Documentation for *German Real Estate Index* (GREIX)

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Contents

1 Introduction

We undertook the task of creating over 100 new housing price indices by gathering valuable information on real estate transactions from a diverse range of 18 cities. While the variables and information we collected from each city were largely consistent, there were notable variations across the cities. In the interest of transparency and upholding rigorous scientific practices, we have meticulously documented the specifics regarding the micro-level data and index methodology for each city in this document.

Since 1960, notaries in Germany have been required by the law stated in section 195 'Purchasing Price Data' of the Federal Bulding Code to report purchase details for every real estate transaction to the "Gutachterausschuss" (GAA), which is comprised of real estate experts organized on a regional basis. Initially, every municipality had their own GAA, but in recent years the numbers are declining as municipalities are merging their GAAs.[1] The GAAs store transaction price information along with house characteristics and compile annual statistics on transaction volumes and price trends, which are used to calculate benchmark land prices ("Bodenrichtwerte") and form the basis for the assessment of real estate values for bank loans and insurance contracts.

The archives of the GAAs contain micro transaction data covering the universe of real estate transactions in (West-) Germany over the past 60 years. Most of the data is only available in digital format since the 1990s, with older transaction registries kept in analog format. In a major co-operation between the MacroFinance Lab at the University of Bonn, the ECONtribute Excellence Cluster and the GAAs, we digitized about one million analog records with the help of professional optical-character-recognition (OCR). The type of documents were varying not only across GAAs but also within a GAA depending on the time-span and market segment. Information on the documents were extracted by localisation of keywords. Eventually, the newly compiled data sets were merged with the existing digital data. The result is the first long-term micro-level data set on residential property transactions in Germany that can be used for research purposes.

In total, we digitized around one million transactions from ten different cities. In

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[1] In 2018, there were approximately 900 GAAs in existence. However, by 2021, this number had experienced a substantial decline, reducing to around 250. For more details on the regional distribution see Figure **??** in Appendix **??**.

some cities, the archives no longer exist, were already digitized or, as is the case with former East German cities, there were simply no real estate market transactions before the 1990s. In those cases, we built on the already digitized data directly from the GAA. For these cities, the data typically starts in the 1990s.

An overview of the cities and time periods for which we have collected data can be found in Table 19, in which the cities are ordered by population size in 2020. Cities are grouped according to a common classification for German cities. A-cities include the largest seven cities in Germany which are of an international significance: Berlin, Hamburg, Munich, Cologne, Frankfurt, Stuttgart and Dusseldorf. The group of B-cities consists of cities which have an important national but particular large regional significance. The cities of groups C and D usually only have a strong regional relevance. Table 19 further illustrates the variations in data coverage within a city for the three distinct market segments: apartments, single-family houses, and multi-family houses. These discrepancies may stem from various factors, including the absence of recorded transactions for certain market segments, insufficient information to accurately identify the segment, or the unavailability of historical records.

Table 1: *City and data coverage*

City	Time coverage			Format	Category
	Apartments	**Single-Family**	**Multi-Family**	**Format**	**Category**
Berlin	1984 - 2023	1965 - 2023	1965 - 2023	digital	A
Hamburg	1964 - 2023	1964 - 2023	1964 - 2023	analog & digital	A
München	1971 - 2023	-	-	analog & digital	A
Köln	1981 - 2023	1966 - 2023	1989 - 2023	analog & digital	A
Frankfurt	1983 - 2023	1982 - 2023	1982 - 2023	analog & digital	A
Stuttgart	1984 - 2023	1984 - 2023	1984 - 2023	analog & digital	A
Düsseldorf	1980 - 2023	1980 - 2023	1980 - 2023	analog & digital	A
Leipzig	2014 - 2022	2014 - 2022	2014 - 2022	digital	B
Dortmund	1971 - 2023	1975 - 2023	1975 - 2023	analog & digital	B
Dresden	1991 - 2023	1991 - 2023	1991 - 2023	digital	B
Duisburg	1972 - 2023	1978 - 2023	1978 - 2023	analog & digital	B
Bonn	1993 - 2023	1994 - 2023	1994 - 2023	digital	B
Münster	1986 - 2022	1986 - 2022	1986 - 2022	digital	B
Wiesbaden	1992 - 2022	1975 - 2022	1975 - 2022	analog & digital	B
Chemnitz	1992 - 2023	1994 - 2023	1993 - 2023	digital	C-D
Lübeck	1993 - 2023	1993 - 2023	1993 - 2023	analog & digital	C-D
Erfurt	1991 - 2023	1991 - 2023	1991 - 2023	digital	C-D
Potsdam	1995 - 2022	1994 - 2022	1994 - 2022	digital	C-D

Note: This table shows the list of cities in our sample alongside their data coverage and the original format of the underlying transaction information, ordered by population size in 2020.

2   Method used to construct the indices

The ideal housing price index would capture the price appreciation of a representative, unchanged property that is sold every period. Unfortunately, houses are sold infrequently and are very heterogeneous. This means that the sample of transacted houses changes substantially from period to period. In order to approximate the ideal price index described above, we need to control for the heterogeneity and infrequent sales of properties. The current literature has identified two main methods to achieve this goal (Balk et al., 2014). The first is the so-called repeat-sales method. The idea

underlying this method is to use the price evolution of the same property over time to build a price index. This method is naturally restricted to properties that are sold more than once and has thus proved to be very popular in liquid real estate markets, such as in the U.S., but it is mostly infeasible in very illiquid markets, such as in Germany. The second method employs so-called hedonic regressions to construct a housing price index. The key idea is to control the transaction price for a set of property and transaction characteristics and estimate a quality-adjusted price index over time.

Rolling window time-dummy hedonic regression.   Due to the low turnover of properties in Germany and the high level of property details available in the dataset, we decided to use hedonic regression methods to construct the city-level indices. These indices are referred to as GREIXX (German Real Estate Indices).[2] In particular, we employed time-dummy rolling window hedonic regressions based on a log-linear specification. In our baseline specification, we regress the log sales price of property i on a set of property characteristics (x_i) and a time dummy (D_τ) using a log-linear specification:

$$ln(P_t^i) = \beta^0 + \sum_{\tau=0}^{T} \gamma_\tau D_\tau^i + \sum_{k=1}^{K} (\beta^k * x^{k,i}) + \epsilon_t, \tag{1}$$

where ϵ_t is the error term.

The time dummy parameter allows us to assess the influence of "time" on the price, while controlling for property characteristics. Our set of controls, denoted by x_i, exhibit variation across market segments, cities, and subperiods.[3] However, there exist certain attributes for every market segment that are indispensable for us constructing indices. Moreover, these variables are deemed the most crucial, and inclusion of additional characteristics thus does not impede the comparability between cities. In the case of apartments, these essential attributes comprise the living area, construction year, and neighborhood. For single-family houses, we consistently incorporate information on

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[2]For a subset of the cities, we have also constructed repeat-sales indices. However, it is worth noting that these indices tend to be upwardly biased when compared with the hedonic indices. This suggests that properties that are transacted more than once are not representative of the full sample of transacted properties and tend to appreciate more than the rest.

[3]For a detailed description of the variables used and the regression models employed for each city, please refer to the documentation available at GREIX.de.

lot size, living area, construction year, and type (e.g. townhouse, detached house, etc.). For multi-family houses, we require the following characteristics: lot size, living area, neighborhood, and construction year.

Additionally, we always account for the non-linear effect of an extra square meter on the price by including the squared living area and squared lot size. The construction year is treated as a categorical variable, and the categories are delineated based on time-spans, due to its non-linear impact on the price. For instance, buildings constructed before World War I are accorded a premium, whereas those built shortly after World War II receive a discount, and newly constructed real estates once again receive a premium. Hence, by always using the construction year we are able to implicitly control for newly build real estate in all market segments. The time-dummy rolling window approach has a distinct advantage in that it enables the continuous updating of coefficients (β^k) over time. This means that the method can account for changes in the impact of property characteristics on the price, such as how an extra square meter of living area affected prices differently in the 1960s compared to the present day.

The description of all variables mentioned in this documentation can be found in table 19. There, in addition to a definition, it is also explained what kind of variable it is.

Data enrichment and missing data. It is important to note that the data obtained from the GAAs may not always encompass all the relevant characteristics required to explain the price of a property. This may be due to the fact that in analog or older digital data, some attributes were simply not collected, or in recent years, the GAAs are unable to gather certain variables. However, despite these limitations, we have the benefit of an exceptionally long period of micro-level transaction data, which allows us to observe multiple transactions of a specific property in many cases, even in a relatively subdued real estate market like Germany. Through the use of precise location information provided by the GAAs, such as the address or a property/apartment ID, we are able to substitute missing data with existing information, provided that the construction year remains constant between transactions.

Some transactions may still have missing variables, which requires us to consider how to handle this missing data. While one option is to simply delete transactions that have missing information in at least one of the essential attributes we require, we avoid this approach because it can introduce selection bias. The missing data is likely not

random, so deleting those cases could lead to inaccurate results. Another option is to impute the missing variables, such as using the lot size to estimate the living area. While we did consider this approach, we found that including missing-dummies in the hedonic regressions is superior, not only when comparing the methods applied on datasets with complete information, but also for the flexible application to categorical variables like year of construction or building type. Thus, proceeded with the missing-dummy method.

It's worth noting that there is no available data for Munich in 1991 and 1992. To estimate the evolution of the price index for these years, we used interpolation. We calculated the average price increase per square meter for various types of apartments, depending on factors such as their size, age, and location. We then computed a weighted average of these increases across different groups to determine the city-wide average increase. We also repeated this process for each neighborhood.

Data cleaning. The data acquired from the GAAs is subject to a rigorous cleaning process before being utilized in our hedonic regressions. We exclusively use the adjusted purchase price of genuine transactions, discarding cases marked as offers, appraisals, or those that never occurred. Transactions that are not at arm's length (i.e. transactions where there is reason to believe that the price does not correspond to a market price) are also removed from the data set, either flagged by the GAAs or identified by us, including those between relatives, involving real estate subject to specific rights that affect the price, co-ownership or heritable building rights. Additionally, we exclude real estate that was sold but only constructed three or more years later. Multi-family houses with more than 20% commercial use are not considered, and the data is windsorized by removing outliers individually for each year. We discard data that falls above the 99th percentile or below the 1st percentile of purchase price, lot size, and living area. Furthermore, we eliminate duplicates via the property/apartment ID from the dataset, retaining only one observation for transactions with the same price and characteristics within a small time window (e.g. the second entry usually includes some kind of addendum). Finally, we remove all transactions of the same property within a small time window that differ in price.

2.1 Variables

Table 2: *Description of the variables used for the hedonic regressions (1/2)*

	Variable Name	Variable Definition	Details
1	AnzahlGaragen	Number of garages belonging to the property	Continuous and categorical variable
2	Aufzug	Whether or not there is a lift in the property	Dummy variable
3	AnzahlStockwerke	Number of floors in the property	Categorical variable - applies to apartments & multi-family houses
3	BalkonTerrasse	Whether or not there is a terrace in the property	Dummy variable
4	BaujahrKategorie	Year of construction of the property	Categorical variable
5	Bauweise	Type of construction of the property	Categorical variable
6	Badezimmeranzahl	Number of bathrooms	Continuous and categorical variable
7	Denkmalschutz	Whether the object is a listed monument	Dummy variable
8	Einbauküche	Whether the property has a built-in kitchen	Dummy variable
9	ETWtyp	Type of apartment	Categorical variable
10	Garage	Type of garage belonging to the property	Categorical variable
11	GästeWC	Number of guest toilets in the property	Continuous and categorical variable
12	Gebietsunterteilung	Specific division of the city	Categorical variable
13	Gebäudestandard	Quality of the property building	Categorical variable
14	Gebäudestellung	Positioning of the property	Categorical variable (e.g. detached)
15	Gebtyp	Type of building	Categorical variable
16	GemarkungKAT	Name of the district (Gemarkung) where property is located	Categorical variable
17	Geschoss	Number of floor where property is located	Categorical variable - applies to apartments

	Variable Name	Variable Definition	Details
18	Geschossanzahl	Number of floors in the object	Categorical variables
19	Geschossfläche	Area of the floors	Continuous variable – applies to multi-family housing
20	Grundstücksfläche	Total lot area of the property in m^2	Continuous variable – applies to single- and multi-family housing
21	Lagequalität	Quality of the neighborhood where property is located	Categorical variable
22	Mietstatus	Whether the property is rented out or not	Dummy variable – applies to apartments
23	Modernisierungsgrad	Degree of modernization of structure of the property	Categorical variable
25	Objektförderung	Whether the property is social housing or not	Categorical variable
26	optischerZustandKategorie	Quality of the structure of the property	Categorical variable
27	Ortsteil	District (Ortsteil) where the property is located	Categorical variable
28	Raumanzahl	Total number of rooms in the property	Continuous and categorical variable
29	Restnutzungsdauer	Remaining useful life of the property	Continuous variable – applies to single- and multi-family housing
30	Stadtbezirk	District (Bezirk) where the property is located	Categorical variable
31	Toilettenanzahl	Number of bathrooms in the property	Continuous variable
32	Verkaufsumstand	Whether it was the first sale of the property or not	Categorical variable
33	Vertragsart	Type of contract	Categorical variable
34	Wasserlage	Whether the property is close to a water area or not	Dummy variable
35	WNF	Living area of the property in m^2	Continuous variable
36	WohnungenAnzahl	Number of apartments in the building	Categorical variable – applies to multi-family housing

3 Berlin

3.1 Digital Data

For the city of Berlin we have obtained data from the dataset covering the period 1965-present. The data for apartments cover the period 1984-present, while the single-family housing data cover the period 1965-present and the multi-family housing data cover the period 1965-present. For the analysis of apartments, we created annual indices for the period 1984-present and quarterly indices for the period 1984-present. For single-family housing, annual indices were compiled for the period 1965-present and quarterly indices for the period 1965-present. Similarly, for multi-family housing, annual indices were developed for the period 1965-present, supplemented by quarterly indices for the period 1965-present. Detailed information on the hedonic regression used for each market segment can be found below. In addition, we have created apartment indices at the neighbourhood level for various neighbourhoods in the period from 1984-present at the earliest. Some neighbourhoods of East Berlin were added at a later date. These include Berlin Mitte and Prenzlauer Berg in the period 1997-present, Friedrichshain in the period 1995-present and Berlin Ost in the period 1994-present. The following section contains comprehensive information on the composition of these different districts.

3.2 Hedonic price indices - city

3.2.1 Single-family housing

1965-2022

$$
\begin{aligned}
ln(P_{i,t}) = \beta^0 &+ \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
&+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0} \\
&+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0} \\
&+ \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \\
&+ \beta^5 * Ortsteil_i \# I_{WNF \neq 0} \\
&+ \beta^6 * Baujahr\ Kategorie_i + \beta^7 * Gebtyp_i \\
&+ \beta^8 * Zustand_i^t + \beta^9 * Lagequalität_i + \epsilon_{i,t}
\end{aligned}
\tag{2}
$$

3.2.2 Multi-family housing

1965-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0}$$

$$+ \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \tag{3}$$

$$+ \beta^5 * Geschossfläche_i \# I_{WNF \neq 0} + \beta^6 * Geschossfläche_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^7 * Stadtbezirk_i \# I_{WNF \neq 0}$$

$$+ \beta^8 * Baujahr\ Kategorie_i + \beta^9 * Gebtyp_i$$

$$+ \beta^{10} * Zustand_i^t + \beta^{11} * Lagequalität_i + \beta^{12} * Gebäudestellung_i + \epsilon_{i,t}$$

3.2.3 Apartments

1984-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^3 * Raumanzahl_i \# I_{WNF \neq 0}$$

$$+ \beta^4 * Mietstatus_i + \beta^5 * Ortsteil_i \# I_{WNF \neq 0} \tag{4}$$

$$+ \beta^6 * Baujahr\ Kategorie_i + \beta^7 * ETWtyp_i +$$

$$+ \beta^8 * Geschoss_i + \beta^9 * Geschoss\ anzahl_i + \beta^{10} * Lagequalität_i$$

$$+ \beta^{11} * Objektförderung_i + \epsilon_{i,t}$$

3.3 Hedonic price indices - city districts

We have created hedonic house price indices for each of the 13 new city districts, using the same model as for the city-level housing index.

Figure 1: *Map of the new division of the city*
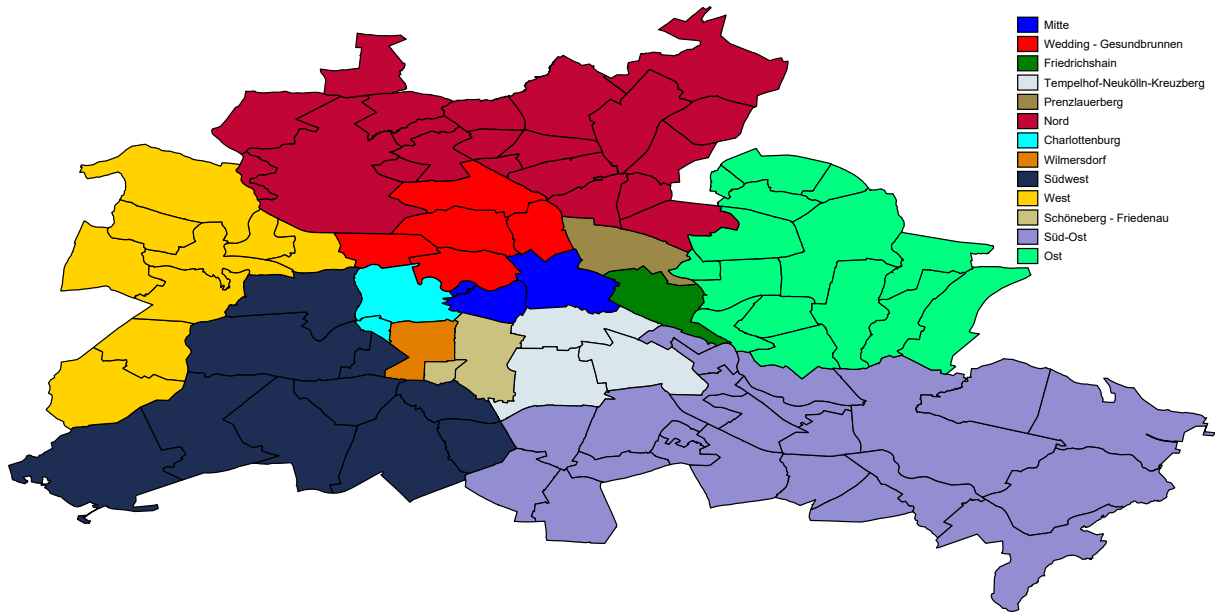
Note: This map shows the division of the city that we propose, via the division of the city by city districts.

Table 4: *Definition of the new division of the city*

	New districts	District number (*Ortsteilnummer*)
1	Mitte	101 Mitte, 103 Hansaviertel, 104 Tiergarten
2	Wedding - Gesundbrunnen	102 Moabit, 105 Wedding, 106 Gesundbrunnen, 406 Charlottenburg-Nord, 1201 Reinickendorf
3	Friedrichshain	201 Friedrichshain
4	Tempelhof - Neukölln - Kreuzberg	202 Kreuzberg, 703 Tempelhof, 801 Neukölln
5	Prenzlauerberg	301 Prenzlauerberg
6	Nord	302 Weißensee, 303 Blankenburg, 304 Heinersdorf, 305 Karow, 306 Stadtrandsiedlung Malrchow, 307 Pankow, 308 Blankenfelde, 309 Buch, 310 Französisch Buchholz, 311 Niederschönhausen, 312 Rosenthal, 313 Wilhemsruh, 1202 Tegel, 1203 Konradshöhe, 1204 Heiligensee, 1205 Frohnau, 1206 Hermsdorf, 1207 Waidmannslust, 1208 Lübars, 1209 Wittenau, 1210 Märkisches Viertel, 1211 Borsigwalde
7	Charlottenburg	401 Charlottenburg, 407 Halensee
8	Wilmersdorf	402 Wilmersdorf
9	Südwest	405 Westend, 403 Schmargendorf, 404 Grunewald, 601 Steglitz, 602 Lichterfelde, 603 Lankwitz, 604 Zehlendorf, 605 Dahlem, 606 Nikolassee, 607 Wannsee, 608 Schlachtensee
10	West	501 Spandau, 502 Haselhorst, 503 Siemensstadt, 504 Staaken, 505 Gatow, 506 Kladow, 507 Hakenfelde, 508 Falkenhagener Feld, 509 Wilhemstadt
11	Schöneberg - Friedenau	701 Schöneberg, 702 Friedenau
12	Süd-Ost	901 Alt-Treptow, 902 Plänterwald, 905 Niederschöneweide, 906 Altglienicke, 907 Adlershof, 908 Bohnsdorf, 909 Oberschöneweide, 910 Köpenick, 911 Friedrichshagen, 912 Rahnsdorf, 913 Grünau, 914 Müggelheim, 915 Schmöckwitz, 704 Mariendorf, 705 Marienfelde, 706 Lichtenrade, 802 Britz, 803 Buckow, 804 Rudow, 805 Gropiusstadt, 903 Baumschulenweg, 904 Johannistal
13	Ost	1001 Marzahn, 1002 Biesdorf, 1003 Kaulsdorf, 1004 Mahlsdorf, 1005 Hellersdorf, 1101 Friedrichsfelde, 1102 Karlshorst, 1103 Lichtenberg, 1104 Falkenberg, 1106 Malchow, 1107 Wartenberg, 1109 Neu-Hohenschönhausen, 1110 Alt-Hohenschönhausen, 1111 Fennpfuhl, 1112 Rummelsberg

Note: This table lists the city districts that are part of the various new city districts.

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4 Bonn

4.1 Digital Data

For the city of Bonn we have obtained data from the dataset covering the period 1993-present. The data for apartments cover the period 1993-present, while the single-family housing data cover the period 1994-present and the multi-family housing data cover the period 1994-present. For the analysis of apartments, we created annual indices for the period 1993-present and quarterly indices for the period 1993-present. For single-family housing, annual indices were compiled for the period 1994-present and quarterly indices for the period 1994-present. Similarly, annual indices for the period 1994-present were developed for multi-family housing. Detailed information on the hedonic regression used for each market segment can be found below. In addition, we have produced apartment indices at the neighbourhood level for various neighbourhoods over the period 1995-present. The following section provides comprehensive information of the composition of these different neighbourhoods.

4.2 Hedonic price indices - city

4.2.1 Single-family housing

1994-2022

$$
\begin{aligned}
ln(P_{i,t}) = \beta^0 &+ \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
&+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0} \\
&+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0} \\
&+ \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \\
&+ \beta^5 * Gemarkung\ KAT_i \# I_{WNF \neq 0} \\
&+ \beta^6 * Baujahr\ Kategorie_i + \beta^7 * Gebtyp_i \\
&+ \beta^8 * Lagequalität \# Bezirk_i + \beta^8 * Garage_i + \epsilon_{i,t}
\end{aligned}
\tag{5}
$$

4.2.2 Multi-family housing

1994-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \#I_{WNF \neq 0} + \beta^2 * WNF_i^2 \#I_{WNF \neq 0}$$

$$+ \beta^3 * Grundstücksfläche_i \#I_{WNF \neq 0}$$

$$+ \beta^4 * Grundstücksfläche_i^2 \#I_{WNF \neq 0} \tag{6}$$

$$+ \beta^5 * Stadtbezirk_i \#I_{WNF \neq 0}$$

$$+ \beta^6 * Baujahr\ Kategorie_i + \beta^7 * Lagequalität_i + \epsilon_{i,t}$$

4.2.3 Apartments

1992-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \#I_{WNF \neq 0} + \beta^2 * WNF_i^2 \#I_{WNF \neq 0}$$

$$+ \beta^3 * Gemarkung\ KAT_i \#I_{WNF \neq 0} \tag{7}$$

$$+ \beta^4 * Baujahr\ Kategorie_i$$

$$+ \beta^5 * Wohnungen\ Anzahl_i + \beta^6 * Lagequalität_i \#Bezirk$$

$$+ \epsilon_{i,t}$$

4.3 Hedonic price indices - city districts

We have created hedonic house price indices for each of the 5 new city districts, using the same model as for the city-level housing index.

Figure 2: *Map of the new division of the city*
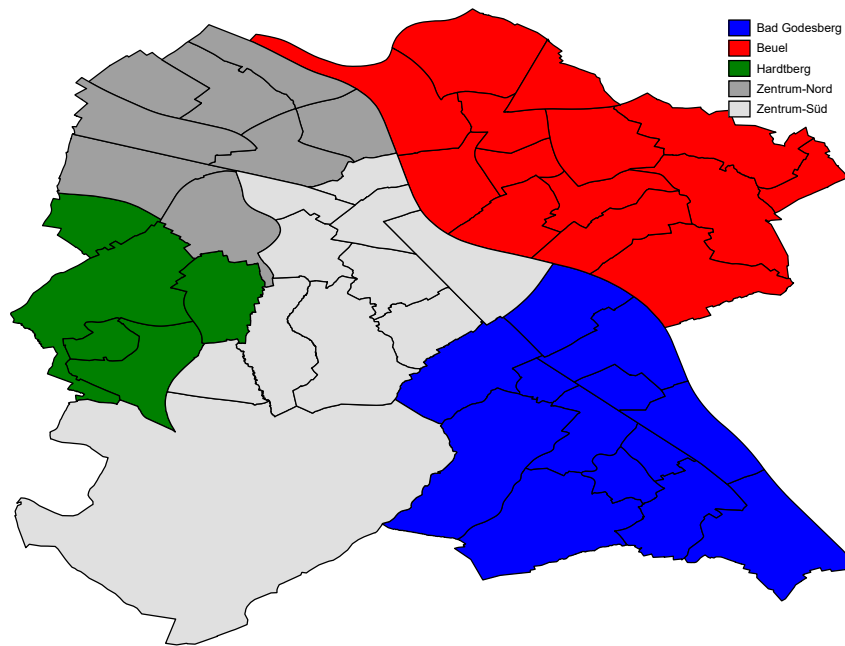
Note: This map shows the division of the city that we propose, via the division of the city by city districts.

Table 5: *Definition of the new division of the city*

	New districts	District number (*Ortsteilnummer*)
1	Bad Godesberg	Friesdorf, Hochkreuz, Plittersdorf, Godesberg-Nord, Schweinheim, Alt-Godesberg, Godesberg-Villenviertel, Rüngsdorf, Pennenfeld, Muffendorf, Heiderhof, Lannesdorf, Mehlem
2	Beuel	Geislar, Schwarzrheindorf, Beuel-Mitte, Villich, Beuel-Ost, Limperich, Villich-Mühldorf, Pützchen, Holzlar, Kündinghoven, Ramersdorf, Holtorf, Hoholz, Oberkassel
3	Hardtberg	Duisdorf, Lengsdorf, Hardthöhe, Brüser Berg
4	Zentrum-Nord	Auerberg, Graurheindorf, Tannenbusch, Lessenich/ Meßdorf, Dransdorf, Buschdorf, Nordstadt, Endenich, Bonn-Castell
5	Zentrum-Süd	Bonn-Zentrum, Südstadt, Poppelsdorf, Weststadt, Kessenich, Gronau, Dottendorf, Venusberg, Ippendorf, Ückesdorf, Röttgen

Note: This table lists the city districts that are part of the various new city districts.

5 Dortmund

5.1 Analog data

The data from this segment contains information on single-family housing, multi-family housing as well as apartments. The data originates from the years 1963-1996. 17,000 documents were read out in total.

Dortmund bebaut doppelseitig handschriftlich. On this type of file card, information on the built-up area, the residential and commercial area as well as the usable area is given, broken down by main and auxiliary building. In addition, information is provided on the year of construction of the property, as well as on the street, house number and size. In individual cases, the size of the annex is listed separately. There is also information on the date of the contract and the corresponding legal transaction. The purchase price is listed, and in some cases an adjusted purchase price is also given. A share of the land and a net yield are listed in addition to the purchase price.

Dortmund A4 Rot Doppelseitig. This type of file card refers exclusively to the sale of apartments. The year of construction, street, house number and number of flats are given for each building. If there are several houses, the flats are sometimes also listed separately for each house. There is a flat number for each flat. For each flat sold, the flat number and location, the contract date, the purchase price, as well as cost shares for garages etc. and the cost share of the flat are noted. Furthermore, there is information on the flat size and purchase price per square meter for each flat. In addition, the type of sale as well as remarks and comments are listed, which we have recorded in a standardised manner.

Gelb A6 einseitig. This type of file card refers exclusively to the sale of apartments. The year of construction, street and house number are noted for each building. The floor, date of contract, purchase price, type of transaction as well as the living space are indicated for the individual flats. Remarks and comments are recorded by us as indicated in "Dortmund A4 Rot Doppelseitig".

5.2 Digital data

For the city of Dortmund we have obtained data from the dataset covering the period 1971-present. The data for apartments cover the period 1971-present, while the single-family housing data cover the period 1975-present and the multi-family housing data cover the period 1979-present. For the analysis of apartments, we created annual indices for the period 1971-present and quarterly indices for the period 1991-present. For single-family housing, annual indices were compiled for the period 1975-present and quarterly indices for the period 1991-present. Similarly, for multi-family housing, annual indices were developed for the period 1975-present. Detailed information on the hedonic regression used for each market segment is provided below. In addition, we have produced district-level apartment indices for various neighbourhoods over the 1991-present period. The following section provides comprehensive information of the composition of these different districts.

5.3 Hedonic price indices - city

5.3.1 Single-family housing

1991-2022

$$
\begin{aligned}
ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0} \\
+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0} \\
+ \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \\
+ \beta^5 * Gebietsunterteilung_i \# I_{WNF \neq 0} \\
+ \beta^6 * Baujahr\ Kategorie_i + \beta^7 * Gebtyp_i \\
+ \beta^8 * Lagequalität_i + \epsilon_{i,t}
\end{aligned}
\tag{8}
$$

5.3.2 Multi-family housing

1991-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0}$$

$$+ \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \tag{9}$$

$$+ \beta^5 * Gebietsunterteilung_i \# I_{WNF \neq 0}$$

$$+ \beta^6 * Baujahr\ Kategorie_i + \beta^7 * Gebtyp_i$$

$$+ \beta^8 * Lagequalität_i + \epsilon_{i,t}$$

5.3.3 Apartments

1991-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^3 * Gebietsunterteilung_i \# I_{WNF \neq 0}$$

$$+ \beta^4 * Baujahr\ Kategorie_i + \beta^5 * Lagequalität_i \tag{10}$$

$$+ \beta^6 * Verkaufsumstand_i + \beta^7 * Mietstatus_i$$

$$+ \beta^8 * Aufzug_i + \beta^9 * GaesteWC_i$$

$$+ \beta^{10} * Gebäudestandard_i + \epsilon_{i,t}$$

5.4 Hedonic price indices - city districts

We have created hedonic house price indices for each of the 5 new city districts, using the same model as for the city-level housing index.

Figure 3: *Map of the new division of the city*
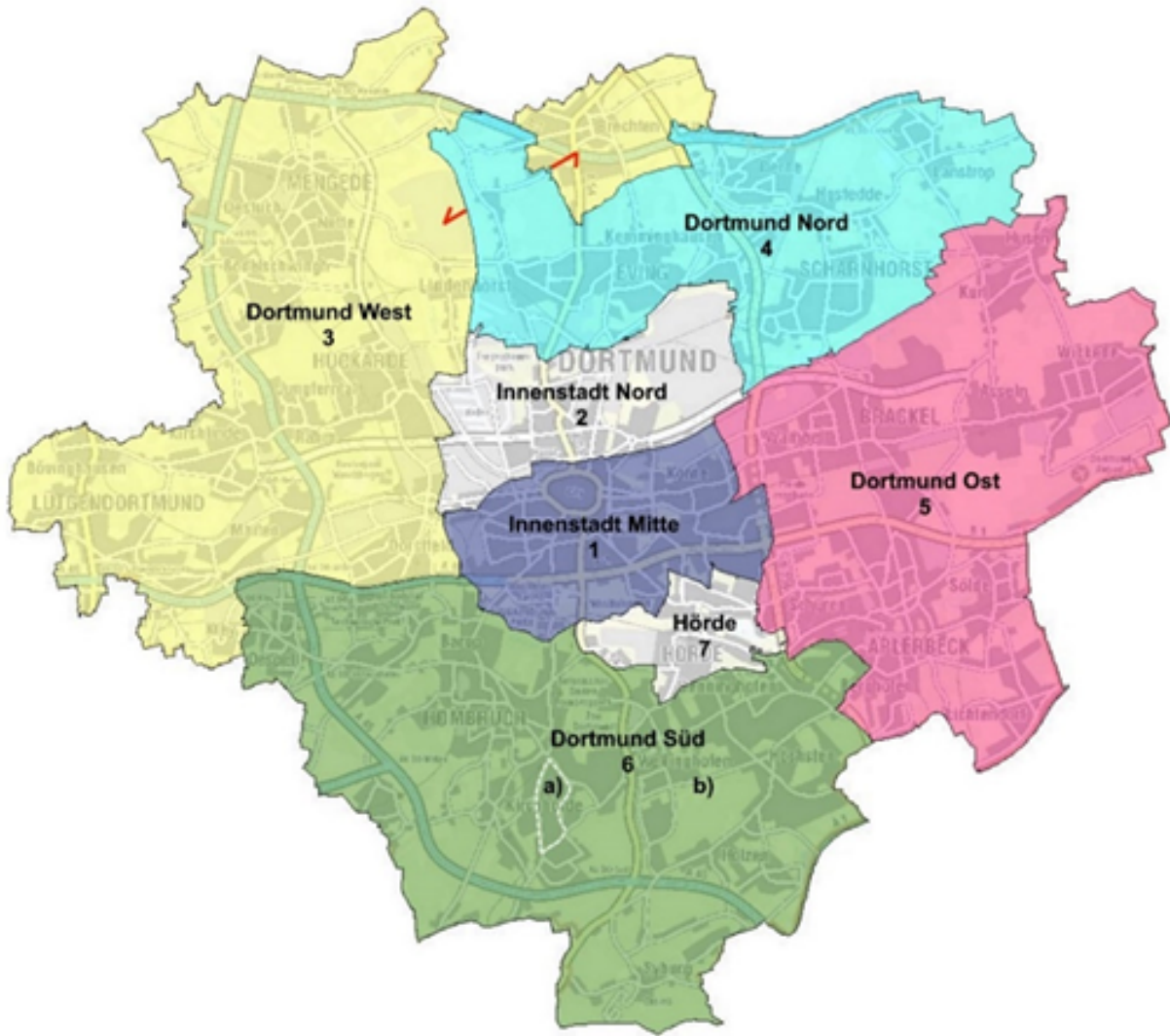
Note: This map shows the division of the city that we propose, via the division of the city by city districts.

Table 6: *Definition of the new division of the city*

	New districts	City districts
1	Innenstadt	000, 010, 020, 090, 070, 080
2	Nord-Scharnhorst	340, 240, 250, 260, 270, 220, 210, 230, 120, 140, 130, 110, 040, 050, 060
3	Ost	420, 430, 410, 440, 450, 310, 320, 330
4	Süd-Hörde	550, 540, 570. 560, 510, 530, 520, 620, 670, 680, 630, 610, 650, 690, 660, 640
5	West-Mengede	030, 750, 720, 730, 710, 760, 840, 740, 830, 820, 960, 930, 910, 940, 920, 950, 810

Note: This table lists the city districts that are part of the various new city districts.

6 Dresden

6.1 Digital data

For the city of Dresden we have obtained data from the dataset covering the period 1991-present. The data for apartments cover the period 1991-present, while the single-family housing data cover the period 1991-present and the multi-family housing data cover the period 1991-present. For the analysis of apartments, we created annual indices for the period 1991-present and quarterly indices for the period 1993-present. For single-family housing, annual indices were compiled for the period 1991-present and quarterly indices for the period 1991-present. Similarly, for multi-family housing, annual indices were developed for the period 1991-present, supplemented by quarterly indices for the period 1991-present. Detailed information on the hedonic regression used for each market segment is provided below. In addition, we have produced district-level apartment indices for various neighbourhoods over the 1993-present period. The following section provides comprehensive information of the composition of these different districts.

6.2 Hedonic price indices - city

6.2.1 Single-family housing

1992-2022

$$
\begin{aligned}
ln(P_{i,t}) = {}& \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
& + \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0} \\
& + \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0} \\
& + \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \\
& + \beta^5 * Grundstückstyp_i + \beta^6 * Bauweise_i \\
& + \beta^7 * Ortsbezirk_i \# I_{WNF \neq 0} + \beta^8 * Ortsteil_i \# Lagequalität \\
& + \beta^9 * Baujahr\ Kategorie_i + \beta^{10} * Zustand_i^t \\
& + \epsilon_{i,t}
\end{aligned} \tag{11}
$$

6.2.2 Multi-family housing

1991-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \#I_{WNF \neq 0} + \beta^2 * WNF_i^2 \#I_{WNF \neq 0}$$

$$+ \beta^3 * Grundstücksfläche_i \#I_{WNF \neq 0}$$

$$+ \beta^4 * Grundstücksfläche_i^2 \#I_{WNF \neq 0}$$

$$+ \beta^5 * Grundstückstyp_i + \beta^6 * Bauweise_i \quad (12)$$

$$+ \beta^7 * Ortsteil_i \#I_{WNF \neq 0} + \beta^8 * Ortsteil_i \#Lagequalitaet$$

$$+ \beta^9 * Baujahr\ Kategorie_i + \beta^{10} * Zustand_i^t$$

$$+ \beta^{11} * Anzahl\ Stockwerke_i + \epsilon_{i,t}$$

6.2.3 Apartments

1991-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \#I_{WNF \neq 0} + \beta^2 * WNF_i^2 \#I_{WNF \neq 0}$$

$$+ \beta^3 * Grundstückstyp_i + \beta^4 * Stockwerk_i$$

$$+ \beta^5 * Ortsteil_i \#I_{WNF \neq 0} + \beta^6 * Ortsteil_i \#Lagequalitaet \quad (13)$$

$$+ \beta^7 * Baujahr\ Kategorie_i + \beta^8 * Bauweise_i$$

$$+ \beta^9 * Verkaufsumstand_i + \beta^{10} * Zustand_i^t$$

$$+ \epsilon_{i,t}$$

6.3 Hedonic price indices - city districts

We have created hedonic house price indices for each of the 7 new city districts, using the same model as for the city-level housing index.

Table 7: *Definition of the new division of the city*

	New districts	City district
1	Altstadt	Altstadt
2	Blasewitz	Blasewitz
3	Cotta	Cotta
4	Klotzsche / Pieschen	Klotzsche, Pieschen
5	Loschwitz / Neustadt	Loschwitz, Neustadt
6	Ortschaft	Weixdorf, Langebrück, Schönborn, Schönfeld-Weißig, Cossebaude, Oberwartha, Mobschatz, Gompitz
7	Plauen / Prohlis / Leuben	Plauen, Prohlis, Leuben

Note: This table lists the city districts that are part of the various new city districts.

7 Duisburg

7.1 Analog data

The data from the segments of single-family and multi-family housing and apartments for Duisburg are available in the form of file cards and lists. Around 13,500 documents were taken into account for the entire period from 1970-1990.

The following information was recorded from the file cards from the years 1970-1990 for Duisburg:

Karteikarten. The file cards contain the district number, the street and house number and the registration number. Furthermore, the size in square metres, the date, the type of change of ownership, the share, the purchase price in DM and the adjusted purchase price are noted. For the building, one finds the type of building, the year of construction, the structural condition, the usable floor space, the percentage of the commercial share of the net yield, the net yield, the operating costs and whether it is a social housing building.

Listen. The lists contain the year of registration, the type of sale (first or resale), the serial number, the street and house number as well as the city district. In addition, one finds the flat location, the year of construction, the furnishings and the subdivision plan number. This is followed by information on the size in square meters, the purchase

price in DM, the price per square meter, whether the flat was sold with a garage and any remarks.

7.2 Digital data

For the city of Duisburg we have obtained data from the dataset covering the period 1972-present. The data for apartments cover the period 1972-present, while the single-family housing data cover the period 1978-present and the multi-family housing data cover the period 1978-present. For the analysis of apartments, we created annual indices for the period 1978-present and quarterly indices for the period 1972-present. For single-family housing, annual indices were compiled for the period 1990-present and quarterly indices for the period 1978-present. Similarly, for multi-family housing, annual indices were developed for the period 1978-present, supplemented by quarterly indices for the period 1978-present. Detailed information on the hedonic regression used for each market segment is provided below. In addition, we have produced district-level apartment indices for various neighbourhoods over the 1990-present period. The following section provides comprehensive information of the composition of these different districts.

7.3 Hedonic price indices - city

7.3.1 Single-family housing

2007-2021

$$
\begin{aligned}
ln(P_{i,t}) = \beta^0 + &\sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
&+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0} \\
&+ \beta^3 * Grundstuckfläche_i I_{WNF \neq 0} \\
&+ \beta^4 * Grundstuckfläche_i^2 I_{WNF \neq 0} \\
&+ \beta^5 * Stadtbezirk_i \# I_{WNF \neq 0} + \beta^6 * Ortsbezirk_i \# Lagequalitaet \\
&+ \beta^7 * Baujahr\ Kategorie_i + \beta^8 * Gebäudetyp_i \\
&+ \epsilon_{i,t}
\end{aligned}
\tag{14}
$$

7.3.2 Multi-family housing

2007-2021

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^3 * Grundstuckfläche_i I_{WNF \neq 0}$$

$$+ \beta^4 * Grundstuckfläche_i^2 I_{WNF \neq 0} \tag{15}$$

$$+ \beta^5 * Stadtbezirk_i \# I_{WNF \neq 0} + \beta^6 * Ortsbezirk_i \# Lagequalitaet$$

$$+ \beta^7 * Baujahr\ Kategorie_i + \beta^8 * Gebäudetyp_i$$

$$+ \epsilon_{i,t}$$

7.3.3 Apartments

2007-2021

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^3 * Stadtbezirk_i \# I_{WNF \neq 0} + \beta^4 * Ortsbezirk_i \# Lagequalitaet \tag{16}$$

$$+ \beta^5 \# Baujahr\ Kategorie_i + \beta^6 * Geschoss_i + \beta^7 * Verkaufsumstand_i$$

$$+ \beta^8 * Anz.Geschoss_i + \epsilon_{i,t}$$

7.4 Hedonic price indices - city districts

We have created hedonic house price indices for each of the 4 new city districts, using the same model as for the city-level housing index.

Table 8: *Definition of the new division of the city*

	New districts	District number (*Ortsteilnummer*)
1	Mitte	501-509
2	Rheinhausen-Homberg-Bearl	601-605, 402, 404
3	Süd	701-710
4	Walsum-Hamborn-Meiderich	101-106, 201-205, 301-307

Note: This table lists the city districts that are part of the various new city districts.

8 Duesseldorf

8.1 Analog data

The data from the multi-family and single-family housing segment are available in the form of separate contract forms per transaction, including supplementary sheets. In the entire period from 1960 onwards, a total of around 12,000 contract forms were taken into account, including more than 4,500 from 1979-1989. In isolated cases, apartments were also recorded, although only the digital data were systematically recorded. In addition, information was recorded that had been handwritten on the cards.

The following information was collected from the forms for multi-family and single-family housing from the years 1960-1989 for Düsseldorf:

62 GA KPS. The contract form contains the district, information on the evaluation, the type of property, the contract date and the street and house number of the property. In addition, one finds information on the change of ownership (purchase, exchange, inheritance, etc.), the size in square meters, the purchase price in DM, the ideal share and the adjusted purchase price. This is followed by information on the ground share. Below this is the ratio of built area to total lot area, the number of existing floors and the floor area in square meters.

62 3 169 KPS und Beiblätter. The contract form contains the GA-number and the GA-year, the object type, information on the evaluation, the contract date, the district as well as the street and the house number of the property. In addition, one finds the type of ownership, the type of legal transaction and possibly special circumstances of sale. This is followed by information on the total area in square meters as well as the purchase price in DM and the purchase price adjustment. Also to be found are rights, encumbrances, restrictions and the type of payment.

The supplementary sheet 3.1 to the contract form contains the GA-number and the GA-year, the type of property and building, the residential location, the business location and outbuildings. Also noted are price-influencing features, the floor area in square meters, the ratio of built area to total lot area, the commercial share and the building class. This is followed by the state of construction, the degree of modernisation, the year of construction, the total residential area, the sustainable residential rent, the total

commercially used area, the sustainable commercial rent and the management costs as a percentage.

The supplement 3.3 to the contract form contains the GA-number and the GA-year as well as the net yield in percent and in absolute terms.

62 5 GA KPS. The contract form contains the district, the type of building, the contract date and the street and house number of the property. In addition, there is information on the change of ownership (purchase, exchange, inheritance, etc.), the size in square meters, the purchase price in DM, the ideal share and the adjusted purchase price including the reason for the adjustment. This is followed by information on the property group, the type of property and outbuildings, the number of floors and the floor area in square meters.

8.2   Digital data

For the city of Düsseldorf we have obtained data from the dataset covering the period 1980-present. The data for apartments cover the period 1980-present, while the single-family housing data cover the period 1980-present and the multi-family housing data cover the period 1980-present. For the analysis of apartments, we created annual indices for the period 1980-present and quarterly indices for the period 1983-present. For single-family housing, annual indices were compiled for the period 1980-present and quarterly indices for the period 1984-present. Similarly, for multi-family housing, annual indices were developed for the period 1980-present, supplemented by quarterly indices for the period 1984-present. Detailed information on the hedonic regression used for each market segment is provided below. In addition, we have produced district-level apartment indices for various neighbourhoods over the 1980-present period. The following section provides comprehensive information of the composition of these different districts.

8.3 Hedonic price indices - city

8.3.1 Single-family housing

1984-2022

$$
\begin{aligned}
ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0} \\
+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0} \\
+ \beta^4 * Grundstuckfläche_i^2 \# I_{WNF \neq 0} \\
+ \beta^5 * Gemarkung_i \# I_{WNF \neq 0} \\
+ \beta^6 * Baujahr\ Kategorie_i + \beta^7 * Gebtyp_i + \\
+ \beta^9 * Lagequalität_i + \beta^{10} * Verkaufsumstand_i + \epsilon_{i,t}
\end{aligned}
\tag{17}
$$

8.3.2 Multi-family housing

1984-2022

$$
\begin{aligned}
ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0} \\
+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0} \\
+ \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \\
+ \beta^5 * Gemarkung_i \# I_{WNF \neq 0} \\
+ \beta^6 * Baujahr\ Kategorie_i + \beta^7 * Gebtyp_i \\
+ \beta^9 * Lagequalität_i + \beta^{10} * Verkaufsumstand_i + \epsilon_{i,t}
\end{aligned}
\tag{18}
$$

8.3.3 Apartments

1980-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^3 * Geschossanzahl_i + \beta^4 * Stadtteil_i \# I_{WNF \neq 0} \tag{19}$$

$$+ \beta^5 * Baujahr\ Kategorie_i + \beta^6 * Verkaufsumstand_i$$

$$+ \beta^7 * Lagequalität_i + \beta^8 * Garage_i$$

$$+ \beta^9 * Modernisierungsgrad_i^t + \epsilon_{i,t}$$

8.4 Hedonic price indices - city districts

We have created hedonic house price indices for each of the 10 new city districts, using the same model as for the city-level housing index.

Figure 4: *Map of the new division of the city*
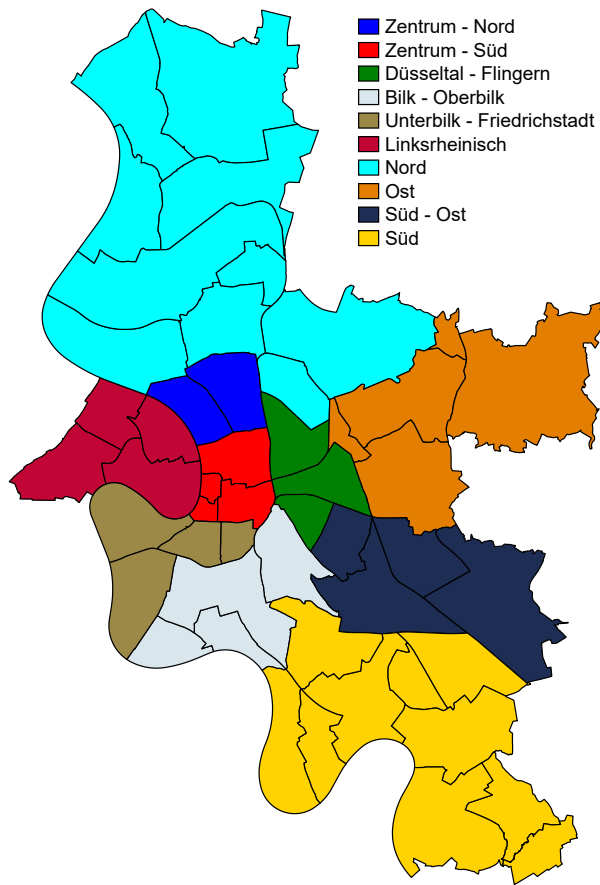
Note: This map shows the division of the city that we propose, via the division of the city by city districts.

Table 9: *Definition of the new division of the city*

	New districts	Actual districts
1	Altstadt - Stadtmitte	Altstadt, Stadtmitte, Pempelfort, Carlstadt
2	Golzheim - Derendorf	Golzheim - Derendorf
3	Düsseltal - Flingern	Düsseltal - Flingern
4	Bilk - Oberbilk	Bilk, Volmerswerth, Flehe, Oberbilk
5	Unterbilk - Hafen - Friedrichstadt	Unterbilk - Hafen - Friedrichstadt, Hamm
6	Oberkassel	Oberkassel, Niederkassel, Lörrick, Heerdt
7	Kaiserswerth - Rath	Kaiserswerth, Kalkum, Angermund, Lohausen, Unterrath,
		Lichtenbroich, Rath, Wittlaer, Mörsenbroich, Stockum
8	Ludenberg - Gerresheim	Grafenberg, Ludenberg, Hubbelrath, Gerresheim, Knittkuhl
9	Eller - Vennhausen	Unterbach, Eller, Vennhausen, Lierenfeld
10	Benrath - Himmelgeist	Hellerhof, Garath, Urdenbach, Benrath, Himmelgeist, Itter,
		Holthausen, Reisholz, Hassels, Wersten

Note: This table lists the city districts that are part of the various new city districts.

9 Erfurt

9.1 Digital data

For the city of Erfurt we have obtained data from the dataset covering the period 1993-present. The data for apartments cover the period 1993-present, while the single-family housing data cover the period 1993-present. For the analysis of apartments, we created annual indices for the period 1993-present and quarterly indices for the period 1995-present. For single-family housing, annual indices were compiled for the period 1993-present and quarterly indices for the period 1995-present. Detailed information on the hedonic regression used for each market segment is provided below. In addition, we have produced district-level apartment indices for various neighbourhoods over the 1995-present period. The following section provides comprehensive information of the composition of these different districts.

9.2 Hedonic price indices - city

9.2.1 Single-family housing

1993-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$
$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$
$$+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0}$$
$$+ \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \tag{20}$$
$$+ \beta^5 * Stadtteil_i \# I_{WNF \neq 0}$$
$$+ \beta^6 * Baujahr\ Kategorie_i + \beta^7 * Gebtyp_i$$
$$+ \beta^8 * Lagequalität_i + \beta^9 Denkmalschutz_i + \epsilon_{i,t}$$

9.2.2 Multi-family housing

1993-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$
$$+ \beta^1 * WNF_i \#I_{WNF \neq 0} + \beta^2 * WNF_i^2 \#I_{WNF \neq 0}$$
$$+ \beta^3 * Grundstücksfläche_i \#I_{WNF \neq 0}$$
$$+ \beta^4 * Grundstücksfläche_i^2 \#I_{WNF \neq 0} \tag{21}$$
$$+ \beta^5 * Stadtteil_i \#I_{WNF \neq 0}$$
$$+ \beta^6 * Baujahr\ Kategorie_i + \beta^7 * Gebtyp_i$$
$$+ \beta^8 * Lagequalität_i + \beta^9 Denkmalschutz_i + \epsilon_{i,t}$$

9.2.3 Apartments

1993-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$
$$+ \beta^1 * WNF_i \#I_{WNF \neq 0} + \beta^2 * WNF_i^2 \#I_{WNF \neq 0}$$
$$+ \beta^4 * Geschossanzahl_i + \beta^5 * Stadtteil_i \#I_{WNF \neq 0} \tag{22}$$
$$+ \beta^6 * Baujahr\ Kategorie_i + \beta^7 * Geschoss_i$$
$$+ \beta^8 * Lagequalität_i + \beta^9 * Denkmalschutz_i$$
$$+ \epsilon_{i,t}$$

9.3 Hedonic price indices - city districts

We have created hedonic house price indices for each of the 2 new city districts, using the same model as for the city-level housing index.

Table 10: *Definition of the new division of the city*

	New districts	Regions
1	Ortsteile	outside central polygon
2	Stadt	within central polygon

Note: This table lists the regions that are part of the various new city districts.

10 Frankfurt

10.1 Analog data

The data from this segment date from 1960-1981 and contain information on the sale of single-family housing and multi-famaly housing. A total of 15,000 documents were analysed.

Lochkarte. This type of card contains information on the city district as well as the street and house number of the sold property. In addition, the contract date (ddmmyyy) is indicated. For the transaction, the total purchase price and legal transaction are indicated. In addition, information is given on the area, use, construction method and class, as well as the development status, gross rent and management costs. Some transactions are marked as unsuitable.

Stammkarte. This card type contains information on the city district as well as the street and house number where the property is located. In addition, the month and year of the transaction are indicated. The purchase price and the legal transaction are indicated for the transaction. In addition, it is noted whether it is a partial ownership or a sale of shares. The area, the state of development, the construction class and the ratio of built area to total lot area are given for the property. In addition, the encumbrances with which the property is provided, as well as the development condition and use and suitability are recorded. Individual documents are marked as unsuitable.

Dokument Typ 3. This card type contains information on the city district as well as the street and house number of the property. For the date of the contract, the month and year of the conclusion of the contract are indicated. For the transaction, the total price, legal form and legal transaction are noted. Information on the area, development, building class, number of floors, front width, ratio of built area to total lot area and location are noted for the property. Some documents are marked as unsuitable.

10.2 Digital data

For the city of Frankfurt we have obtained data from the dataset covering the period 1982-present. The data for apartments cover the period 1983-present, while the

single-family housing data cover the period 1982-present and the multi-family housing data cover the period 1982-present. For the analysis of apartments, we created annual indices for the period 1983-present and quarterly indices for the period 1983-present. For single-family housing, annual indices were compiled for the period 1982-present and quarterly indices for the period 1983-present. Similarly, for multi-family housing, annual indices were developed for the period 1982-present, supplemented by quarterly indices for the period 1983-present. Detailed information on the hedonic regression used for each market segment is provided below. In addition, we have produced district-level apartment indices for various neighbourhoods over the 1983-present period. The following section provides comprehensive information of the composition of these different districts.

10.3 Hedonic price indices - city

10.3.1 Single-family housing

2006-2021

$$
\begin{aligned}
ln(P_{i,t}) = \beta^0 &+ \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
&+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0} \\
&+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0} \\
&+ \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \\
&+ \beta^5 * Grundstückstyp_i + \beta^6 * Baujahr\ Kategorie_i \\
&+ \beta^7 * Stadtbezirk_i \# I_{WNF \neq 0} + \beta^8 * Lagequalitaet \\
&+ \epsilon_{i,t}
\end{aligned}
\tag{23}
$$

10.3.2 Multi-family housing

2006-2021

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0}$$

$$+ \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^5 * Grundstückstyp_i + \beta^6 * Baujahr\ Kategorie_i \tag{24}$$

$$+ \beta^7 * Stadtbezirk_i \# I_{WNF \neq 0} + \beta^8 * Lagequalitaet$$

$$+ \epsilon_{i,t}$$

10.3.3 Apartments

2006-2021

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^3 * Raumanzahl_i \# I_{WNF \neq 0}$$

$$+ \beta^4 * Mietstatus_i + \beta^5 * Ortsteil_i \# I_{WNF \neq 0} \tag{25}$$

$$+ \beta^6 * Baujahr\ Kategorie_i + \beta^7 * ETWtyp_i +$$

$$+ \beta^8 * Geschoss_i + \beta^9 * Geschoss\ anzahl_i + \beta^{10} * Lagequalität_i$$

$$+ \epsilon_{i,t}$$

10.4 Hedonic price indices - city districts

We have created hedonic house price indices for each of the 9 new city districts, using the same model as for the city-level housing index.

Table 11: *Definition of the new division of the city*

	New districts	City districts
1	Bornheim-Ostend	14, 24, 25, 27, 28, 29
2	Mitte-Nord	44, 46, 45, 47
3	Mitte-West	34, 15, 16, 9
4	Nord-West	40, 41, 42, 43, 48
5	Norden	64, 67, 66, 49, 50, 65
6	Osten	26, 38, 39, 51, 68
7	Süden	30, 31, 32, 33, 37, 71
8	West-Autobahn	53, 54, 56, 57, 63, 62, 61, 60
9	Westend/Innenstadt	1, 12, 13, 10, 11, 17, 18, 19, 20, 21, 22, 23, 70

Note: This table lists the city districts that are part of the various new city districts

11 Hamburg

11.1 Analog data

The data from the segment Hamburg contains transactions from the segments apartments, single-family housing and multi-family housing. The data originates from the years 1950-1990. 87,000 documents were analysed.

Hamburg Karteikarten bebaut Typ alt. This document contains information on the street and house number (if available) of the building belonging to the transaction. In addition, the size of the building as well as the corresponding district is indicated. For the individual transactions, the date of the contract (usually in the format ddmmyy) and the type of legal transaction as well as the purchase price, if applicable divided into subcomponents (e.g. "cash", "mortgage" or similar) are listed. In addition, an adjusted purchase price is named in individual cases. Individual transactions are marked by stamp as "unsuitable" or sale to relatives or similar.

Some of the documents consist of a total of 4 pages, on which however the same tables and fields are found.

Hamburg Karteikarten bebaut Typ neu. This card type is structured similarly to "Hamburg Karteikarten bebaut Typ alt". In addition to this, there is occasional information on the category of the transaction (e.g. "condominium", "collective contract", "unsuitable", "heritable building"). In addition, the type of building is indicated separately. In the case of condominium ownership, the flat number is noted under building

type, if applicable. All information from "Hamburg Karteikarten bebaut Typ alt" is also available.

11.2   Digital data

For the city of Hamburg we have obtained data from the dataset covering the period 1964-present. The data for apartments cover the period 1964-present, while the single-family housing data cover the period 1964-present and the multi-family housing data cover the period 1964-present. For the analysis of apartments, we created annual indices for the period 1964-present and quarterly indices for the period 1991-present. For single-family housing, annual indices were compiled for the period 1964-present and quarterly indices for the period 1991-present. Similarly, for multi-family housing, annual indices were developed for the period 1964-present, supplemented by quarterly indices for the period 1991-present. Detailed information on the hedonic regression used for each market segment is provided below. In addition, we have produced district-level apartment indices for various neighbourhoods over the 1991-present period. The start of the collection of data on individual districts did not take place until 1992-1994. The following section provides comprehensive information of the composition of these different districts.

11.3 Hedonic price indices - city

11.3.1 Single-family housing

1991-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0}$$

$$+ \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^5 * Anzahl\ Bad_i + \beta^6 * Anzahl\ Garagen_i + \beta^7 * Balkon\ Terrasse_i \quad (26)$$

$$+ \beta^8 * Stadtteil_i \# I_{WNF \neq 0}$$

$$+ \beta^9 * Baujahr\ Kategorie_i + \beta^{10} * Gebtyp_i$$

$$+ \beta^{11} * Wasserlage_i^t + \beta^{12} * Lagequalität_i$$

$$+ \beta^{13} * Gebäudestellung_i + \epsilon_{i,t}$$

11.3.2 Multi-family housing

1991-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0}$$

$$+ \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^6 * Stadtbezirk_i \# I_{WNF \neq 0} \quad (27)$$

$$+ \beta^7 * Baujahr\ Kategorie_i + \beta^8 * Gebtyp_i$$

$$+ \beta^9 * Wasserlage_i^t + \beta^{10} * Lagequalität_i$$

$$+ \beta^{11} * Gebäudestellung_i + \beta^{12} * Wohnungen Anzahl_i$$

$$+ \beta^{13} * Anzahl\ Stockwerke_i + \epsilon_{i,t}$$

11.3.3 Apartments

1991-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^3 * Anzahl\_Bad_i + \beta^4 * Balkon\_Terrasse_i + \beta^5 * Einbauküche_i$$

$$+ \beta^6 * Mietstatus_i + \beta^7 * Stadtteil_i \# I_{WNF \neq 0} \qquad (28)$$

$$+ \beta^8 * Baujahr\ Kategorie_i + \beta^9 * Aufzug_i$$

$$+ \beta^{10} * Stockwerk_i + \beta^{11} * Lagequalität_i$$

$$+ \beta^{12} * Vertragsart_i + \epsilon_{i,t}$$

11.4 Hedonic price indices - city districts

We have created hedonic house price indices for each of the 12 new city districts, using the same model as for the city-level housing index.

Figure 5: *Map of the new division of the city*
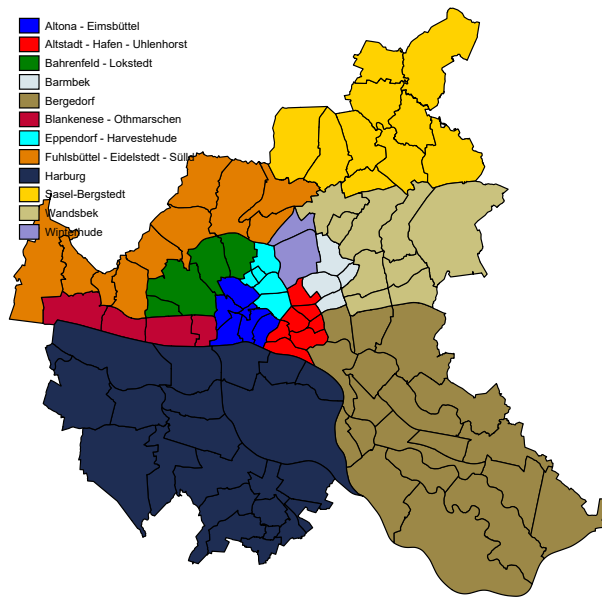
Note: This map shows the division of the city that we propose, via the division of the city by city districts.

Table 12: *Definition of the new division of the city*

	New districts	Actual districts
1	Altona - St. Pauli - Eimsbüttel	103, 104, 201, 202, 203, 301
2	Altstadt - Hafen - Uhlenhorstv	101, 102, 105, 106, 107, 406, 407
3	Bahrenfeld - Lokstedt	205, 206, 309, 305
4	Barmbek	408, 409, 410, 501
5	Bergedorf	108, 111, 112, 113, 114, 601-614
6	Blankenese - Othmarschen	204, 207, 210, 211
7	Eppendorf - Harvestehude	302, 303, 304, 401, 402
8	Fuhlsbüttel - Eidelstedt - Sülldorf	208, 209, 212, 214, 306, 307, 308, 403, 412
9	Harburg	115-120, 701-717
10	Sasel-Bergstedt	413, 509-517
11	Wandsbek	502-508, 518, 411
12	Winterhude	404, 405

Note: This table lists the city districts that are part of the various new city districts.

12 Cologne

12.1 Analog data

12.2 Digital data

For the city of Cologne we have obtained data from the dataset covering the period 1966-present. The data for apartments cover the period 1981-present, while the single-family housing data cover the period 1966-present and the multi-family housing data cover the period 1989-present. For the analysis of apartments, we created annual indices for the period 1981-present and quarterly indices for the period 1981-present. For single-family housing, annual indices were compiled for the period 1966-present and quarterly indices for the period 1992-present. Similarly, for multi-family housing, annual indices were developed for the period 1989-present, supplemented by quarterly indices for the period 1992-present. Detailed information on the hedonic regression used for each market segment is provided below. In addition, we have produced district-level apartment indices for various neighbourhoods over the 1989-present period. The following section provides comprehensive information of the composition of these different districts.

12.3 Hedonic price indices - city

12.3.1 Single-family housing

1992-2022

$$
\begin{aligned}
ln(P_{i,t}) = {} & \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
& + \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0} \\
& + \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0} \\
& + \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \\
& + \beta^5 * Stadtbezirk_i \# I_{WNF \neq 0} \\
& + \beta^6 * Baujahr\ Kategorie_i + \beta^7 * Gebtyp_i \\
& + \beta^8 * Lagequalität_i + \epsilon_{i,t}
\end{aligned} \tag{29}
$$

12.3.2 Multi-family housing

1992-2022

$$
\begin{aligned}
ln(P_{i,t}) = \beta^0 &+ \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
&+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0} \\
&+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0} \\
&+ \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \\
&+ \beta^5 * Geschossfläche_i \# I_{WNF \neq 0} + \beta^6 * Geschossfläche_i^2 \# I_{WNF \neq 0} \qquad (30) \\
&+ \beta^7 * Stadtbezirk_i \# I_{WNF \neq 0} \\
&+ \beta^8 * Baujahr\ Kategorie_i + \beta^9 * Gebtyp_i \\
&+ \beta^{10} * Zustand_i + \beta^{11} * Lagequalität_i + \beta^{12} * Gebäudestellung_i + \epsilon_{i,t}
\end{aligned}
$$

12.3.3 Apartments

1981-2022

$$
\begin{aligned}
ln(P_{i,t}) = \beta^0 &+ \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
&+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0} \\
&+ \beta^3 * Geschossanzahl_i + \beta^4 * Stadtteil_i \# I_{WNF \neq 0} \qquad (31) \\
&+ \beta^5 * Baujahr\ Kategorie_i + \beta^6 * Erstverkauf_i \\
&+ \beta^7 * Lagequalität_i + \epsilon_{i,t}
\end{aligned}
$$

12.4 Hedonic price indices - city districts

We have created hedonic house price indices for each of the 9 new city districts, using the same model as for the city-level housing index.

Figure 6: *Division of the city into city districts*
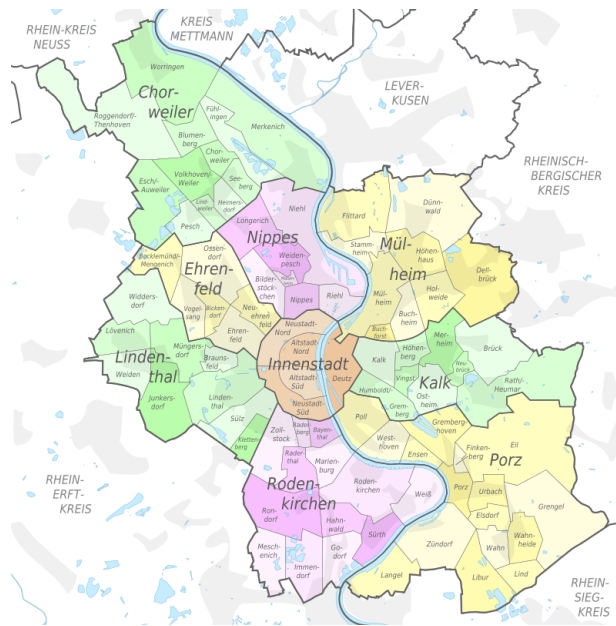
Note: This map shows the division of the city by city districts.

Table 13: *Division of the city by city districts*

	New districts	City districts
1	Innenstadt	Innenstadt
2	Rodenkirchen	Rodenkirchen
3	Lindenthal	Lindenthal
4	Ehrenfeld	Ehrenfeld
5	Nippes	Nippes
6	Chorweiler	Chorweiler
7	Porz	Porz
8	Kalk	Kalk
9	Mülheim	Mülheim

Note: This table lists the city districts that are part of the various new city districts.

13 Leipzig

13.1 Digital data

For the city of Leipzig we have obtained data from the dataset covering the period 2014-present. The data for apartments cover the period 2014-present, while the single-family housing data cover the period 2014-present and the multi-family housing data cover the period 2014-present. For the analysis of apartments, we created annual

indices for the period 2014-present and quarterly indices for the period 2014-present. For single-family housing, annual indices were compiled for the period 2014-present and quarterly indices for the period 2014-present. Similarly, for multi-family housing, annual indices were developed for the period 2014-present, supplemented by quarterly indices for the period 2014-present. Detailed information on the hedonic regression used for each market segment is provided below. In addition, we have produced district-level apartment indices for various neighbourhoods over the 2014-present period. The following section provides comprehensive information of the composition of these different districts.

13.2 Hedonic price indices - city

13.2.1 Single-family housing

2014-2022

$$
\begin{aligned}
ln(P_{i,t}) = \beta^0 + &\sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
+ &\beta^1 * WNF_i + \beta^2 * WNF_i^2 \\
+ &\beta^3 * Grundstücksfläche_i \\
+ &\beta^4 * Grundstücksfläche_i^2 \\
+ &\beta^5 * Gebäudestellung_i + \beta^6 * Verkaufsumstand_i \\
+ &\beta^7 * Ortsteil_i + \beta^8 * Ortsteil_i\#Lagequalität \\
+ &\beta^9 * Baujahr\ Kategorie_i + \beta^{10} * Zustand_i^t \\
+ &\epsilon_{i,t}
\end{aligned}
\tag{32}
$$

13.2.2 Multi-family housing

2014-2022

$$
\begin{aligned}
ln(P_{i,t}) = \beta^0 &+ \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
&+ \beta^1 * WNF_i + \beta^2 * WNF_i^2 \\
&+ \beta^3 * Grundstücksfläche_i \\
&+ \beta^4 * Grundstücksfläche_i^2 \\
&+ \beta^5 * Gebäudestellung_i + \beta^6 * Verkaufsumstand_i \\
&+ \beta^7 * Ortsbezirk_i + \beta^8 * Ortsbezirk_i\#Lagequalität \\
&+ \beta^9 * Baujahr\ Kategorie_i + \beta^{10} * Zustand_i^t \\
&+ \epsilon_{i,t}
\end{aligned}
\tag{33}
$$

13.2.3 Apartments

2014-2022

$$
\begin{aligned}
ln(P_{i,t}) = \beta^0 &+ \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
&+ \beta^1 * WNF_i\#I_{WNF\neq0} + \beta^2 * WNF_i^2\#I_{WNF\neq0} \\
&+ \beta^3 * Ortsteil_i\#I_{WNF\neq0} + \beta^4 * Ortsbezirk_i\#Lagequalität \\
&+ \beta^5 * Baujahr\ Kategorie_i + \beta^6 * Denkmalschutz_i \\
&+ \beta^7 * Verkaufsumstand_i + \beta^8 * Mietstatus_i \\
&+ \epsilon_{i,t}
\end{aligned}
\tag{34}
$$

13.3 Hedonic price indices - city districts

Wir haben hedonische Wohnungspreisindizes für jedes der 8 neuen Stadtteile erstellt und dabei das gleiche Modell wie für den Wohnungsindex auf Stadtebene angewandt.

Figure 7: *Map of the new division of the city*

Note: This map shows the division of the city by city districts.

Table 14: *Definition of the new division of the city*

	New districts	City districts
1	Altwest	Altwest
2	Mitte	Mitte
3	Nord	Nord
4	Nordwest	Nordwest
5	Ost	Ost, Nordost
6	Süd	Süd
7	Südost	Südost
8	Südwest	Südwest, West

Note: This table lists the city districts that are part of the various new city districts.

14 Luebeck

14.1 Digitale Daten

For the city of Lübeck we have obtained data from the dataset covering the period 1993-present. The data for apartments cover the period 1992-present, while the single-family housing data cover the period 1993-present and the multi-family housing data cover the period 1993-present. For the analysis of apartments, we created annual indices for the period 1993-present and quarterly indices for the period 1993-present. For single-family housing, annual indices were compiled for the period 1993-present and quarterly indices for the period 1993-present. Similarly, for multi-family housing, annual indices were developed for the period 1993-present, supplemented by quarterly indices for the period 1993-present. Detailed information on the hedonic regression used for each market segment is provided below. In addition, we have produced district-level apartment indices for various neighbourhoods over the 1994-present period. The following section provides comprehensive information of the composition of these different districts.

14.2 Hedonic price indices - city

14.2.1 Single-family housing

1993-2022

$$
\begin{aligned}
ln(P_{i,t}) = \beta^0 &+ \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
&+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0} \\
&+ \beta^3 * Badezimmeranzahl_i + \beta^4 * Toilettenanzahl_i \\
&+ \beta^5 * Grundstücksfläche_i \# I_{WNF \neq 0} \\
&+ \beta^6 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \\
&+ \beta^7 * Ortsbezirk_i \# I_{WNF \neq 0} + \beta^8 * Ortsbezirk_i \# Lagequalitaet \\
&+ \beta^9 * Baujahr\ Kategorie_i + \beta^{10} * Gebtyp_i \\
&+ \beta^{11} * Bauweise_i \\
&+ \epsilon_{i,t}
\end{aligned}
\tag{35}
$$

14.2.2 Multi-family housing

1993-2022

$$
\begin{aligned}
ln(P_{i,t}) = \beta^0 &+ \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
&+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0} \\
&+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0} \\
&+ \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \\
&+ \beta^5 * Ortsbezirk_i \# I_{WNF \neq 0} + \beta^6 * Ortsbezirk_i \# Lagequalitaet \\
&+ \beta^7 * Baujahr\ Kategorie_i + \beta^8 * Bauweise_i \\
&+ \epsilon_{i,t}
\end{aligned}
\tag{36}
$$

14.2.3 Apartments

1993-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^3 * Badezimmeranzahl_i + \beta^4 * Toilettenanzahl_i$$

$$+ \beta^5 * Ortsbezirk_i \# I_{WNF \neq 0} + \beta^6 * Ortsbezirk_i \# Lagequalitaet \qquad (37)$$

$$+ \beta^7 * Baujahr\ Kategorie_i + \beta^8 * Verkaufsumstand_i$$

$$+ \beta^9 * Stockwerk\ Kategorie_i + \beta^{10} * Garage_i$$

$$+ \beta^{11} * Bauweise_i$$

$$+ \epsilon_{i,t}$$

14.3 Hedonic price indices - city districts

We have created hedonic house price indices for each of the 3 new city districts, using the same model as for the city-level housing index.

Table 15: *Definition of the new division of the city*

	New districts	City districts
1	Nord	3,4,6,8,9
2	Südost-Innenstadt	1,2,5,7
3	Travemünde	10

Note: This table lists the city districts that are part of the various new city districts.

15 Munich

15.1 Analog data

The data from the apartments segment for Munich are available in the form of lists. In the period 1972-1990 there are a total of over 300 lists with information from 1972-1974, over 300 lists from 1975, and a total of more than 3,200 lists from the period 1976-1990. Each list consists of a header and a table from which the data was taken.

The following information was collected from the lists for apartments from the years 1972-1990:

Listen 1972-1974. The header contains the year in four-digit form and the district. In the table, one first finds the parcel number, the street, the house number (if available) and the number of total deeds (usually 1). This is followed by information on the flats, including the number of deeds, the number of housing units and, in the case of garages, the number of them together with the purchase price in DM. For evaluated apartments, the number of deeds and the number of housing units (usually 1 for both), the corresponding floor area in square metres, the price per square metre and the total purchase price in DM are given. For apartments not evaluated, only the number of deeds and the total purchase price in DM are given. In addition, the year of construction in two digits, any special legal transactions and, in most cases, the month can be found.

Listen 1975. The header contains the district, information on the type of property and the evaluation. The table first lists the parcel number, the street and the house number (if available). This is followed by the information on the flats. Below that the number of deeds and the number of purchase cases (for both usually 1), the corresponding flat area in square metres, the price per square metre and the total purchase price in DM. In the case of garages, the number of garages together with the purchase price in DM. In addition, the year of construction in two digits, any special legal transactions, the month and information on whether it is a first or resale.

Listen 1976-1982. The header contains the district, information on the type of property, the evaluation and whether it is a first-time or resale sale. The table first lists the parcel number, the street and the house number (if available). This is followed by the information on the flats. Below that the number of deeds and the number of purchase cases (for both usually 1), the associated flat area in square metres, the price per square metre and the total purchase price in DM. In the case of garages, the number of garages together with the purchase price in DM. In addition, the year of construction in two digits and the subdivision plan number are to be taken. The subdivision plan numbers have already been recorded here partially but not systematically.

Listen 1983-1990. The header contains the district, information on the type of property, the evaluation and whether it is a first-time or resale sale. The table first lists the parcel number, the subdivision plan number, the date of the transaction and the street and house number (if available). This is followed by the information on the flats. Below this the number of deeds and the number of purchase cases (for both usually 1), the associated flat area in square metres, the price per square metre and the total purchase price in DM. In the case of garages, the type and number of garages together with the purchase price in DM. In addition, the year of construction in two digits, the floor and whether the property is rented or not.

15.2   Digital data

For the city of Munich we have obtained data from the dataset covering the period 1972-present. The data for apartments cover the period 2014-present. For the analysis of apartments, we created annual indices for the period 1972-present and quarterly indices for the period 1983-present. Detailed information on the hedonic regression used for each market segment is provided below. In addition, we have produced district-level apartment indices for various neighbourhoods over the 1972-present period. The following section provides comprehensive information of the composition of these different districts.

15.3 Hedonic price indices - city

15.3.1 Single-family housing

1993-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^3 * Gemarkung\_KAT_i \# I_{WNF \neq 0}$$

$$+ \beta^4 * Baujahr\ Kategorie_i \tag{38}$$

$$+ \beta^5 * Denkmalschutz_i + \beta^6 * Lagequalität_i$$

$$+ \beta^7 * Verkaufsumstand_i + \beta^8 * Geschoss_i$$

$$+ \beta^9 * Mietstatus_i$$

$$+ \epsilon_{i,t}$$

15.4 Hedonic price indices - city districts

We have created hedonic house price indices for each of the 11 new city districts, using the same model as for the city-level housing index.

Figure 8: *Map of the new division of the city*
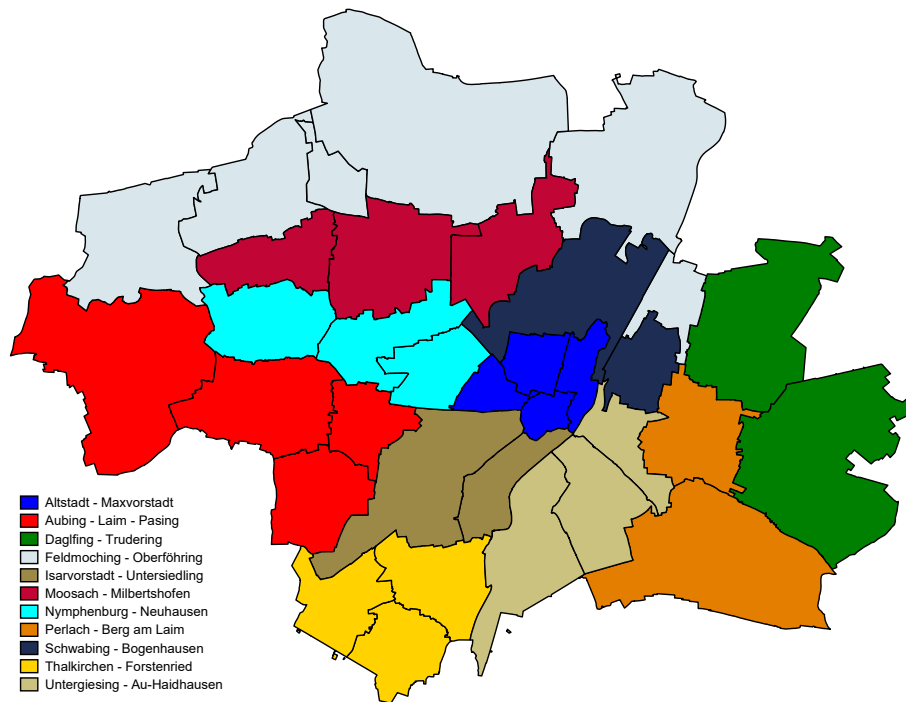
Note: This map shows the division of the city that we propose, via the division of the city by city districts.

Table 16: *Definition of the new division of the city*

	New districts	City districts
1	Altstadt - Maxvorstadt	München I - München IV
2	Aubing - Laim - Pasing	Großhadern, Laim, Pasing, Aubing
3	Daglfing - Trudering	Daglfing, Trudering
4	Feldmoching - Oberföhring	Langwied, Allach, Ludwigsfeld, Feldmoching, Freimann, Oberföhring
5	Isarvorstadt - Untersendling	München V - München VI
6	Moosach - Milbertshofen	Untermenzing, Moosach, Milbertshofen
7	Nymphenburg - Neuhausen	Obermenzing, Neuhausen, Nymphenburg
8	Perlach - Berg am Laim	Perlach , Berg am Laim
9	Schwabing - Bogenhausen	Schwabing, Bogenhausen
10	Thalkirchen - Forstenried	Forstenried, Solln, Thalkirchen
11	Untergiesing - Au - Haidhausen	München VII - München IX

Note: This table lists the city districts that are part of the various new city districts.

Indices

16 Muenster

16.1 Digital data

For the city of Münster we have obtained data from the dataset covering the period 1986-present. The data for apartments cover the period 1986-present, while the single-family housing data cover the period 1986-present and the multi-family housing data cover the period 1986-present. For the analysis of apartments, we created annual indices for the period 1986-present and quarterly indices for the period 1986-present. For single-family housing, annual indices were compiled for the period 1986-present and quarterly indices for the period 1986-present. Similarly, for multi-family housing, annual indices were developed for the period 1986-present. Detailed information on the hedonic regression used for each market segment is provided below. In addition, we have produced district-level apartment indices for various neighbourhoods over the 1988-present period. The following section provides comprehensive information of the composition of these different districts.

16.2 Hedonic price indices - city

16.2.1 Single-family housing

1986-2022

$$
\begin{aligned}
ln(P_{i,t}) = {} & \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
& + \beta^1 * WNF_i \#I_{WNF \neq 0} + \beta^2 * WNF_i^2 \#I_{WNF \neq 0} \\
& + \beta^3 * Grundstücksfläche_i \#I_{WNF \neq 0} \\
& + \beta^4 * Grundstücksfläche_i^2 \#I_{WNF \neq 0} \\
& + \beta^5 * Ortsbezirk_i \#\#Lagequalitaet \\
& + \beta^6 * Baujahr\ Kategorie_i + \beta^7 * Gebtyp_i \#I_{WNF \neq 0} \\
& + \beta^8 * EntfernungStadtzentrum_i \\
& + \epsilon_{i,t}
\end{aligned}
\tag{39}
$$

16.2.2 Multi-family housing

1986-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$
$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$
$$+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0}$$
$$+ \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \tag{40}$$
$$+ \beta^5 * Ortsbezirk_i$$
$$+ \beta^6 * Baujahr\ Kategorie_i + \beta^7 * Lagequalitaet_i$$
$$+ \epsilon_{i,t}$$

16.2.3 Apartments

1986-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$
$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$
$$+ \beta^3 * Garage_i + \beta^4 * Verkaufsumstand_i$$
$$+ \beta^6 * Ortsbezirk_i \#\# Lagequalitaet \tag{41}$$
$$+ \beta^7 * Ortsbezirk_i \# I_{WNF \neq 0}$$
$$+ \beta^8 * Baujahr\ Kategorie_i + \beta^9 * Verkaufsumstand_i$$
$$+ \beta^{10} * Garage_i$$
$$+ \beta^{11} * EntfernungStadtzentrum_i$$
$$+ \epsilon_{i,t}$$

16.3 Hedonic price indices - city districts

Table 17: *Definition of the new division of the city*

	New districts	New statistical districts
1	Mitte-Nordwest+Altstadt	11,12,13,14,15,23,26,27,28,29,46,47
2	Mitte-Südost	21,22,24,31,32,33,34,43,44,45
3	Nordost	61,62,63,68,71,76,77
4	Südost	81,82,86,87,91,95,96,97,98
5	West	51,52,54,56,57,58

Note: This table lists the new statistical city districts that are part of the various new city districts.

17 Potsdam

17.1 Digital data

For the city of Potsdam we have obtained data from the dataset covering the period 1995-present. The data for apartments cover the period 1995-present, while the single-family housing data cover the period 1996-present and the multi-family housing data cover the period 1995-present. For the analysis of apartments, we created annual indices for the period 1995-present and quarterly indices for the period 1995-present. For single-family housing, annual indices were compiled for the period 1996-present and quarterly indices for the period 1996-present. Similarly, for multi-family housing, annual indices were developed for the period 1995-present. Detailed information on the hedonic regression used for each market segment is provided below. In addition, we have produced district-level apartment indices for various neighbourhoods over the 1995-present period. The following section provides comprehensive information of the composition of these different districts.

17.2 Hedonic price indices - city

17.2.1 Single-Family Houses

1996-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$
$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$
$$+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0}$$
$$+ \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \tag{42}$$
$$+ \beta^5 * NeueBezirke_i \# Lagequalitaet$$
$$+ \beta^6 * Baujahr\,Kategorie_i + \beta^7 * NeueBezirke_i \# I_{WNF \neq 0}$$
$$+ \beta^8 * optischerZustandKategorie_i$$
$$+ \beta^9 * Denkmalschutz_i + \beta^{10} * Badezimmeranzahl$$
$$+ \beta^{11} * GebTyp_i + \beta^{12} * GarageDummy$$
$$+ \epsilon_{i,t}$$

17.2.2 Multi-Family Houses

1994-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$
$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$
$$+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0}$$
$$+ \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \tag{43}$$
$$+ \beta^5 * NeueBezirke_i \# Lagequalitaet$$
$$+ \beta^6 * Baujahr\,Kategorie_i + \beta^7 * NeueBezirke_i \# I_{WNF \neq 0}$$
$$+ \beta^8 * optischerZustandKategorie_i$$
$$+ \beta^9 * RND_i \# I_{RND \neq 0} + \beta^{10} * Bauweise_i$$
$$+ \epsilon_{i,t}$$

17.2.3 Apartments

1995-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \#I_{WNF \neq 0} + \beta^2 * WNF_i^2 \#I_{WNF \neq 0}$$

$$+ \beta^3 * Stockwerk\ Kategorie_i + \beta^4 * optischer\ Zustand\ Kategorie_i \qquad (44)$$

$$+ \beta^5 * neuer\ Bezirk_i \#Lagequalität$$

$$+ \beta^6 * Baujahr\ Kategorie_i$$

$$+ \epsilon_{i,t}$$

17.3 Hedonic price indices - city districts

We have created hedonic house price indices for each of the 3 new city districts, using the same model as for the city-level housing index.

Table 18: *Definition of the new division of the city*

	New districts	City districts
1	Babelsberg - Dreiwitz	Babelsberg, Dreiwitz
2	Nord-Ost	Golm, Eiche, Bornstedt, Nedlitz, Sacrow, Krampnitz, Groß Glienicke, Gatow, Neu Fahrland, Fahrland, Kartzow, Satzkorn, Paaren, Uetz, Grube, Marquardt
3	Potsdam	Potsdam

Note: This table lists the city districts that are part of the various new city districts.

18 Stuttgart

18.1 Analog data

The data from the Stuttgart segment contain information on apartments, single-family housing and multi-family housing. They date from the years 1963-1984. 15,000 cards were analysed.

Lochkarte Typ 1. For each transaction there is information relating to the district, street and house number as well as the type of change of ownership (purchase, exchange,

auction, etc.) and in some cases also references e.g. to heritable building rights or condominium ownership. Further fields refer to the type of evaluation (building, land or unsuitable) as well as the construction method and the type of building. In addition, there is information on the transaction date as well as the size of the transaction object. In the case of apartments, information is available on the flat number, the share of the flat, the number of rooms as well as the location and furnishings of the flat. A purchase price and, if applicable, an adjusted purchase price is noted for each transaction. In the case of apartments, the purchase price per square metre is also listed. Individual flats are marked as unsuitable.

Lochkarte Typ 2. This card type contains the same information as "Lochkarte Typ 1".

Lochkarte Typ 3. Like the previous card types, there is also information on the parcel, street, house number, type of change of ownership, reference to, contract date and property size. In addition, information on the location of the object is given for each transaction. The transaction property is listed in individual parts (e.g. residential building + garage), with the area covered by buildings, the number of floors, the year of construction as well as any renovations, furnishings, floor areas, enclosed space, living space and usable space indicated for each part. In particular, the same information as mentioned under "Lochkarte Typ 1" is given for apartments.

Karte WE/TE. The transactions from the card type WE/TE refer only to apartments. For each flat there is information on the size of the main plot and the total area of the property in which the flat is located. In addition, there is information on the construction method, traffic connections, immission influences as well as residential and commercial location, type of building, number of floors of any outbuildings and year of construction of the building. There is also information on the street and house number. The flats are listed with the respective contract date, the flat number, the flat share, as well as the purchase price and possibly the adjusted purchase price. In addition, there is information on the number of rooms, location and furnishings of the flat as well as living space and purchase price per square metre. Individual flats are marked as unsuitable.

Karte bebaut Ausführlich. This card contains information on the date of the contract as well as the size of the property and the partial area sold in the contract. In addition, there is information on the location, the purchase price as well as the purchase share, the district, the street and the house number of the object. Each transaction is listed in individual parts (cf. "Lochkarte Typ 3"), with each part of the property listed with information on built-up area, number of floors, year of construction, reconstruction, type of construction, equipment, floor area, converted space, living space and usable space. In addition, an annual net yield and the adjusted purchase price are given.

18.2 Digital data

For the city of Stuttgart we have obtained data from the dataset covering the period 1988-present. The data for apartments cover the period 1988-present, while the single-family housing data cover the period 1988-present and the multi-family housing data cover the period 1988-present. For the analysis of apartments, we created annual indices for the period 1988-present and quarterly indices for the period 1988-present. For single-family housing, annual indices were compiled for the period 1988-present and quarterly indices for the period 1988-present. Similarly, for multi-family housing, annual indices were developed for the period 1988-present, supplemented by quarterly indices for the period 1988-present. Detailed information on the hedonic regression used for each market segment is provided below. In addition, we have produced district-level apartment indices for various neighbourhoods over the 1988-present period. The following section provides comprehensive information of the composition of these different districts.

18.3 Hedonic price indices - city

18.3.1 Single-family housing

1988-2022

$$
\begin{aligned}
ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau & \\
& + \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0} \\
& + \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0} \\
& + \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \\
& + \beta^5 * NeueStadtteile_i + \beta^6 * Baujahr\ Kategorie_i \\
& + + \beta^7 * Lagequalität_i \\
& + \epsilon_{i,t}
\end{aligned}
\tag{45}
$$

18.3.2 Multi-family housing

$$
\begin{aligned}
ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau & \\
& + \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0} \\
& + \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0} \\
& + \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \\
& + \beta^5 * NeueStadtteile_i + \beta^6 * Baujahr\ Kategorie_i \\
& + + \beta^7 * Lagequalität_i \\
& + \epsilon_{i,t}
\end{aligned}
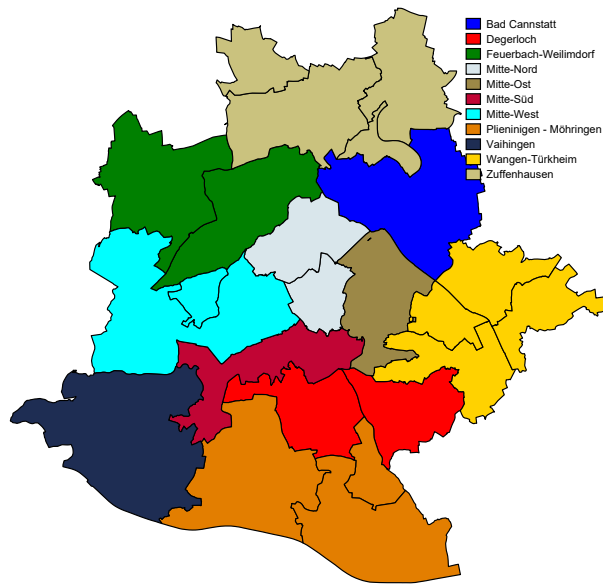\tag{46}
$$

18.3.3 Apartments

1988-2022

$$ln(P_{i,t}) = \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau$$

$$+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0}$$

$$+ \beta^3 * Stadtbezirk_i \# I_{WNF \neq 0} \tag{47}$$

$$+ \beta^4 * Baujahr\ Kategorie_i$$

$$+ \beta^5 * Lagequalität_i$$

$$+ \epsilon_{i,t}$$

18.4 Hedonic price indices - city districts

We have created hedonic house price indices for each of the 11 new city districts, using the same model as for the city-level housing index.

Figure 9: *Map of the new division of the city*

Note: This map shows the division of the city that we propose, via the division of the city by city districts.

Table 19: *Definition of the new division of the city*

	New districts	City districts
1	Bad Cannstatt	Bad Cannstatt
2	Degerloch - Sillenbuch	Degerloch, Sillenbuch
3	Feuerbach-Weilimdorf	Feuerbach, Weilimdorf
4	Stuttgart Mitte-Nord	Mitte, Nord
5	Stuttgart Ost	Ost
6	Stuttgart Süd	Süd
7	Stuttgart West - Botnang	West, Botnang
8	Plieningen - Möhringen - Birkach	Plieningen , Möhringen, Birkach
9	Vaihingen	Vaihingen
10	Neckar Ost	Wangen, Türkheim, Hedelfingen, Untertürkheim, Obertürkheim
11	Neckar Nord - Zuffenhausen	Münster, Zuffenhausen, Stammheim, Mühlhausen

Note: This table lists the city districts that are part of the various new city districts.

19 Wiesbaden

19.1 Analog data

The data from the multi-family and single-family housing segment for Wiesbaden are available in the form of file cards. Around 41,000 documents were taken into account

for the entire period from 1960-1992.

The following information was collected from the index cards from the years 1960-1992 for Wiesbaden:

Karteikarten 1960-1980.   The file cards contain information on the street and house number, the district, the total area of the property in square metres and the date. In addition, the type of change of ownership, the purchase price in DM, the land price, whether constructed or unconstructed, the expected use, the type of building and the year of construction are noted.

Karteikarten 1975-1992.   The file cards contain information on the street and house number, the district, the total area of the property in square metres and the date. In addition, the type of change of ownership, the purchase price in DM, the land price, whether constructed or unconstructed, the expected use, the type of building and the year of construction are noted. In addition, the number of floors, whether a garage was sold with the property and information on the evaluation are given.

19.2   Digital data

For the city of Wiesbaden we have obtained data from the dataset covering the period 1975-present. The data for apartments cover the period 1992-present, while the single-family housing data cover the period 1975-present and the multi-family housing data cover the period 1975-present. For the analysis of apartments, we created annual indices for the period 1992-present and quarterly indices for the period 1993-present. For single-family housing, annual indices were compiled for the period 1975-present. Similarly, for multi-family housing, annual indices were developed for the period 1975-present. Detailed information on the hedonic regression used for each market segment is provided below. There are no district-level apartment indices for Wiesbaden yet. These are currently being worked on and will be added as soon as they are ready.

19.3 Hedonic price indices - city

19.3.1 Single-family housing

1992-2021

$$
\begin{aligned}
ln(P_{i,t}) = \beta^0 &+ \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
&+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0} \\
&+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0} \\
&+ \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \\
&+ \beta^5 * NeueStadtteile_i + \beta^6 * Gebart_i \\
&+ \beta^7 * Baujahr Kategorie_i + \beta^8 * Lagequalität_i \\
&+ \epsilon_{i,t}
\end{aligned}
\tag{48}
$$

19.3.2 Multi-family housing

1992-2021

$$
\begin{aligned}
ln(P_{i,t}) = \beta^0 &+ \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
&+ \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0} \\
&+ \beta^3 * Grundstücksfläche_i \# I_{WNF \neq 0} \\
&+ \beta^4 * Grundstücksfläche_i^2 \# I_{WNF \neq 0} \\
&+ \beta^5 * NeueStadtteile_i + \beta^6 * Gebart_i \\
&+ \beta^7 * Baujahr Kategorie_i + \beta^8 * Lagequalität_i \\
&+ \epsilon_{i,t}
\end{aligned}
\tag{49}
$$

19.3.3 Apartments

1992-2021

$$
\begin{aligned}
ln(P_{i,t}) = {} & \beta^0 + \sum_{\tau=0}^{5} \gamma^\tau D_i^\tau \\
& + \beta^1 * WNF_i \# I_{WNF \neq 0} + \beta^2 * WNF_i^2 \# I_{WNF \neq 0} \\
& + \beta^3 * NeueStadtteile_i \# I_{WNF \neq 0} \\
& + \beta^4 * Baujahr\ Kategorie_i \\
& + \beta^5 * Lagequalität_i + \beta^6 * Geschoss_i \\
& + \epsilon_{i,t}
\end{aligned}
\tag{50}
$$

References

Balk, Bert, Walter Erwin Diewert, David Fenwick, Marc Prud'homme, and Jan de Haan (2014). "Handbook on residential property prices indices (RPPIs)". In: *Disclosure*.