Datenbeschreibung

RWI – Leibniz-Institut für Wirtschaftsforschung

Regional Real Estate Price Indices for Germany (RWI-GEO-REDX) - Version 11: 2008-06/2023

August 2023

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Abstract

The FDZ Ruhr at RWI provides price indices for apartments and houses (rentals and sales) in Germany starting in 2008. The price indices are based on the real estate dataset RWI-GEO-RED, which combines real estate listings from ImmoScout24. We perform three types of hedonic regressions to allow comparisons across time (annual or quarterly), across regions (labor market regions, counties, or municipalities), and in combination across time and regions. The data are publicly available and can be requested from the FDZ Ruhr website. A weakly anonymized version is also available for researchers on request.

This data report is an updated version of previous reports and refers to RWI-GEO-REDX v11, which covers data until May 2023.

1 Introduction

An important topic in the current public and political discourse in Germany is the development of housing prices. Rising rents, housing shortages in urban areas, and rural-urban migration are some of the problems being discussed. Despite its topicality, little data is available on the recent development of house prices in Germany. To fill this gap, the RWI-GEO-REDX dataset quantifies regional differences in house purchase, apartment rent and purchase prices on the level of districts (Kreise, NUTS 3 level) and municipalities (Gemeindeverband, LAU 1 level) as well as labor market areas defined by RWI (2018).

Several methods are used to derive real estate indices. First, median sales prices are the easiest to construct and are used by the U.S. Census Bureau. However, they do not adjust for the quality of the properties on the market (Ghysels et al. 2013). Case and Shiller (1989) propose a repeat-sales price index, which is a constant-quality index that uses only information on houses that have been sold at least twice during the sample period. This index requires very little data. However, these properties may not be representative of the market (Clapp and Giacotto 1998), and the index relies on the crucial assumption that quality does not change due to renovation or modernization. This second method is used by the US Federal Housing Finance Agency for the HPI index.

Third, hedonic price indices are based on hedonic price regressions, where the price is expressed as a function of the characteristics of the dwelling or house. The characteristics thus describe the quality of the property. For all three types of indices, it is important that the sale of a property can be correlated with local economic conditions, as more expensive homes tend to be put on the market during expansions. Gatzlaff and Haurin (1998) take into account the selectivity of using only sold houses. Englund et al. (1998) combine the hedonic index with the repeat sales index. Finally, there are stock market-based indices that are obtained by trading real estate investment trust shares.

While a simple study of regional average rents and prices is not sufficient to make reliable statements on housing prices, the RWI-GEO-REDX is based on hedonic price regressions. The hedonic price regressions take into account qualitative differences in housing supply, such as different amenities. Hedonic price regressions are a commonly used method for real estate pricing in Germany, e.g., in the hedonic EPX of Europace AG (2019), a commercial online distributor of real estate financing, and the real estate price index of the Verband deutscher Pfandbriefbanken e.V. (vdp) (2019), which processes transaction data from certain financial institutions. The real estate price index by bulwiengesa AG (2018) focuses on cities and larger towns, but does not include consistent information on data structure and methodology and is available for commercial use only. The AK-OGA, a cooperation of all German federal advisory committees on real estate issues, publishes housing price indices for different house types on an annual basis and at the federal and sub-district level. These price indices are partly derived by median sales observation and hedonic price regressions. In addition, the IMX Offer Index is a hedonic price index that is derived from the offers placed by the online real estate agency ImmobilienScout24 for the sale and rental of houses or apartments.

The first two indices report house price changes at the national level and do not provide further information for smaller regions. This study fills this gap by combining a comprehensive, up-to-date dataset and a hedonic price regression; it provides regional price indices relative to the German mean, capturing regional differences, the region-specific time trend as well as the national development over time. The analysis is based on a dataset of online real estate advertisements, the RWI-GEO-RED. This comprehensive data set is obtained from ImmobilienScout24. The data

is regularly updated, which makes it possible to analyze the latest developments. It is therefore possible to update the price indices on a regular basis.

We use a hedonic price regression for the price indices in order to capture various characteristics of sales and rental prices beyond the median. The repeat sales approach may not be representative for the German real estate market, as Voigtländer (2017) mentions. Here, too, it is not possible to link two sales of the same property due to data limitations.

While other published price indices are constructed using financial data, the following analysis deals with seller-listed listings. This means that only apartments and houses that are for rent or sale and listed on the listing website are available in the dataset. Consequently, the analysis is based on advertised prices and not transaction prices.

In addition, indices for home purchases are also included in the dataset, complementing the regional price information for home purchases and rentals. In addition to the municipality and district level, all three supply categories are also reported at the level of labor market regions according to the delineation of RWI (2018).

2 Data

We use the RWI-GEO-RED data (RWI 2023 a-c) of the FDZ Ruhr at the RWI to generate the price indices. They are based on real estate listings published on Germany's largest real estate listing website, ImmobilienScout24. Here, property owners and estate agents can advertise their houses and apartments for a fee. All information is provided by the owner or agent selling or renting the property. While some information is required to place an ad online, most information is provided voluntarily. More information about the property helps to present it appropriately and is likely to increase the chances of it being sold or rented.

The dataset includes information on the prices of property listings as well as various characteristics that determine the value of a property. Monthly data are used. The present dataset covers the period from January 2007 to June 2023. Since there are few observations in 2007, we restrict the data in the following to the years 2008 to May 2023. The restriction to May 2023 is to avoid a look-ahead bias in the time trend.

The RWI-GEO-RED provides information on the building at the level of the housing unit, municipality, district and federal state. Furthermore, the data includes information on the size of the house or apartment (e.g., living space, plot area, number of rooms), on its facilities (e.g., balcony, garden, bathrooms, level of facilities), on financial aspects (e.g., price and additional costs), as well as information on energy consumption. Unfortunately, some variables are characterized by many missing values, which had to be taken into account for the following analysis.

The selection of variables for the analysis is based on two considerations. First, we aim for coherence in the data set to ensure comparability between properties. Second, the set of characteristics used in the analysis must be comprehensive enough to capture the different characteristics of apartments and houses. In order to get as close as possible to the real market price of the property, we only include advertisements in their most recent month of publication, i.e., when they leave the listing website. Previously updated versions of the listed apartment or house are not included. This strategy aims to best approximate the actual sale price with the published, self-reported listing price. Further information on excluded homes from the original dataset is described in the Appendix.

We calculate price indices for districts and municipalities based on the regional definitions of 2019 (BKG 2019). In 2019, there were 401 counties in Germany, varying in area and population size. In addition, there were 4,625 municipalities. As a supplement, we included labor market regions according to the delineation in RWI (2018) as a third type of region, defining 182 areas. This delineation is advantageous for modeling real estate price indices, as it follows the idea of labor market accessibility for commuters. The labor market boundaries are drawn from existing commuting relationships. The advantage of this delineation is that these interrelationships are a stronger determinant of residence decisions and real estate market developments than pure administrative boundaries.

3 Methodology

Regional price indices should take into account the characteristics of the property as well as regional and time differences. Therefore, we first develop a hedonic price regression that takes into account the characteristics of property advertisements. The regression is comparable to common hedonic price regressions (e.g., Sirmans 2005), such as those applied for Germany in Bauer et al. (2013).

The purchase price per square meter is used as the dependent variable for purchases and the exclusive rent per square meter (Kaltmiete) is used for rentals. The endogenous variable is thus independent of the size of the apartment or house. Other characteristics that determine the rental or purchase price are included as exogenous variables in the hedonic price regression.

The purpose of the indices is to show the time evolution of housing prices for Germany, their regional differences, and the regional time evolution. Different models are needed to estimate these three types of indices. First, we use the following model to estimate price indices for the whole of Germany over time:

$$\ln(y_{igt}) = \beta X_{igt} + u_g + \delta_t + \varepsilon_{igt}, \quad (1)$$

where the dependent variable *y* is the sale or rental price per square meter of dwelling unit *i* in region *g* (county, municipality, or labor market area) in year *t*. The characteristics of the property are included in vector *X*. The characteristics in the hedonic regressions vary between rental, owner-occupied, and homeownership; a list of the characteristics used as exogenous variables is given in Table 1 in the Appendix.

This first model includes a time-independent price index u_g for region *g* (fixed effect). In addition, year fixed effects δ_t are included. The time evolution in Germany is described by the evolution of δ_t for each year t = {2008, ..., 2023}, respectively each quarter t = {2008-Q1, 2008-Q2, ..., 2023-Q2}. Since all regions and years are examined together, it is assumed that the characteristics are valued in the same way for all years and all regions. The error term ε_{igt} is assumed to have a standard normal distribution.

The second regression describes a yearly cross-sectional approach with a regional price index u_g for region *g* and a specific year t_0:

$$\ln(y_{igt_0}) = \gamma X_{igt_0} + u_{gt_0} + \varepsilon_{igt_0} \quad (2)$$

In this approach, it is assumed that the characteristics are valued in the same way throughout Germany at the respective time t_0 and in the respective region *i*. It is given annually from 2008 to 2023 and for the last available quarter of 2023, as well as for all three region types. The price index *u* indicates the price differences between the regions at time *t*. The indices derived from this regression describe the regional price discrepancy to the German average for all properties offered in this specific time. In a nutshell: What is the regional premium for a square meter of living space in a property of the same quality and features as all listed properties in the respective year?

The first approach provides insights into the overall development over time, while the second provides insights into year-specific regional differences. However, in addition to absolute price

differences, regional differences over time are also of interest for research and policy discussion. Therefore, we use a third approach to measure the respective time development of region *g* via the year-region fixed effects η:

$$\ln(y_{igt}) = \theta X_{igt} + \eta_{gt} + \varepsilon_{igt} \quad (3)$$

The specific time evolution of region g between year t_0 and t_1 can be derived by

$$\eta_{gt_1} - \eta_{gt_0} \quad (4)$$

The main assumptions in this analysis are similar to those in equation 2, namely that the characteristics are valued the same in each region and across years. In addition, the time evolution may differ between regions. This approach is used for all three types of regions on a yearly basis as the development compared to the base year 2008.

To ensure the coherence of the price indices, only price indices for regional units with more than 50 observations are shown in regressions (2) and (3) in the Public Use File (PUF) of the RWI-GEO-REDX data. The Scientific Use File (SUF) version requires at least five observations. It is up to the researcher to decide whether this lower threshold is reliable in the considered research design.

4 Descriptive Evidence

Figure 1 shows the time evolution of the German price indices derived from regression (1). House and apartment prices declined or stagnated at the beginning of the period. While apartment rents rose steadily, apartment sales began to rise in 2011 and house sales followed suit in 2014. All three types then experienced strong price increases. The ever-increasing trend for sales (both apartments and houses) was only interrupted in 2022. Rising inflation and interest rates, the war in Ukraine, and a lack of investment in the construction sector led to a shortage of housing, making it difficult for people to finance new homes. Apartment rents, on the other hand, remain on an upward trend.

To illustrate the possibilities offered by the RWI-GEO-REDX dataset, a few examples of descriptive analyses are given below. The same can be done for the indices for rental housing and apartment purchases. We limit our results here to home purchases. These have a wide coverage, even in more rural areas, while rental and apartment ownership tend to be concentrated in urban areas.

Figure 2 shows the distribution of the house purchase price indices in 2023, taken from regression (2). The distribution is skewed to the right. The majority of counties have a value between -50 and 50, but there are several urban counties that reach values above 200.

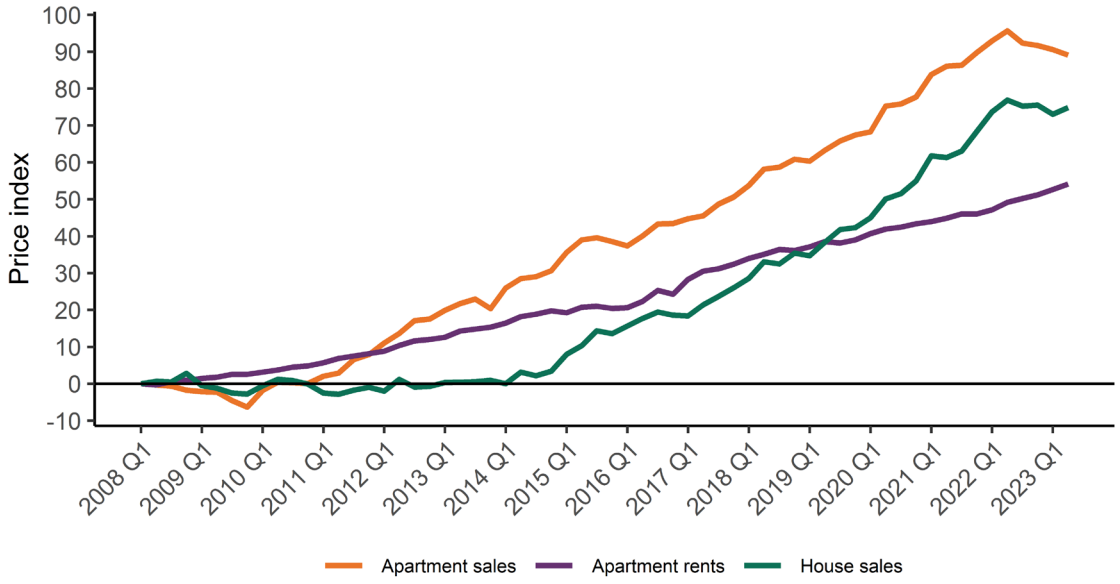
This pattern is also supported by Figure 3a, which shows the regional price index for home purchases at the county level in 2023. The areas with the highest prices are located in or around major cities, which makes sense as these locations are typically hot spots for working and living. It also reflects the tight housing market with limited housing supply in urban areas. Figure 3b shows the same price index at the municipality level. While the dataset is based on an extensive collection of housing units, the map shows that it is not possible to calculate a price index for all municipalities every time. By choosing to work with the dataset at the regional level of municipalities, the detailed analysis is carried out at the expense of regional coverage.

The rates of change in house prices between 2008 and 2023 (Figure 4b) are also highest in the regions with a high price level in 2023. In particular, urban regions, but also some local centers, show high rates of change. Selling prices in the Munich metropolitan area are an exception in terms of house price growth, as the whole region - including more rural areas - experiences large increases. In other regions, the urbanized independent cities show the highest changes.

Figure 1

Time development of the German Price Indices for House Purchases, Apartment Rentals and Apartment Purchases

Change in percentage points to base quarter 2008-Q1

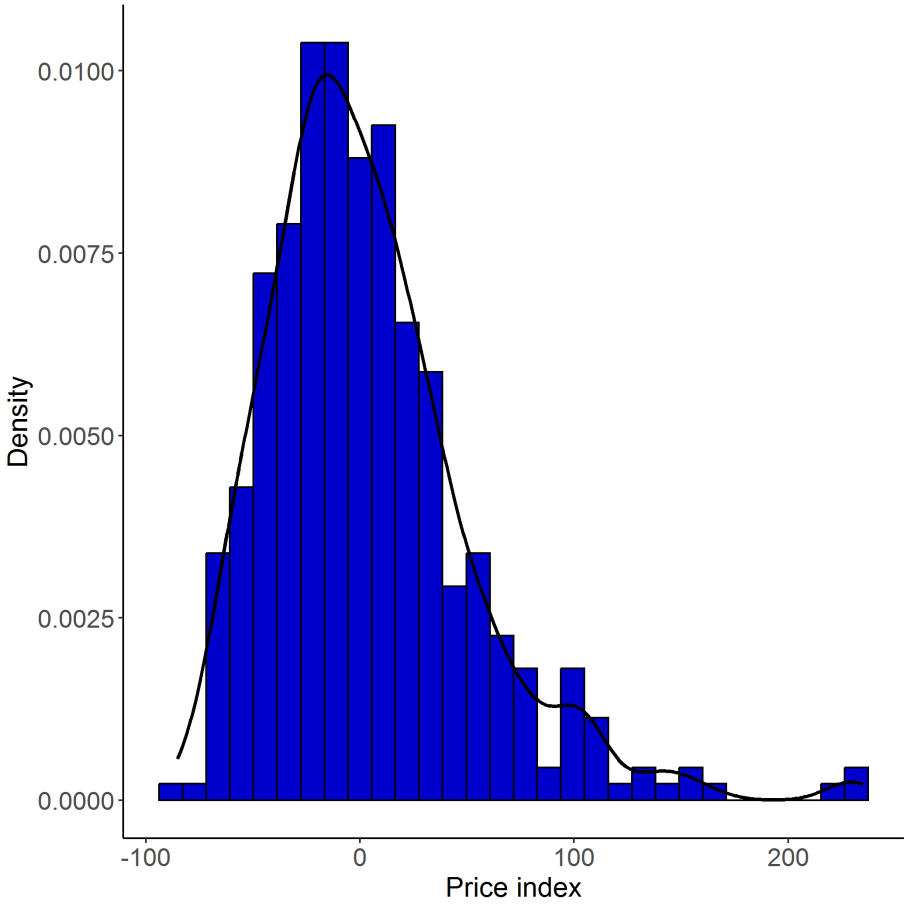


Source: RWI-GEO-REDX (RWI 2023d). Time effects gives change in δ_t in percentage points.

Figure 2

Distribution of the Regional Price Index for House Purchases in 2023

Deviation of hedonic house price from the German mean, based on regression 2 on district level in 2023

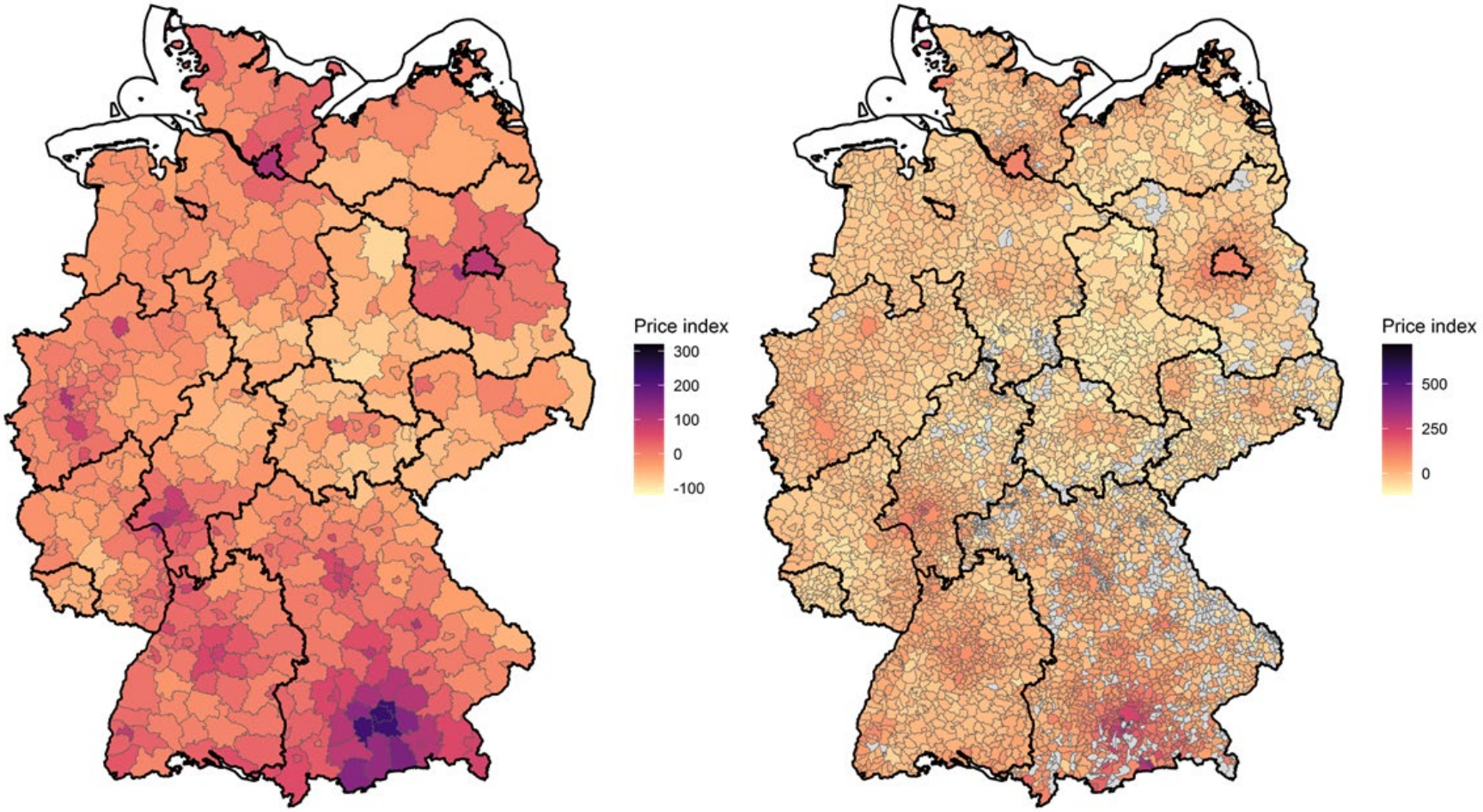


Source: RWI-GEO-REDX (RWI 2023d).

Figure 3

Regional price indices in 2023 on district level and municipality level for house purchase

Deviation in % from the German mean



(a) District level

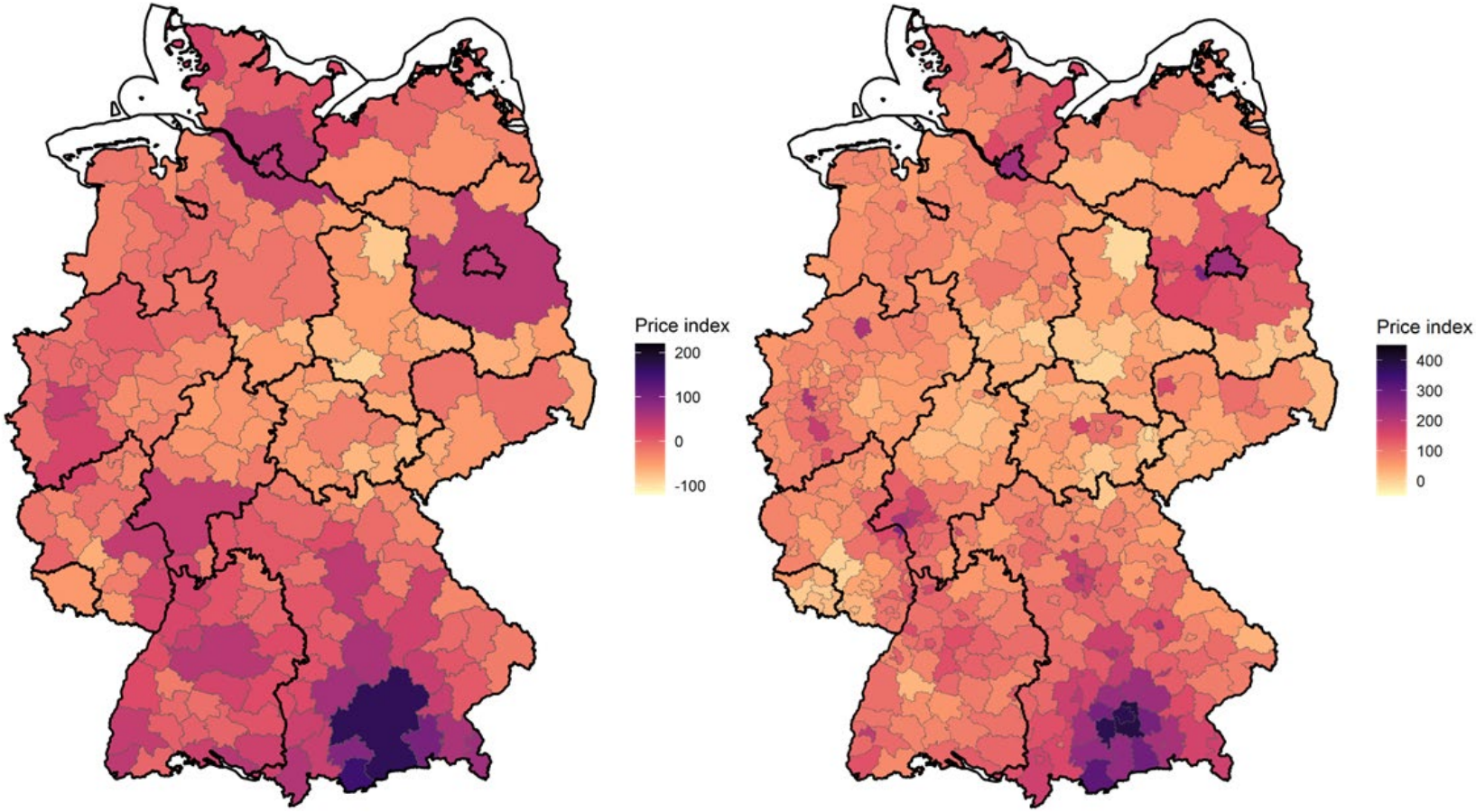
(b) Municipality level

Source: RWI-GEO-REDX (RWI 2023d).

Figure 4

Regional price indices in 2023 on labor market area level and changes of the regional price index between 2008 and 2023 on district level for house purchase

Deviation in % from the German mean



(a) Labour Market Region

(b) Change in Regional Price 2008-2023

Source: RWI-GEO-REDX (RWI 2023d).

5 Data Access

The data can be obtained as Public Use File (PUF) or Scientific Use File (SUF) from the FDZ Ruhr at RWI. The FDZ Ruhr is the research data center of the RWI - Leibniz Institute for Economic Research. In order to ensure that the indices are not driven by small sample sizes, the PUF dataset includes only those indices that are based on at least 50 observations per year and region. The indices based on less than 50 observations per year and region are also available on request as a SUF for scientific research purposes only. Since the RWI-GEO-REDX subsumes aggregated information, it does not contain any information that is restricted for data security reasons. The indices presented here are available as Excel (.xlsx) files.

Data access does not require a data use agreement, but users must register to access the data. Interested users should visit our website https://www.rwi-essen.de/en/research-advice/further/research-data-center-ruhr-fdz/data-access.

Users are requested to cite the source correctly and to inform the FDZ Ruhr about publications using the data. When using the dataset RWI-GEO-REDX, please cite the data as RWI (2023): RWI-GEO-REDX: Regional Real Estate Price Index for Germany, 2008-05/2023. Version: 1. RWI – Leibniz Institute for Economic Research. Dataset. http://doi.org/10.7807/immo:redx:v11. Further, we recommend citing this data description.

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7 Appendix

Information on data restriction in the RWI-GEO-REDX Price Indices

From the original RWI-GEO-RED-dataset, we exclude luxury apartments for the estimation of the RWI-GEO-REDX price indices. So that, rental apartment with rents exclusive utilities above 5,000 Euro per month are omitted. The living area is restricted from 15 to 400 sqm and up to 7 rooms per rental apartment. These restrictions still cover a very large range of rent prices and living space, but it discards the extremely small or very exclusive apartments from the portfolio. It is likely that the luxury apartment market is not fully integrated into the average rental market, which makes comparisons over regions across these markets difficult. We further set a bottom limit of 15 sqm living space to include only self-efficient apartments and to exclude typing errors.

House purchases are restricted in a similar fashion; the living area ranges from 50 to 600 sqm and the house price varies up to 5 Million Euro. The number of rooms is restricted to 15. The aim, here, is to ensure self-efficiency but rule out possibly faulted on the one hand and extremely luxurious houses on the other hand, too. The focus of the analysis of house purchases lies on single-family homes, thus, apartment buildings are excluded. Furthermore, holiday homes are excluded if declared explicitly by the seller as well as houses with more than five floors. The constraints are imposed on the offers for apartment purchase likewise. Offered apartments with a price higher than 2 Million Euro, more than eight rooms and an adverted living area below the 1^{st} percentile and above the 99^{th} percentile are not accounted for in the following estimation.

When placing the advertisement online, the user decides which information to publish on the advertised real estate. Working with these self-declared information leads to many missing values in many variables that need to be handled with care. For the binary variables a missing is accounted for as a zero, so the offer does not meet the feature in question. This seems reasonable to the extent that the owner or agent tends to publish benefits of the real estate to attract searchers with certain preferences. Furthermore, in some years many characteristics are collected using checkboxes which means that there is no difference between “no” and “no answer”. Examples are especially positive characteristics of the property, such as a balcony or guest toilet. In the analysis, we deal with missing values as a separate category for categorical variables. In the considered metric variable, number of rooms, missing values are given as "zero rooms".

Table 1
Explanatory Variables in Analysis of House, Apartment and Rent Prices

Variable	Description	house-pur-chase	apart-ment-rent	apart-ment purchase	Restrictions
		Metric variable			
number of rooms	number of rooms in apartment	x	x	x	restricted to 15 (houses), 7 rooms (apartment rent) and 8 rooms (apartment pur-chase), repectively
		Categorical variables			
number of total floors	1 := missing 2 := 1-3 floors 3 := 4-5 floors 4 := 6-10 floors 5 := more than 10 floors			x	
floor number of object	0 := missing 1 := ground floor (UG) 2 := first floor (EG) 3 := 2nd to 3rd floor 4 := 4th to 5th floor 5 := 6th to 10th floor 6 := above 10th floor			x	
equipment	0 := missing 1 := Simple 2 := Normal, 3 := Sophisticated, 4 := Deluxe	x	x	x	
		Binary variables			
year of construc-tion	1 := missing 2 := before 1900 3 := 1900-1945 4 := 1946-1959 5 := 1960-1969 6 := 1970-1979 7 := 1980-1989 8 := 1990-1999 9 := 2000-2009 10 := after 2009	x	x	x	
plot area	[in sqm] 0 := missing 1 := (0-200] 2 := (200-400],	x			restricted to 2 500 sqm due to possible agricul-tural use

	3 := (400-600] 4 := (600-800] 5 := (800-1,200] 6 := (1,200-2,500]			
first occupancy	1 if new owner or renter move in as first occupancy	x	x	x
detached house	1 if house is detached	x		
semi-detached house	1 if house is semi-detached	x		
terraced house	1 if house is a terrace house	x		
exclusive house	1 if property is declared as a mansion or castle	x		
other house type	1 if house is categorized differently	x		
balcony	1 if property has a balcony		x	x
garden	1 if apartment has access to a private garden		x	x
guest toilet	1 if object includes a guest toilet	x	x	x
fitted kitchen	1 if object comes with a fitted kitchen		x	x
granny flat	1 if property contains a separate “granny flat” or secondary suite	x		
cellar	1 if cellar room is available		x	x
assisted living	1 if object is declared as assisted living			x
common charge	1 if common charge is declared in offer			x
lift	1 if property contains a passenger lift			x

Note: In the report on the property market of the federal state of North Rhine-Westphalia (Der Obere Gutachterausschuss für Grundstückswerte im Land Nordrhein-Westfalen 2017) the referees do not count sales of undeveloped rural plot area under 2,500 sqm in their statistics of farmland sales. This is also the case in the report on the property market for the scarcely populated state of Saxony-Anhalt (Gutachterausschuss für Grundstückswerte in Sachsen-Anhalt 2017). This gives a notion that plot areas above the margin of 2,500 sqm can be of interest for agricultural and not only residential purpose. To focus on house sales for living purposes without further commercial use, only plot areas smaller than 2,500 sqm are included in the following. Source: RWI.

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