components of the Real Estate Market. *Vestnik Evraziyskoy Nauki [The Eurasian Scientific Journal], 2(33),* 52–61. (In Russ.)

Lunkov, A. (2015). Spatial Panel Data Models for Real Estate. In: *Matematicheskoe Modelirovanie v Ekonomike, Strakhovanii i Upravlenii Riskami [Mathematical Modeling in Economics, Insurance and Risk Management]* (pp. 142-145). Saratov. (In Russ.)

Miller, H. J. (2004). Tobler's First Law and Spatial Analysis. *Annals of the Association of American Geographers, 94(2),* 284–289.

Miller, N. G., Sklarz, M. & Thibodeau, T. G. (2005). The Impact of Interest Rates and Employment on Nominal Housing Prices. *International Real Estate Review, 8(1),* 27–43.

O'Donovan, B. & Rae, D. (1997). The determinants of house prices in New Zealand: An aggregate and regional analysis. *New Zealand Economic Papers, 31(2),* 175–198. DOI: https://doi.org/10.1080/00779959709544273

Semerikova, E. & Blokhina, A. (2020). Determinants of Regional Differences in Housing Prices: Spatial Analysis of German Regions. In: *Sistemnoe modelirovanie sotsialno-ekonomicheskikh protsessov: trudy 43-y Mezhdunarodnoy nauchnoy shkoly-seminara [System modeling of social-economic processes: The Material 43-d International scientific school-seminar]* (pp. 463-468). Voronezh: Istoki. (In Russ.)

Semerikova, E., Nastansky, A. & Blokhina, A. (2022). Convergence in German Regional Housing Markets. *Ekonomicheskiy zhurnal VShE [HSE Economic Journal], 26(1),* 120–144.

Sunde, T. & Muzindutsi, P.-F. (2017). Determinants of house prices and new construction activity: An empirical investigation of the Namibian housing market. *The Journal of Developing Areas, 51(3),* 389–407. DOI: https://doi.org/10.1353/jda.2017.0080

Tripathi, S. (2020). *Macroeconomic Determinants of Housing Prices : A Cross Country Level Analysis*. MPRA Paper No. 98089, 17.

Vizek, M. (2011). Short-Run and Long-Run Determinants of House Prices in Eastern and Western European Countries. *Privredna Kretanja i Ekonomska Politika [Economic Trends and Economic Policy], 20(125),* 27–60.

Wang, Y., Wang, S., Li, G., Zhang, H., Jin, L., Su, Y. & Wu, K. (2017). Identifying the determinants of housing prices in China using spatial regression and the geographical detector technique. *Applied Geography, 79,* 26–36. DOI: https://doi.org/10.1016/j.apgeog.2016.12.003.

About the authors

Elena V. Semerikova — Cand. Sci. (Econ.), Associate Professorr, HSE University; PhD Student, Humboldt University of Berlin; Scopus Author ID: 56942418500; https://orcid.org/0000-0003-2527-7527 (11, Pokrovsky Boul., Moscow, 109028, Russian Federation; e-mail: esemerikova@hse.ru).

Anastasia O. Blokhina — Bachelor, Faculty of Economic Sciences, HSE University; Master Student in Economics and Management Science, Humboldt University of Berlin; Working Student of Business Excellence Data & Digitalization, Vattenfall GmbH; http://orcid.org/0000-0001-9813-6747 (11, Pokrovsky Boul., Moscow, 109028, Russian Federation; 1, Spandauer St., Berlin, 10178; 2, Hildegard-Knef-Platz, Berlin, 10829, Germany; e-mail: anastasia.blokhina@student.hu-berlin.de).

Andreas Nastansky — PhD, Berlin School of Economics and Law (60, Alt-Friedrichsfelde, Berlin, 10315, Germany; e-mail: andreas.nastansky@hwr-berlin.de).

Информация об авторах

Семерикова Елена Вячеславовна — кандидат экономических наук, доцент, Национальный исследовательский университет «Высшая школа экономики»; PhD студент, Берлинский университет имени Гумбольдта; Scopus Author ID: 56942418500; https://orcid.org/0000-0003-2527-7527 (Российская Федерация, 109028, г. Москва, Покровский б-р, 11; e-mail: esemerikova@hse.ru).

Блохина Анастасия Олеговна — бакалавр факультета экономических наук, Национальный исследовательский университет «Высшая школа экономики»; студент магистерской программы «Экономика и наука управления»,

Берлинский университет имени Гумбольдта; работающий студент, «Совершенствование бизнеса: данные и цифровизация», Vattenfall GmbH; https://orcid.org/0000-0001-9813-6747 (Российская Федерация, 109028, г. Москва, Покровский б-р, 11; Германия, 10178, г. Берлин, ул. Шпандау, 1; 10829, г. Берлин, площадь Хильдегард Кнеф, 2; e-mail: anastasia.blokhina@student.hu-berlin.de).

Настанский Андреас — PhD, Берлинская высшая школа экономики и права (Германия, 10315, г. Берлин, ул. Альт-Фридрихсфельде, 60; e-mail: andreas.nastansky@hwr-berlin.de).

Дата поступления рукописи: 26.08.2020.
Прошла рецензирование: 26.02.2021.
Принято решение о публикации: 15.06.2023.

Received: 26 Aug 2020.
Reviewed: 26 Feb 2021.
Accepted: 15 Jun 2023.