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Vera Baye – University of Osnabrueck; vera.baye@uni-osnabrueck.de
Valeriya Dinger – University of Osnabrueck and Leeds University Business School;
valeriya.dinger@uni-osnabrueck.de

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Abstract

We investigate how housing returns are influenced by the introduction of a rent brake as a form of rental control in Germany in 2015. We derive the housing returns by matching micro-level quotes on similar objects offered for rent and for sale. We exploit the temporal, regional and object-specific variation in the framework of a multi period difference-in-differences analysis to identify the effect of the rent brake. Our results show that the main goal of the political intervention to secure affordable living space in tense housing markets cannot be attained due to construction incentives in newbuilds and fostered gentrification.

Keywords: rent control, housing supply, regional data, rent-price ratio, gentrification, housing affordability

JEL Classification: R38, R31, E65, R21, R23, R10

1 Introduction

In times of rising rents and sale prices for residential properties caused by a severe demand overhang combined with inelastic supply at the housing market, low interest rates and population growth in most large cities, interventions that promote affordable housing in tense markets are part of the current policy debate. To protect tenants and secure affordable housing, regulations like rent controls that put an upper ceiling on rent prices are introduced. However, investment impulses to increase affordable living space are needed for a sustainable long-term solution and it is disputed if measures like rent controls set the right incentives in the market.

In our analysis, we focus on Germany, a country with a large share of tenant households and a comparably small homeownership rate of 46.5% (Federal Statistical Office, 2021b). The Federal Statistical Office states that in 2019 14% of the German population was overburdened by housing costs (Federal Statistical Office, 2021a). From 2015 onwards, a rent brake was introduced by the Federal States at different points in time in municipalities with tense housing markets. The regulation limits the rents in new contracts by a ceiling of 10% above the local rent index and excludes newbuilds.

Our main goal is to examine if the German rent brake is a sufficient instrument to foster the provision of affordable living space. In our paper, we focus on the supply side and put housing returns proxied by the rent-price ratio in the center of the analysis because they reflect investment incentives which are needed to address supply shortages. We concentrate on the return on investment in housing because it reflects the attractiveness of housing and it proxies the relative price of renting. The rent-price ratio is calculated for each rental object from the reported net rent and the matched potential sale price.

For our estimations, we exploit a unique micro data set on rental and sale listings, covering several value-determining, object-specific characteristics as well as data on rent control, regional characteristics and regional socioeconomic variables. The micro-level housing data are based on residential real estate advertisements from one of the largest internet platforms for real estate advertisements in Germany, ImmobilienScout24. To calculate the rent-price ratio we match objects for sale and

for rent based on a similarity index that relies on object-specific characteristics and on object condition.

We develop two research questions to disentangle the dynamics at the housing market caused by the rent brake. First, how does the introduction of the rent brake influence the return on investment in housing? To address this question, we estimate the effect of the introduction of the rent brake on the rent-price ratio. In our regression framework, we take advantage of the introduction of rent control at different points in time in various municipalities and exploit the temporal, local and condition-specific variation. We find evidence for investment incentives into unregulated newbuilds in areas where the rent controls apply because their rent-price ratio appears to be 14 percentage points higher due to the introduction of the rent control. At the same time, the rent-price ratio of regulated objects decreases on average by 6.5 percentage points, thus, their sale prices do not decline in the same proportion as their rental prices.

As incentivized building activity does not allow inference on the affordability of the additional living space, we address the second question: Does the rent-income ratio decrease due to the introduction of the rent brake? With this question we add the factor of affordability to our analysis. We explicitly do not focus on the development of the rent prices, but on the rent-income ratio because we intend to rule out increased demand for higher living and housing standards due to growing income which could foster the supply of new (unregulated) apartments as well.

We apply a multiple period difference-in-difference framework to estimate the causal effect of the introduction of rent controls on the rent-income ratio. As our estimation results indicate that the rent burden increases in rent control areas after the introduction of the regulation, we conclude that it causes a supply shift towards more expensive newbuilds. Because of the fact that the rent burden, proxied by the rent-income ratio, rises, we assume that this shift is not demand driven, but results from the decreased returns of regulated inventory objects.

In summary, our results suggest that the introduction of the rent brake does promote investments in tense housing markets due to the exclusion of newbuilds from the

regulation. However, this does not lead to a reduction of the growing rent burden in these areas as the rent control causes a within-market supply shift towards unregulated newbuilds, which is supply-driven due to significantly higher returns resulting from higher net rents in relation to the sale prices.

Our work adds to two strands of literature. The first field includes studies investigating the influence of rent controls providing contradictory reports concerning the effectiveness of the regulation, when focusing on price developments in rental markets, renters' mobility, misallocations and incentives for residential development, see for example Diamond et al. (2019a), Sims (2007) and Autor et al. (2014). The relation between rents and sale prices is hardly addressed in previous works on rent regulation. Moreover, most international studies examine the relation in selected cities or metropolitan areas. The second strand covers studies that investigate determinants and developments of the gross returns of residential real estates, represented by the rent-price ratio. Following Halket & Pignatti Morano di Custoza (2015) and Bracke (2015) among others, we choose suitable control variables for our analysis, including object-specific characteristics, local attributes and socioeconomic factors. We thus contribute to the literature by combining evidence on housing return and rent regulation, using a unique dataset covering the nationwide housing market on micro-level which also allows us to address the heterogeneity across metropolitan regions. Moreover, we provide new insights into the efficiency of rent controls addressing housing shortages resulting in higher rent burdens.

The rest of the paper proceeds as follows: Section 2 provides a short summary of previous works focusing on determinants of housing returns and addressing effects of rent controls as well as a brief overview of the institutional background of the rent brake in Germany. In section 3, we describe our data and outline the matching approach of rent and sale objects. Section 4 provides the results of our main analysis. First, we estimate the effects of the rent brake on the rent-price ratio of regulated and unregulated objects, considering different regression setups. In the second subsection, we examine dynamics in regulated housing markets and estimate the effect of the rent brake on the rent-income ratio based on a multiple period difference-in-differences framework. Section 5 offers some concluding remarks.

2 Related literature and institutional background

2.1 Related previous works

This paper is based on two existing strands in the literature. In the first literature strand, the impact of rent control schemes is investigated. The second covers studies examining determinants and developments of the rent-price ratio of residential real estates which are used to find the necessary control variables for our analysis. The relationship between the housing return, proxied by the rent-price ratio, and rent regulation receives little attention, even though the return on housing might be one of the most important factors to solve problems arising from the small amount of affordable living space. In the following chapter, first general issues concerning the rent-price ratio are addressed, before we deal with different studies on rent control.

Rent-price ratio

The rent-price ratio is an important value for investors as it indicates the return on property and can be used to identify deviations from fundamental values of residential real estates. Davis et al. (2008) emphasize the role of the ratio to understand housing return dynamics and to estimate expectations concerning future capital gains to housing.

Our research is connected to literature in which the development of the relation between rental and sales values of residential properties is investigated using **different approaches to match micro data** on sales and rental prices. Clark & Lomax (2019) calculate the rent-price ratio for individual properties in English housing sub-markets using listed sales and matched rental data. Bracke (2015) use housing sale and rental transaction data for London and measure the rent-price ratio by isolating properties sold and rented within 6 months. Garner & Verbrugge (2009) compare self-reported rents and house values. Smith & Smith (2006) match information on purchased homes with those of similar rented homes, calculate the rent-price ratio and estimate the fundamental values of the objects. Huang et al. (2018) use micro data in form of matched sale-rental pairs from Hong Kong in a random search model.

General determinants of the rent-price ratio are often examined using hedonic methods and can be classified into different categories. On micro-level, **object-specific characteristics** like housing type, condition, living space and number of rooms and floors are used to explain different rent-price ratios (Bracke, 2015; Clark & Lomax, 2019; Halket et al., 2020). In addition, neighborhood properties might be considered like distance to public transport, health services and schools (Clark & Lomax, 2019). In a current analysis, Cui et al. (2018) add the effects of the living environment, distance to employment centers and availability of public transport.

Furthermore, **local attributes** play an important role (Clark & Lomax, 2019), which might for example be controlled via postcode dummy variables (Bracke, 2015). Further influencing factors might be land use restrictions, as Hilber & Mense (2021) point out. They add the effects of labor demand shocks and supply constraints occurring due to binding local land use restrictions to the explanation of the dynamics between sale prices and rents. Furthermore, **time-fixed effects** may play a role (Bracke, 2015).

Socioeconomic factors are considered analyzing the rent-price ratio, as well. Huang et al. (2018) relate the rent-price ratio negatively to the housing transaction volume, to the level of housing popularity and to income. Moreover, their results suggest that human capital, mortgage burdens and long-run rent growth influence the rental yield. Hilber & Mense (2021) add the effects of labor demand shocks.

Moreover, **financial indicators** like credit constraints and interest rates are covered by previous analysis. Sommer et al. (2013) suggest that different developments of rents and sale prices occur due to low levels of credit constraints and interest rates which lead to higher house prices but have a comparably small influence on rent prices. Based on Ambrose et al. (2013), who analyze the rent-price ratio for a period of 355 years in Amsterdam to estimate deviations of house prices from fundamentals, inflation and interest rates as fundamentals influencing the rent-price ratio can be added.

Estimation results suggest that lower **rent-price ratios indicate** higher homeownership rates (Halket & Pignatti Morano di Custoza, 2015) and more

desirable properties (Clark & Lomax, 2019) and precisely bigger, more central and more expensive units (Bracke, 2015; Smith & Smith, 2006). Garner & Verbrugge (2009) explain lower rent-price ratios of more expensive properties occur due to different dependence on mortgage interests. Moreover, the results of Bracke (2015) point to systematic differences in rent-price ratios across property types within the same urban area.

In another field, the rent-price ratio based on micro data is used to **evaluate the efficiency of housing markets**. Case & Shiller (1990) estimate quarterly indexes of existing single-family home prices with micro data and excess returns and find that the market of single-family homes is not efficient for four metropolitan areas in the US between 1970 and 1986. Following this, Ito & Hirono (1993) investigate the dynamics of the Tokyo housing prices using developments of the price-rent ratio in hedonic regressions to show determinants of housing prices and rents.

As the rent-price ratio is used to proxy the return to investors, several studies apply **tools** that characterize **returns in stock and bond markets**. Campbell et al. (2009) examine how housing returns can be explained by expected real risk-free rate of interest, expected risk premium and expected growth rate of rents by using a variance decomposition based on regional data for US metropolitan areas. Hwang et al. (2006) calculate rent-price ratios for apartments in Seoul and evaluate the efficiency of the Korean housing market by applying a dividend-price ratio model to panels of housing rents and returns controlling for location and types. Gallin (2008) examines the predictability of future changes in real rents and prices based on long-run developments of the rent-price ratio and draws a parallel to the dividend-price ratio in the stock market. His results suggest that real prices may be predicted using the rent-price ratio, but changes in real rents not. While most studies focus the US housing market, the results of Engsted & Pedersen (2015) suggest that the predictive power of the rent-price ratio concerning future returns also holds for most OECD countries. Glaeser & Gyourko (2007) criticize the financial approach to investigate the volatility of housing returns because the variation determining factor location is not adequately considered.

Rent controls

In this section, a brief review on studies that investigate the effect of rent regulation is given. The effectiveness of rent controls has been subject of some international studies, however empirical findings are rare due to difficulties that occur when measuring price effects of rental regulations (Thomschke, 2019). Most international studies are sub-national case studies, using data from US urban areas, only few investigations are based on European data or samples from other countries. The focus on a specific area is quite common, and the nationwide housing situation is hardly taken into account.

In previously published studies, potential negative effects of limiting rental prices below market prices are stressed. **International literature** suggests rent controls having significant effects on rental housing supply, construction activities and renters' mobility. One of the most prominent recent works is the quasi-experimental study based on an unexpected introduction of rent controls in a subset of San Francisco buildings in 1994. Diamond et al. (2019a) show that the number of renters who live in regulated objects decreased due to property redevelopments to exempt buildings from rent control. This conversion of existing rental properties ultimately led to a higher-end housing stock which is only affordable for higher income individuals. They find a 15 percent reduction of rental housing supply and a 20 percent decrease of renters' mobility due to the introduction of rent controls. Following this, they conclude that the primary goal of the rent controls is missed because of the gentrification and the decreased rental housing supply which is likely to foster rent increases in the long-run. Estimations of Asquith (2019), who proxies supply changes via evictions in the San Francisco's housing market, also suggest a reduction of controlled rental housing supply. Supplementary to this are the results of Oust (2018), who investigates the effects of the removal of the Norwegian rent control in Oslo's housing market. The findings suggest that it is more costly, in terms of time and money, to find a home in a rent controlled housing market.

Estimating a fixed-effects regression using micro data, Diamond et al. (2019b) investigate the source of the long-run decrease of supply in rental housing due to rent control. According to their results, the development is driven by the reduced supply

of objects managed by corporate landlords. While the supply of rent controlled housing owned by individuals decreases by 14 percent, corporate landlords are more likely to evade rent controls and replace rent controlled housing by 64 percent through selling to owner-occupants and increasing their supply of non-regulated objects.

Further related papers are those of Sims (2007) and Autor et al. (2014) who investigate end of rent controls in Massachusetts and emphasize several inefficiencies caused by rent controls. Sims (2007) find increases in rental supply after the end of the rent regulation using micro data for the metropolitan area Boston, Massachusetts, from the American Housing Survey for the time period 1985-1998. Their results suggest that rent controls artificially decreased rents, led to a deterioration of the quality of rental units and incentivized owners to shift objects away from rental status, thereby reducing the quantity supplied.
Unlike Sims (2007) who address effects on rental prices and the supply of rental units, Autor et al. (2014) analyze the effect of the rent control on the market value of the entire residential housing stock. They show that the regulation led to spillover effects on non-controlled units since after its abolition, price appreciations were observable for both regulated and unregulated objects. These results support the findings of Early (2000), who emphasizes that the average benefits to tenants in regulated units is negative. Concerning supply changes, both, Sims (2007) and Autor et al. (2014), find little evidence for effects of the rent control on new housing construction. In addition, Autor et al. (2019) discover robust evidence that the rent decontrol in Cambridge caused an increase of residential property values, which may be explained via an overall reduction in crime.

Like Diamond et al. (2019a), Munch & Svarer (2002) state that rent control reduces mobility. **Further effects** of the rent controls might be increasing misallocation and welfare losses, as studies of Glaeser & Luttmer (2003), Chapelle et al. (2019), Favilukis et al. (2019), Skak & Bloze (2013) and Bulow & Klemperer (2012) suggest. Gyourko & Linneman (1990) find a damaging effect of rent controls on rental structure quality. Moreover, they emphasize that rent controls might affect the socioeconomic composition of regulated areas as minority, as poor or working-class

families may have the possibility to live in cities. The results of Sims (2011) suggest that the presence of minority residents is increased due to rent controls, however, the proportion of poor residents decreased and traditional measures of residential segregation increased. Kholodilin & Kohl (2021) evaluate the effect of rent controls as a tool of redistribution on inequality.

The design of rent controls in other areas might slightly differ from the rent brake in **Germany** whose effects are investigated in this paper. Thus, the above-mentioned findings might be only partly transferable to the German housing market. Several investigations have been conducted to study the price effect of the German rent brake in various regions. Some findings indicate that the rent brake led to a reduction of rent price growth, although this effect on the price level seems to vary at different levels in different regions. However, unintended side effects like market segmentation and misallocations are observed as well.

Thomschke (2019) examines the effects of the German rent brake separately for six selected cities using difference-in-differences estimations following Sims (2007), to examine causal effects of the applied regulation. He finds varying price effects. In three cities a significant stop of increases in new contract rents can be shown, while the price effect is not observable in the other considered regions.

Breidenbach et al. (2019) apply a triple-differences framework controlling for both flat-type specific trends and region-specific time trends to address the endogeneity problem that evolves using the difference-in-differences method because the rent brake only applies in municipalities with dynamic price developments and tight housing markets. For the estimations, they use detailed micro-level housing data based on German residential real estate advertisements from the internet platform ImmobilienScout24. They find that the rental price growth of regulated units in controlled municipalities is reduced on average by 2.5%, although this result varies across object-specific characteristics. The reduction of rent growth appears to be more effective for smaller units as well as objects with initially lower rent price and inferior quality.

Mense et al. (2018) study causal effects of the rental brake in Germany and exploit the spatial-temporal variation for a difference-in-differences setup relying on data on

advertised rents offered on three large online market places between 2011 and 2016. They find evidence for rent price increases of uncontrolled units and a negative effect on rental prices of regulated objects. Their results suggest that the regulation fosters new construction in controlled municipalities as the resulting higher returns for newbuilds appear to increase the number of demolitions of one- and two-family homes in order to build new residential buildings. These results are extended by empirical evidence that land values in regulated municipalities increased and spillover effects leading to misallocation due to the introduction of the rent brake (Mense et al., 2019a, 2019b).

Most published studies on rent controls in Germany focus on rental price effects. Additionally, some consider supply effects and unintended side effects. However, the rent-price ratio is not addressed in previous investigations.

2.2 Institutional background of rent control

Various laws of rent control have been passed in the last decades. Recently investigated examples are in US metropolitan areas like San Francisco and Cambridge (e.g. Diamond et al., 2019a; Sims, 2007). However, Latin American and European countries experienced periods of rent controls as well (Chapelle et al., 2019; Jacobo & Kholodilin, 2020; Oust, 2018).

Since June 2015, the tenancy law reform empowers every federal state in Germany to regulate initial rents in regions where the housing markets are tight. A tight housing market is characterized by rents that increase faster than the national average, a rent-to-income ratio that is significantly higher than national average, a low vacancy rate combined with a high demand, and a residential population growing faster than the new construction activity. To identify a housing market as “tight”, at least one of the mentioned conditions has to be fulfilled (Kholodilin, 2016; Simons et al., 2020). As rising housing costs is a problem that is often more severe in cities, the regulation is mostly concentrated on urban and metropolitan areas.

The law stipulates that new rents are not allowed to exceed the standard local comparative level given by the local rental index by 10% in the following five years.

The local rent index represents the typical local private market rents for comparable flats given similar characteristics and location, however its composition and suitability are disputed in this context (Thomschke, 2019). Condition-specific exceptions of the regulation apply to new buildings, completed in the year 2014 or later, and extensively modernized apartments. Moreover, if the previous tenant paid a rent beyond 10% of the local rental index, the same rent level can be asked in new contracts, and rental contracts for a limited period of time are excluded as well. The 2015 introduced rent control only covers new contracts, however, increases of inventory rents are also tied to the local rent index via the capping limit in tight housing markets (Breidenbach et al., 2019; Thomschke, 2016). The law was not introduced in all Federal States at the same time.

To analyze the effect of the rent control, we take advantage of its variation on temporal, regional and individual level since it is applied in a selected number of municipalities at different points in time and new and modernized units are not regulated.

3 Data and Matching Approach

For the analysis, we merge data from different sources, including micro-level rental and sale price data for flats, self-collected data on the rent control introduction in Germany as well as regional characteristics and regional socioeconomic variables from the regional database of German Federal statistical offices.

The micro-level housing data (**RWI-GEO-RED data)** are based on German residential real estate advertisements from the internet platform ImmobilienScout24[1], which are provided by the research data center FDZ Ruhr at the RWI on monthly basis from January 2007 to March 2020. The data cover information on the asking price, several object-specific value determining characteristics, like number of rooms, living space and object condition, and details concerning the location on municipality level (Boelmann & Schaffner, 2019). For the empirical analysis, we use data on apartments for sale and apartments for rent. The raw data provide a high number of observations. However, incomplete advertisements that do not contain a net rent or the following characteristics could not be included in the analysis. Only objects that are located in a five digits postcode area, that were built in 1800 or later, with the minimum number of rooms of one, a reported living space and that do not belong to the cheapest or most expensive 1% in terms of price per square meter are considered.
Recent studies based on these data were for example published by Deschermeier et al. (2016), Breidenbach et al. (2019), Klick & Schaffner (2019) and Eilers (2017, 2018) who focus on recent developments in the housing market for rentals and sales.

However, in our analysis, we do not focus on the sales and rental prices, but on the **rent-price ratio** which is calculated by the yearly net rent divided by the potential sale price, the rent-price ratio. In our dataset, we only have either rental or sale offers because the same object obviously cannot be owner-occupied and rented at the same time. To calculate the potential rent-price ratio for each rental object, we match all sales objects in the same postcode area in the same quarter to each rental object and

[1] ImmobilienScout24 is one of the largest internet platforms for real estate advertisements in Germany and can be used by both private and commercial users. Of all real estate objects offered for rent or sale, it has a self-reported market share of about 50% (…) and is used by 74.3% professionals to offer their objects (Statista, 2020). For a detailed description, see Boelmann & Schaffner (2019), (RWI-GEO-RED, 2020b, 2020a).

identify the most similar **matches**. As a similarity measure, the **Euclidean Distance (ED)** is calculated based on object-specific characteristics. The matching variables are the year of construction, the living space, the number of rooms, and the object condition which are used to compute the square root of the sum of the squared standardized differences. The smaller the ED of a match, the more similar are the rental and the sale object, according to the underlying characteristics. For each rental object, we keep the matches that have one of the three lowest EDs and whose ED lies under a minimum similarity level of 3, which is set to prevent the creation of unsuitable matches. Finally, to proxy a suitable potential sales price for each rental object, we take the mean of the kept, most similar sale objects. The rent-price ratio, which can be used as a proxy for the gross return is calculated for each rental object from the reported net rent and the matched potential sale price. This results in a dataset covering 5,524,234 observations. As presented in figure 1, the average rent-price ratio in Germany decreases since 2010, thus, sale prices for residential properties grow faster than rents.

Figure 1: Evolution of the average quarterly rent-price ratio
Source: Own calculations

The unique features of the dataset, covering rents and the estimated sale prices are exploited in the following analysis. We are aware that the asking prices might deviate from actual transaction prices, but as Kholodilin (2016), Lyons (2013) and Dinkel & Kurzrock (2012) emphasize, these asking price data show reliable price trends. Especially for the advertised rent prices, significant deviations from the transactions do not need to be assumed because, as Zhu (2005) emphasizes, bargaining over rent

prices is relatively rare, especially in regions with a demand overhang. Thus, landlords will generally obtain their asking prices (Deschermeier et al., 2016). Moreover, the consideration of the object condition in the calculation of the similarity measure allows a quality-adjusted matching which helps to generate a reliable rent-price ratio. This is important because, based on applying hedonic methods using micro data from the Sydney housing market, Hill & Syed (2015) emphasize that rented and sold objects may not be of equal quality and recommend quality-adjustments to approximate the actual ratio.

The real estate data set is supplemented by self-collected data from the Federal State's laws on the application of **rent controls**, which were introduced on municipality level at various points in time by the Federal States. The introduction of the rent control is indicated by a dummy variable which equals 1 if the rent control applies in a municipality in that quarter and is zero otherwise. In the regulated municipality, the rent control only applies for buildings that were built before 2014 and are not completely modernized. In combination with the object-specific characteristics "year of construction" and "object condition", we can implement further dummy variables that indicate if a particular object is subject to rent control in a regulated municipality or not on micro-level.

Further data on regional characteristics, local economic activity and socioeconomic variables on municipality and district level are collected from the "Genesis" regional data platform maintained by the German Federal Statistical Institute (Statistisches Bundesamt) and the German Federal Institute for research on building, urban affairs and spatial development which offers indicators of spatial and urban development (INKAR).

4 Empirical Estimation and Results

4.1 Micro-level analysis: Effects of rent control on rent-price ratio

4.1.1 Estimation strategy

To identify the effects of the rent brake, a simple difference-in-differences framework is not applicable because the assumption of parallel trends, meaning that the development in treated and untreated municipalities would have been the same without the policy intervention, does not hold in this context. The introduction of the rent brake depends on previous price dynamics in the local rental housing market which causes an endogeneity problem. Thus, we exploit time-, regional- and object condition-specific variations concerning the application of the rent brake.

To estimate the effect of the **rent brake** on the rent-price ratio, we use a two-way fixed-effects linear regression, which is inspired by a multi-period difference-in-differences framework. Our baseline regression is specified as follows:

$$\begin{aligned} rent\_price\_ratio_i = \alpha & \\ & + \gamma \ \ municip\_reg_m \\ & + \delta_1 \, municip\_reg\_applied_{mq} * object\_reg_i \\ & + \delta_2 \, municip\_reg\_applied_{mq} * object\_unreg_i \\ & + \beta \, X + A_d + B_q + \varepsilon \end{aligned} \quad (1)$$

Therefore, we introduce several dummy variables to isolate the effect of the rent brake. The dummy variable $municip\_reg_m$ varies on municipality level and divides municipalities into a treatment group, where the rent brake is introduced in 2015 or later, and a control-group, where the regulation is never applied. Precisely, this means the variable equals 1 for the treatment group for the whole observation period if there are any periods when the rent brake applies and it equals 0 if the regulation is never passed for this area. Therefore, the coefficient γ accounts for general differences between the treated and the untreated areas.

The dummy variable $municip\_reg\_applied_{mq}$ varies in the cross-section on municipality level and in the time-section on quarterly basis. It takes the value 1 if the rent brake applies in a certain municipality per quarter. Because of the fact that not all

rental objects are subject to the rent control and we use data on micro-level, we combine the rent brake variable with additional dummy variables $object\_reg_i$ and $object\_unreg_i$ via an interaction term. $object\_reg_i$ is a dummy variable that equals 1 if the object is regulated due to its year of construction and condition and 0 otherwise. To control for the unregulated objects in regulated areas as well, the dummy variable $object\_unreg_i$ equals 1 if the rent brake does not apply for this object because it was built after 2014 or its condition is categorized as "first occupancy", "first occupancy after reconstruction" or "like new". Consequently, the coefficients δ_1 and δ_2 show the effects of the rent brake for regulated and unregulated objects in areas, where the regulation applies. Thus, we can exploit variation on the micro-level in our regression framework.

Moreover, X contains several object-specific and region-specific influences which are discussed in detail in section 4.1.4 where the basic framework explaining general determinants of the rent-price ratio is developed. The included object-specific variables are the year of construction, the living space, the number of rooms, dummy variables for the existence of a basement, balcony, terrace or garden and the object condition. On regional level, we control for the quarterly base yield per municipality, if the object is located in an urban or metropolitan area in Western or Eastern Germany, the population density and growth, the completion of living space, the primary income per capita, the number of students in the district, the unemployment rate and the proportion of social assistance recipients. Furthermore, we add cross-sectional fixed-effects on district level (A_d) and time-fixed effects on quarterly basis (B_q). The use of time-fixed effects absorbs the variation in the risk-free return, which is important because, as Campbell et al. (2009) emphasize, housing returns correlate with the expected future risk-free rates. Based on this set-up, we are able to identify effects of the rent brake while controlling for different levels and dynamics of the rent-price ratio in controlled areas even if the introduction of the regulation is endogenous.

Our model is estimated using an OLS regression with robust standard errors. The estimated effects concerning the rent control are robust and rather independent from the considered covariates (table 1). The estimated coefficients of the effect of the rent brake might be biased due to spillover effects for the regulated to the unregulated

areas. Moreover, objects might be mistakenly identified as regulated if the regulation is evaded due to furnishing or temporal limitation of the rental contract.

4.1.2 Results

To identify the effect of the introduction of the rent brake on the rent-price ratio, we estimate different versions of the framework described in the previous section (table 1). In the first column, the regression results for the previously explained equation are given. In column 2, the control variable which indicates the social assistance recipients is excluded because it restricts the observation period due to data availability problems. Additionally, in column 3, district fixed-effects are left out.

Table 1 (short version) VARIABLES	(1) Rent-price ratio	(2) Rent-price ratio	(3) Rent-price ratio
municip_reg$_m$ (Dummy treatment municipality)	-0.0179*** (0.00414)	-0.0208*** (0.00389)	0.00868*** (0.00266)
municip_reg_applied$_{mq}$ * object_reg$_i$ (Dummy regulated objects)	-0.0653*** (0.00430)	-0.0670*** (0.00425)	-0.0708*** (0.00400)
municip_reg_applied$_{mq}$ * object_unreg$_i$ (Dummy unregulated objects)	0.147*** (0.00489)	0.152*** (0.00485)	0.143*** (0.00460)
Object-specific variables	YES	YES	YES
Region specific variables	YES	YES	YES
Socio economic variables	YES	YES	YES
Social assistance recipients	YES	NO	NO
Year FE	YES	YES	YES
District FE	YES	YES	NO
Constant	15.62*** (0.0825)	15.10*** (0.0755)	15.21*** (0.0695)
Observations R-squared	2,774,267 0.432	3,116,542 0.424	3,116,542 0.422
Observation period	2011-2018	2008-2018	2008-2018

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1. Complete version in Appendix

The regression **results** reveal that the rent-price ratio in the treatment group lies on average 1.8 to 2.1 percentage points under the rent-price ratio of the control group. Moreover, the results show that the average impact of the rent brake on the return of

regulated real estates is negative, thus their rents increase less than their sale prices. The estimated coefficient δ_1 suggests that their rent-price ratio lays 6.5-7.1 percentage points lower than the rent-price ratio of comparable objects in not regulated areas. Although the level and dynamic of rent prices is controlled, the sales price of comparable objects in these areas do not adapt to the regulation in a similar proportion.

The return of unregulated objects in areas, where the rent brake is applied, seems to be positively affected by the rent control and lies on average 14.3-15.2 percentage points above the return of comparable objects in unregulated areas. The coefficients of the covariates as determinates of the rent-price ratio take the expected signs and sizes (detailed results in see Appendix – table 1).

All in all, our results suggest that rents and sale prices react differently to the introduction of the rent control, as the proportion of the two variables changes, shown by the significant effects on the rent-price ratio. The return of regulated objects decreases due to the introduction of the rent control on average by 6.5 percentage points because the rent prices decrease faster or increase slower than the sale prices for similar objects. For unregulated objects in regulated areas, the opposite appears to hold: On average, the rent prices of these objects rise 14.7 percentage points faster than the sale prices after the application of the regulation.

For investors, who clearly influence the supply of living space, these results induce a clear incentive to invest in new apartments. The rent brake seems to foster new construction in tense markets and the supply of living space might be influenced positively by this. These results are in line with the findings of Mense et al. (2018) who suggest that the German rental brake fosters new construction in controlled municipalities. However, it is not clear if the main goal to generate more affordable living space can be achieved by this because rent prices of newbuilds are not regulated.

4.1.3 Subsample analysis

In this section, we conduct various estimations to ensure that our results are robust with different subsamples and are not driven by dynamics in subsamples. We estimate the same regression like described in the previous section for the **seven biggest cities** (Appendix, table 5). The dummy variables for urban and metropolitan areas, as well as the treatment group variable $municip\_reg_m$ are excluded because these variables do not vary due to the sample selection. The identification of the effect of the rent brake cannot be calculated comparing to evolutions in an unregulated control group because the rent brake is introduced in all cities although at different points in time[2]. However, the influence of the market division into regulated and unregulated objects can be investigated. The results suggest that the influence on the rent-price ratio is notably smaller than in the whole sample, as the ratio of regulated objects appears to be 3.48 percentage points smaller after the introduction of the rent control. Moreover, the rents of unregulated objects rise 4.02 percentage points more than the sale prices after the rent brake applies.

Furthermore, the sample is divided by the number of building permits (Appendix table 6) and the number of building completions (Appendix table 7-9) to assess the effect of the rent brake depending on the supply elasticity. For both subsample analyses, the median of the number of building permits or building completions per inhabitant for every quarter is used to assign the municipalities into the two groups. The overall average effect of the introduction of the rent control on the proportion of rents and sale prices almost does not vary between municipalities with little and many **building completions**. The rent-price ratio of unregulated objects decreased on average by 6 percentage points after the introduction of the rent brake. The reduction seems to be slightly larger in municipalities with higher building activity. The rent-price ratio of unregulated objects seems to be 14.2 percentage points higher in municipalities with few building completions and increases 15.3 percentage points in areas with many

[2] Small variation of quarter in which rent control is introduced in different cities: Berlin (2015q2), Duesseldorf (2015q3), Frankfurt am Main (2015q4), Hamburg (2015q3), Cologne (2015q3), Munich (2016q1) and Stuttgart (2015q4)

building completions with the introduced rent brake. Summarized, the effects of the rent brake on the rent-price ratio does not vary depending on building completions.

However, if we divide the sample by the number of **building permits** per inhabitant, the effect of the introduction of the rent brake on the rent-price ratio varies notably. In the group of municipalities where, in the quarter of the published rent offer, comparably few building permits per inhabitant were granted, the effect of the rent control application on regulated and unregulated objects was smaller. The extend of the effect is similar to the one in the seven big cities. The rent-price ratio of regulated objects appears to decrease by 3.9 percentage points, while the rent of unregulated objects increases on average 5.3 percentage points more than the sale price due to the introduction of the rent control. In municipalities with comparably many building permits per inhabitant, the spread between the return to regulated and unregulated objects is notably higher. The renting of a regulated apartment appears especially unattractive, as the rent grows 9.8 percentage points slower than the sale price. In contrast, the rent-price ratio of unregulated units lies on average 18.5 percentage points higher due to rent controls, thus, rents are 18.5 percentage points higher in proportion to the corresponding sale prices. These results are robust if we divide the sample using the lagged number of building permits per inhabitant (see table 8 with lag = 4 quarters and table 9 with lag = 8 quarters). As the supply of living space is inelastic in the very short-run, our results indicate that the artificial shortage of supply growth, triggered by relatively few building permits, leads to a comparably small effect of the rent brake on the relative price of renting. In regions where many building permits are issued, the rent brake more strongly incentivizes the buildup of new apartments as the spread between regulated and unregulated objects lays at approximately 28 percentage points. We address the endogeneity problem resulting if a high number of building permits was influenced by a high demand for them due to high housing returns by using the lagged building permits in tables 8 and 9.

The subsample analysis shows that the effect of the rent brake on regulated and unregulated objects does not concentrate on big cities. Furthermore, in areas where

the rent brake applies, the spread of the rent-price ratio due to the market division into regulated and unregulated apartments seems to be higher in growing housing markets.

4.1.4 Determinants of the rent-price ratio

The framework to analyze the effect of the rent brake on the rent-price ratio is based on an empirical examination of the general determinants of the rent-price ratio. This analysis is conducted to elaborate how characteristics of the properties, their location and socioeconomic characteristics of the district explain the ratio. For this, the unique features of the dataset are exploited, covering rents and the estimated sale prices, calculated based on matching the most similar entities.

For the fundamental analysis of the relation between the rent-price ratio, several object-specific characteristics, location specific parameters and socioeconomic variables, a simple linear regression framework with robust standard errors is used. As documented in table 2, first only object-specific characteristics are considered and then regional and socioeconomic parameters are added to test the significance of the different variables carefully, before regressing the complete model. The size, the direction as well as the significance of the estimated coefficients are robust to changes in the model and to adding further variables. The number of observations of the different versions varies due to availability of the regional and socioeconomic variables.

The results reveal that the mean yield in each postcode area per quarter has a positive significant effect, thus, the gross return is likely to move in the same direction like the average developments in the surrounding area at that time period.

The micro dataset covering rents, estimated sale prices and various object characteristics allows a detailed analysis of several **object-specific effects** on real estate returns whose correlations seem as expected. The estimation results reveal negative coefficients of the year of construction, the number of rooms and of the living space, thus newer buildings, larger apartments and flats with less rooms generate lower returns. The existence of a basement and a balcony, terrace or garden is included via dummy variables into the estimation regression. While an additional basement

negatively relates to the object's return, a balcony, terrace or garden is connected to higher returns. The positive coefficient of the object condition variable shows that flats with a better condition generate less returns since the object condition variable equals 1 for new flats and 10 for objects which are ready for demolition.

These results suggest that the rent-price ratios for small, old apartments in a poor condition with no balcony are the highest, thus, their rent prices are higher in relation to their sale prices in comparison to larger apartments in a better condition. These finding go into the same direction as those of previous studies described above (see for example Bracke (2015), Clark & Lomax (2019), Smith & Smith (2006)).

The coefficients of the **regional variables** propose that an apartment located in an urban area or metropolitan area is connected to a smaller rent-price ratio. The results propose that in urban areas, the sale prices are higher in relation to rents than in rural areas. In big cities the rent-price ratio is even smaller. Because of the fact that the rent level there is higher than in regional centers and rural areas, this coefficient displays the even higher sale prices for flats.
Moreover, we control if the object is located in Western or Eastern Germany which reveals that rents are higher in relation to sale prices in Western Germany. However, if we control for socioeconomic variables, this relation is not significant anymore. In addition, the coefficients of population density and population growth show that a smaller rent-price ratio is related to a higher population density on municipality level and a faster population growth. Further completion of living space in the municipality is related to the gross return with a small significant negative coefficient. The creation of additional living space, therefore, is related to a smaller increase of rents in proportion to changes of corresponding sale prices.

The additional consideration of **socioeconomic variables** generates expected results. A higher primary income per capita, which includes labor income and income from investments, is positively related to a higher rent-price ratio although the small significant coefficient suggests a weak connection. The same holds for the number of students. In university cities the renting of small rather expensive rooms might be one aspect that drives up the rents in relation to sale prices. Both the unemployment rate

and the number of social assistance recipients are negatively related to the rent-price ratio which might be justifiable with a smaller ability to pay for rents.

4.2 District-level analysis: Effects of rent control on rent-income ratio

4.2.1 Dynamics at the housing markets: Prove estimation strategy

The results from the previous section indicate that it is more attractive to let unregulated apartments in regulated areas to tenants. This suggests that there is a clear investment incentive for unregulated apartments in regulated areas which leads to the buildup of more expensive living space and does not help to generate a higher amount of affordable housing. To confirm this hypothesis, general dynamics of the housing market are investigated. When we look at the mechanisms of the housing market in this context, it is important to remember that sale prices are not covered by this regulation.

In the initial situation, we find tight housing markets because of a severe demand overhang and an inelastic supply which causes constantly rising rental prices. For example, Glaeser et al. (2008) emphasize that tenants in more inelastic regions with less building activities face higher price increases. The objective of the rent brake is the provision of affordable housing in these markets, thus, it puts an upper barrier on the rent level which lies below the market price. This intervention into the housing market prevents a natural supply-demand equilibrium achieved by price adjustments because the maximum rental price, determined by the rent brake, lies under the equilibrium price. This further intensifies the demand overhang because the payment ability of more potential tenants is met.

However, the rent brake does not lower the price of every rental object in regions, where the regulation applies. A division of the market into regulated and unregulated apartments can be expected. The rental price of regulated objects rises -as legally defined- slower, while the asking prices of newer objects are still determined by market forces.

The tensions at the market for regulated apartments are intensified because the rental price determined by the rent controls lies under the equilibrium market price. This

leads to a higher demand for these apartments because the new regulated price meets the willingness to pay of more potential tenants. At the same time, the supply of rental apartments is less attractive for landlords, because the return may be scheduled for servicing a loan or retirement provisions. The landlords might decide to sell the object, use it themselves or renovate it so that it is not covered by the rent control anymore. Tensions at the market for regulated apartments increase because of higher demand and reduced supply. Tenants, who do not find a regulated apartment, have to spend more money on housing and rent an unregulated flat.

Living space in unregulated apartments increases because the supply is more elastic. If an apartment is offered for rent the first time, it is likely to be new or at least newly renovated. Thus, the supply of regulated apartments is fixed, while the market for unregulated apartments is likely to grow. However, prices do not fall here, because tenants, who do not find an apartment in the regulated, lower-price segment, have to increase their housing expenditure and rent an unregulated object. Thus, the demand for more expensive rental objects rises which does not allow a price decrease that would possibly occur if demand remained stable and supply increases. If this hypothesis holds, the average rent burden rises although the rent brake is applied in tense housing markets. In our empirical analysis, we explicitly do not focus on the development of the rent prices, but on the rent-income ratio because we intend to rule out increased demand for higher living and housing standards due to growing income which could foster supply of new (unregulated) apartments as well. The results of this analysis are described in the following chapter.

4.2.2 Multiple period difference-in-differences framework

To examine the hypothesis that the rent control causes an increase in the rent burden of new tenants, we estimate a model on district level focusing on the **rent-income ratio**. As described above, this indicator is also used to identify tight housing markets (Simons et al., 2020). The variable displays the proportion of the household income that is spend on rental payments proxied by the yearly median net rent of the newly offered flats per district. Due to data availability for the household income variable, the micro data are compressed to a district-year-level panel dataset.

In our analysis of the rent burden, proxied by the rent-income ratio, we apply a **multi-period difference-in-differences framework** to estimate the causal effect of the introduction of rent controls. The method is used based on Callaway & Sant'Anna (2021), who explain the unified framework for the estimation of an average treatment effect in difference-in-differences frameworks with multiple time periods. To generate valuable results with this method, the development of the rent-income ratios in the treatment and the control group need to follow the same trend prior to the treatment, which is the introduction of the rent control in our case. Following Heckman et al. (1997), Callaway & Sant'Anna (2021) describe the conditional parallel trends assumption, which allows for covariate-specific trends. This assumption is more plausible in the context of rent controls because the introduction of the regulation is not randomized. According to the conditions of the application of the regulation, we assume that the distribution of the observed socioeconomic and locational variables differs between municipalities that are subject to rent controls and those with an unregulated housing market. As Heckman et al. (1997) emphasize, ignoring covariate-specific trends may lead to biases of the estimated causal effects of policy interventions. Additional to the graphical illustration, the test of the conditional parallel trends-assumption reveals that the method is applicable here if we apply a significance level of 5%. However, if district level fixed-effects are considered, anticipation effects become visible (Appendix table 4).

We apply to following regression framework to elaborate the effects on the rent burden:

$$rent\_burden_m = \alpha + \gamma\ district\_reg_d + \delta\ district\_reg_d * period\_reg_y + \beta\ X + B_y + \varepsilon \quad (2)$$

In the panel data analysis with yearly data on district level, the dummy variable $district\_reg_d$ divides the sample into a treatment- and a control-group, thus, γ reveals the average difference of the rent burden between regulated and unregulated municipalities. The dummy variable $period\_reg_y$ identifies the treatment period and equals 1 if the rent brake is applied in one or more municipalities in the district in a certain year. The yearly variation allows the smoothing of anticipation effects. Please consider that the aggregation of the application areas of the rent brake on district level

leads to little information losses because the regulation mostly applies for cities which are counted as individual districts in the data set. Moreover, we consider various control variables in X and year fixed effects. Thus, the coefficient δ estimates the effect of the introduction of the rent brake on the rent-income ratio in our difference-in-differences setup. Oriented on Marcus & Sant'Anna (2020), the estimates based on the two-way fixed-effects regression model is interpreted as the weighted averages of causal effects. The results are explained in the following section (short version: table 3, complete version in Appendix).

Although the approach to estimate the average treatment effect via a difference-in-differences setup based on a two-way fixed-effects linear regression model is used in many studies to identify causal effects, this procedure is criticized in various studies if it comes to staggered treatment and time varying treatment effects (De Chaisemartin & D'Haultfoeuille, 2020; Goodman-Bacon & Marcus, 2020). To reduce the possibility of a biased estimator, the rent brake effect is additionally estimated combined with interaction terms for each year in which it is introduced (table 4).

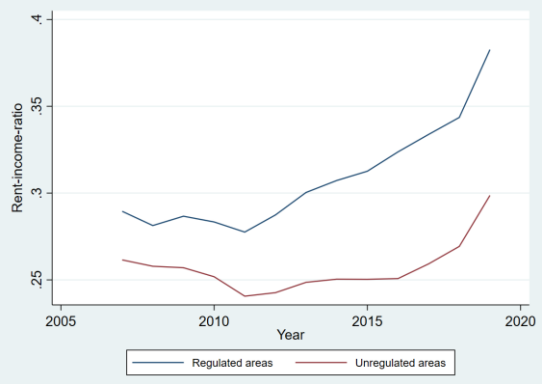

Figure 2: Evolution of average rent-income ratio
Source: Own calculations

4.2.3 Results

The estimation results (table 3) reveal that the rent-income ratio in the treatment group lies 3.03 percentage points higher than in municipalities from the control group where the rent brake is never applied in the observation period. The introduction of the rent brake increases the rent burden further by 1.45 percentage points on average. Although the rent control is introduced in these areas, the rental payments seem to

increase faster than the household incomes in these tight markets. This supports the hypothesis that the demand of living space overshoots the supply, so that tenants are forced to pay higher rents for unregulated objects.

In order to assess if the average treatment effect of the rent brake is identified correctly by the calculated coefficient, an additional regression with interaction terms of the year and treatment group indicator ($district\_reg$) is estimated (table 4, Appendix). The significance levels of the interaction terms reveal that the conditional parallel trends assumption holds and supports the estimation of the significant average additional rent burden in regulated municipalities of about 2 percentage points.

Table 3 (short version)

VARIABLES	Rent-income ratio
district_reg	**0.0303***** (0.00193)
district_reg * period_reg	**0.0145***** (0.00277)
Control variables	YES
Year FE	YES
Constant	0.391*** (0.00690)
Observations	3,949
R-squared	0.583

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
District-year level. Observation period: 2010-2019
Control variables: Yield, urban area (dummy), metropolitan area (dummy), western / eastern Germany (dummy), population density, students, unemployment rate, construction completions
Complete results: see Appendix, table 3

In addition to the division of the housing market, one long-term effect of the rent brake might be the exclusion of financially weak tenants from cities with tight rental markets although the main goal of the political intervention is to secure the provision of affordable living space. The combination of the district level results and the micro-level results further strengthens the evidence that the German rent control misses the goal to generate more affordable living space, although new construction is incentivized through excluding newbuilds from the regulation. However, in tense

housing markets, this might lead to more gentrification and a supply shift towards more expensive newbuilds.

Our results go along with recently published international studies like Diamond et al. (2019a) who show that the number of renters living in rent-controlled units decreased because of property redevelopment. The incentivized redevelopment of buildings to exempt them from rent control shifts the housing supply toward less affordable living space and fosters long-run increases in rents. Our study shows that these developments, identified for the San Francisco housing market by Diamond et al. (2019a, 2019b), can be found in the German market as well. Possibly, the results of Diamond et al. (2019b), that the supply of rent-regulated housing decreases because especially corporate landlords evade regulations by investing in new construction rentals and selling to owner occupants, can be applied to the German market as well. Although we cannot observe which landlords reduce the supply of controlled rental housing, we can assume that corporate landlords are one of the drivers in Germany, too, because evasion of rent controls through investment in new construction rentals is capital intensive.

5 Conclusion

In this paper we provide new evidence on housing market dynamics caused by rent regulation. Using residential real estate micro data, we match potential sale prices to rental offers to calculate the rent-price ratio. In our regression framework, we take advantage of the introduction of rent control at different points in time in various municipalities and exploit the temporal, local and condition specific variation to examine the effects on housing returns and evaluate the regulations' goal attainment by analyzing its effect on the rent burden.

The main contribution of the paper is evaluating the effects of the rent control in Germany on housing returns proxied by the rent-price ratio. We show that the rent brake incentivizes new construction in tight markets as the rent-price ratio of unregulated new apartments on average rises by 14 percentage points and the rent-price ratio of controlled inventory objects decreases by 6.5 percentage points after the introduction of the law. However, the multiple period difference-in-differences analysis of the rental payments in proportion to average incomes reveals that the rent burden in controlled areas rise after the introduction of the rent brake. Thus, we draw the conclusion that the rent brake causes a supply-driven within-market shift towards an increased supply of high priced newbuilds in tense housing markets.

These results reveal that the introduction of the rent brake does not relax the situation of tenants in regulated housing markets. The goal to foster the provision of affordable living space is undermined by investment incentives for higher priced newbuilds which increases gentrification and does not improve the situation for low-income tenants in tight markets. For policy makers, the results of this paper show that a rent regulation like the rent brake in Germany is not suitable to solve the problem of rising housing costs because it amplifies the supply shortage of moderately priced living space in tense housing markets. As these misleading investment incentives seem to be intensified in regions with comparably many building permits, our results stress the need to coordinate political interventions in the housing market to improve the target achievement.

Although we use a large data set on micro-level, the housing market might be not perfectly represented, as for example shadow rental agreements and subletting may be used to bypass the regulation. Moreover, our estimations are based on listing prices and may not reflect the actual transaction prices properly.

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Annexes

Table 1: Micro data analysis - Rent-price ratio and rent brake

OLS regression of rent-price ratio with micro data:

Table 1 VARIABLES	(1) Rent-price ratio	(2) Rent-price ratio	(3) Rent-price ratio
Treatment municipality (municip_reg_{m})	-0.0179*** (0.00414)	-0.0208*** (0.00389)	0.00868*** (0.00266)
Rent brake * reg ($\text{municip\_reg\_applied}_{mq} * \text{object}_{reg_i}$)	-0.0653*** (0.00430)	-0.0670*** (0.00425)	-0.0708*** (0.00400)
Rent brake * unreg ($\text{municip\_reg\_applied}_{mq} * \text{object}_{unreg_i}$)	0.147*** (0.00489)	0.152*** (0.00485)	0.143*** (0.00460)
Object-specific variables:			
Base yield	0.872*** (0.00148)	0.875*** (0.00138)	0.881*** (0.00124)
Year of construction	-0.00774*** (3.74e-05)	-0.00745*** (3.52e-05)	-0.00716*** (3.43e-05)
Living space	-0.00884*** (6.66e-05)	-0.00917*** (6.26e-05)	-0.00893*** (6.11e-05)
Number of rooms	-0.00346* (0.00181)	-0.00523*** (0.00171)	-0.0111*** (0.00168)
Basement (Dummy)	0.00255 (0.00218)	-0.000341 (0.00204)	-0.00387* (0.00202)
Balcony (Dummy)	0.161*** (0.00260)	0.169*** (0.00247)	0.168*** (0.00247)
Object condition (1 = new; 10 = demolition)	0.0129*** (0.000486)	0.0151*** (0.000457)	0.0154*** (0.000454)
Region specific variables:			
Urban area (Dummy) (Regional centers)	-0.0497*** (0.00786)	-0.0448*** (0.00747)	-0.0488*** (0.00404)
City / Metropolitan area (Dummy)	-0.00588 (0.00918)	-0.00959 (0.00874)	-0.0489*** (0.00430)
West / East Germany (Dummy) (1 = West, 0 = East)	0.767*** (0.0451)	0.746*** (0.0434)	0.0140*** (0.00398)
Socioeconomic variables:			
Population density	-0.0303*** (0.00340)	-0.0261*** (0.00318)	-0.0564*** (0.00155)
Population growth	0.0557 (0.0750)	0.0264 (0.0734)	0.343*** (0.0697)
Primary income per capita	-0.00361*** (0.00119)	-0.00352*** (0.00106)	0.00487*** (0.000297)

Students	-1.766***	-1.642***	0.197***
	(0.200)	(0.171)	(0.0272)
Unemployment rate	4.870***	3.953***	0.708***
	(0.598)	(0.478)	(0.130)
Construction completions	0.0494**	-0.0176	-0.00295
	(0.0210)	(0.0147)	(0.00749)
Social assistance recipients	0.000603*		
	(0.000341)		
Constant	15.62***	15.10***	15.21***
	(0.0825)	(0.0755)	(0.0695)
Observations	2,774,267	3,116,542	3,116,542
R-squared	0.432	0.424	0.422
YEAR FE	YES	YES	YES
DISTRICT FE	YES	YES	
Observation period	2011-2019	2010-2019	2010-2019

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1.

Table 2: Determinants of rent-price ratio

Table 2 A	(1)	(2)	(3)
VARIABLES	Baseline Model	Regional parameter	
Base yield	0.900***	0.885***	0.883***
	(0.000823)	(0.000931)	(0.000978)
Year of construction	-0.00545***	-0.00681***	-0.00699***
	(2.64e-05)	(3.08e-05)	(3.23e-05)
Living space	-0.00920***	-0.00874***	-0.00861***
	(5.26e-05)	(5.56e-05)	(5.79e-05)
Number of rooms	0.00113	-0.0166***	-0.0136***
	(0.00144)	(0.00153)	(0.00160)
Basement (Dummy)	-0.0205***	-0.0143***	-0.00969***
	(0.00158)	(0.00178)	(0.00191)
Balcony (Dummy)	0.181***	0.177***	0.172***
	(0.00213)	(0.00224)	(0.00234)
Object condition	0.0173***	0.0101***	0.00870***
(1 = new; 10 = demolition)	(0.000368)	(0.000392)	(0.000409)
Urban area (Dummy)		-0.0283***	-0.0261***
(Regional centers)		(0.00329)	(0.00340)
City / Metropolitan area		-0.0666***	-0.0690***
(Dummy)		(0.00356)	(0.00368)
West / East GER (Dummy)		0.0252***	0.0305***
(1 = West, 0 = East)		(0.00271)	(0.00290)
Population density		-0.0287***	-0.0307***
		(0.00113)	(0.00118)
Construction completions		-0.0904***	-0.0814***
		(0.00592)	(0.00617)
Population growth			-0.276***
			(0.0604)
Primary income per capita			
Students			
Unemployment rate			
Social assistance recipients			
Constant	11.67***	14.58***	14.94***
	(0.0526)	(0.0619)	(0.0649)
Observations	4,014,957	3,661,382	3,376,833
R-squared	0.424	0.430	0.436
Observation period	2008-2019	2009-2019	2010-2019

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1.

Table 2 B	(4)	(5)	(6)	(7)
VARIABLES	Socioeconomic parameter			
Base yield	0.885***	0.881***	0.885***	0.881***
	(0.00111)	(0.00105)	(0.00111)	(0.00103)
Year of construction	-0.00696***	-0.00707***	-0.00700***	-0.00726***
	(3.24e-05)	(3.40e-05)	(3.24e-05)	(3.43e-05)
Living space	-0.00860***	-0.00878***	-0.00860***	-0.00825***
	(5.80e-05)	(6.08e-05)	(5.80e-05)	(6.17e-05)
Number of rooms	-0.0138***	-0.0137***	-0.0134***	-0.0123***
	(0.00160)	(0.00167)	(0.00159)	(0.00169)
Basement (Dummy)	-0.0100***	-0.00952***	-0.00959***	-0.00570***
	(0.00192)	(0.00201)	(0.00191)	(0.00203)
Balcony (Dummy)	0.172***	0.173***	0.172***	0.165***
	(0.00235)	(0.00246)	(0.00234)	(0.00245)
Object condition	0.00909***	0.0106***	0.00879***	0.00624***
(1 = new; 10 = demolition)	(0.000409)	(0.000430)	(0.000408)	(0.000429)
Urban area (Dummy)	-0.0255***	-0.0371***	-0.0251***	-0.0264***
(Regional centers)	(0.00342)	(0.00390)	(0.00340)	(0.00353)
City / Metropolitan area	-0.0653***	-0.0667***	-0.0613***	-0.0712***
(Dummy)	(0.00372)	(0.00400)	(0.00389)	(0.00381)
West / East GER (Dummy)	0.0146***	0.0319***	0.0185***	0.00893**
(1 = West, 0 = East)	(0.00353)	(0.00305)	(0.00344)	(0.00432)
Population density	-0.0326***	-0.0309***	-0.0294***	-0.0329***
	(0.00128)	(0.00127)	(0.00118)	(0.00128)
Construction completions	-0.0858***	-0.0769***	-0.0871***	-0.0282***
	(0.00615)	(0.00705)	(0.00615)	(0.00743)
Population growth	-0.333***	-0.348***	-0.328***	-0.357***
	(0.0610)	(0.0629)	(0.0612)	(0.0624)
Primary income per capita	0.00168***			
	(0.000220)			
Students		0.0987***		
		(0.0267)		
Unemployment rate			-0.661***	
			(0.0990)	
Social assistance recipients				-0.000126***
				(1.24e-05)
Constant	14.84***	15.11***	14.98***	15.50***
	(0.0651)	(0.0682)	(0.0651)	(0.0691)
Observations	3,355,305	3,135,516	3,376,833	3,033,063
R-squared	0.435	0.422	0.436	0.444
Observation period	2010-2019	2010-2019	2010-2019	2011-2019

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1.

Table 2 C	(8)
VARIABLES	Complete model
Base yield	0.882***
	(0.00127)
Year of construction	-0.00734***
	(3.64e-05)
Living space	-0.00842***
	(6.51e-05)
Number of rooms	-0.0122***
	(0.00178)
Basement (Dummy)	-0.00578***
	(0.00216)
Balcony (Dummy)	0.165***
	(0.00260)
Object condition	0.00857***
(1 = new; 10 = demolition)	(0.000454)
Urban area (Dummy)	-0.0350***
(Regional centers)	(0.00410)
City / Metropolitan area	-0.0606***
(Dummy)	(0.00449)
West / East GER (Dummy)	-0.00595
(1 = West, 0 = East)	(0.00477)
Population density	-0.0350***
	(0.00158)
Construction completions	-0.0315***
	(0.00878)
Population growth	-0.499***
	(0.0661)
Primary income per capita	0.00145***
	(0.000302)
Students	0.0738***
	(0.0282)
Unemployment rate	-0.367***
	(0.137)
Social assistance recipients	-0.000111***
	(1.48e-05)
Constant	15.63***
	(0.0741)
Observations	2,774,267
R-squared	0.430
Observation period	2011-2019

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1.

Table 3: Analysis of rent-income-ratio with district-year-panel data

Table 3	
VARIABLES	Rent-income ratio
Yield	-0.0212***
	(0.000923)
Urban area (Dummy)	-0.00746***
(regional centers)	(0.00198)
City / Metropolitan area (Dummy)	0.000796
	(0.00276)
Western / Eastern GER (Dummy)	-0.0139***
(1 = West, 0 = East)	(0.00267)
Population density	0***
	(0)
Students	0.0598***
	(0.0184)
Unemployment rate	0.125
	(0.0762)
Construction completions	0.129***
	(0.0140)
district_reg_d	0.0303***
	(0.00193)
$\text{district\_reg}_d * \text{period\_reg}_y$	0.0145***
	(0.00277)
Constant	0.391***
	(0.00690)
Observations	3,949
R-squared	0.583
Year FE	YES
District FE	
Observation period	2010-2019

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Multi-period DiD for rent-income framework with interaction terms

Table 4	
VARIABLES	Rent-income ratio
Yield	-0.0210***
	(0.000930)
Urban area (Dummy)	-0.00750***
(regional centers)	(0.00198)
City / Metropolitan area (Dummy)	0.000730
	(0.00276)
Western / Eastern GER (Dummy)	-0.0136***
(1 = West, 0 = East)	(0.00266)
Population density	0***
	(0)
Students	0.0600***
	(0.0184)
Unemployment rate	0.120
	(0.0761)
Construction completions	0.130***
	(0.0141)
1.district_reg$_d$	0.0263***
	(0.00444)
1. district_reg$_d$#2010.m_jahr	0.000296
	(0.00620)
1. district_reg$_d$#2011.m_jahr	-0.000111
	(0.00616)
1. district_reg$_d$#2012.m_jahr	0.00424
	(0.00608)
1. district_reg$_d$#2013.m_jahr	0.00813
	(0.00605)
1. district_reg$_d$#2014.m_jahr	0.00978
	(0.00612)
1. district_reg$_d$#2015.m_jahr	0.0106*
	(0.00633)
1. district_reg$_d$#2016.m_jahr	0.0170***
	(0.00636)
1. district_reg$_d$#2017.m_jahr	0.0205***
	(0.00642)
1. district_reg$_d$#2018.m_jahr	0.0204***
	(0.00652)
1. district_reg$_d$#2019.m_jahr	0.0196***
	(0.00690)
Constant	0.391***
	(0.00699)
Observations	3,949
R-squared	0.584
Year FE	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1. Observation period: 2010-2019.

Table 5: Subsamples - Micro data analysis - Rent-price ratio - Big 7 Cities

VARIABLES	(1) Top 7	(2) Top 7	(3) Top 7
Rent brake * reg (municip_reg_applied$_{mq}$ * object$_{reg_i}$)	-0.0348***	-0.0373***	-0.0513***
	(0.00881)	(0.00874)	(0.00857)
Rent brake * unreg (municip_reg_applied$_{mq}$ * object$_{unreg_i}$)	0.0402***	0.0483***	0.0348***
	(0.00955)	(0.00946)	(0.00929)
Object-specific variables:			
Base yield	0.927***	0.928***	0.928***
	(0.00304)	(0.00274)	(0.00271)
Year of construction	-0.00277***	-0.00270***	-0.00269***
	(4.58e-05)	(4.34e-05)	(4.33e-05)
Living space	-0.00553***	-0.00594***	-0.00590***
	(0.000106)	(9.88e-05)	(9.84e-05)
Number of rooms	-0.0444***	-0.0529***	-0.0537***
	(0.00316)	(0.00296)	(0.00295)
Basement (Dummy)	-0.0291***	-0.0256***	-0.0256***
	(0.00372)	(0.00349)	(0.00349)
Balcony (Dummy)	0.150***	0.166***	0.165***
	(0.00431)	(0.00411)	(0.00411)
Object condition	-0.00845***	-0.00732***	-0.00761***
(1 = new; 10 = demolition)	(0.000884)	(0.000835)	(0.000830)
Region specific variables:			
West / East Germany (Dummy)	0.933***	0.753***	0.263***
(1 = West, 0 = East)	(0.227)	(0.121)	(0.0293)
Socioeconomic variables:			
Population density	0.0645	0.129**	0.0687***
	(0.0721)	(0.0570)	(0.0123)
Population growth	0.00217	0.163	0.151
	(0.267)	(0.254)	(0.237)
Primary income per capita	-0.0463***	-0.0442***	-0.0144***
	(0.00640)	(0.00588)	(0.00225)
Students	-0.710	-0.750	-1.453***
	(0.693)	(0.646)	(0.305)
Unemployment rate	5.580***	8.476***	-0.0461
	(1.928)	(1.167)	(0.375)
Social assistance recipients	0.000828		
	(0.000636)		
Construction completions	5.04e-05	2.86e-05	-0.000145***
	(3.33e-05)	(3.00e-05)	(2.13e-05)
Constant	6.031***	5.893***	6.219***
	(0.343)	(0.275)	(0.101)
Observations	763,986	878,829	878,829

R-squared	0.363	0.368	0.368
YEAR FE	YES	YES	YES
DISTRICT FE	YES	YES	
Observation period	2011-2019	2010-2019	2010-2019

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1.

Table 6: Subsamples - Micro data analysis - Rent-price ratio and rent brake – Division by building completions

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Few building completion			Many building completions		
Treatment municipality ($municip\_reg_m$)	-0.0136**	-0.0165***	-0.00717**	-0.0257***	-0.0284***	-0.0108***
	(0.00585)	(0.00550)	(0.00357)	(0.00614)	(0.00570)	(0.00404)
Rent brake * reg ($municip\_reg\_applied_{mq} * object_{reg_i}$)	-0.0609***	-0.0618***	-0.0682***	-0.0631***	-0.0643***	-0.0568***
	(0.00549)	(0.00543)	(0.00495)	(0.00754)	(0.00726)	(0.00676)
Rent brake * unreg ($municip\_reg\_applied_{mq} * object_{unreg_i}$)	0.142***	0.148***	0.137***	0.153***	0.156***	0.151***
	(0.00662)	(0.00654)	(0.00604)	(0.00787)	(0.00756)	(0.00698)
Object-specific variables:						
Base yield	0.858***	0.862***	0.868***	0.916***	0.918***	0.927***
	(0.00167)	(0.00158)	(0.00143)	(0.00331)	(0.00305)	(0.00266)
Year of construction	-0.00726***	-0.00702***	-0.00682***	-0.00922***	-0.00873***	-0.00841***
	(4.39e-05)	(4.16e-05)	(4.07e-05)	(7.24e-05)	(6.73e-05)	(6.52e-05)
Living space	-0.00974***	-0.0100***	-0.00978***	-0.00677***	-0.00732***	-0.00718***
	(8.50e-05)	(8.01e-05)	(7.84e-05)	(0.000103)	(9.66e-05)	(9.40e-05)
Number of rooms	-0.00752***	-0.00957***	-0.0157***	-0.000195	-0.000961	-0.00241
	(0.00232)	(0.00219)	(0.00215)	(0.00279)	(0.00261)	(0.00256)
Basement (Dummy)	0.00622**	0.00266	0.000324	-0.00853**	-0.00917***	-0.0137***
	(0.00279)	(0.00263)	(0.00261)	(0.00337)	(0.00312)	(0.00308)
Balcony (Dummy)	0.176***	0.183***	0.184***	0.124***	0.131***	0.127***
	(0.00321)	(0.00306)	(0.00305)	(0.00430)	(0.00405)	(0.00404)
Object condition (1 = new; 10 = demolition)	0.00299***	0.00496***	0.00549***	0.0259***	0.0284***	0.0287***
	(0.000657)	(0.000622)	(0.000619)	(0.000715)	(0.000669)	(0.000663)
Region specific variables:						
Urban area (Dummy)	-0.0375***	-0.0292**	-0.0382***	-0.0550***	-0.0550***	-0.0566***

(Regional centers)	(0.0124)	(0.0117)	(0.00513)	(0.0106)	(0.0101)	(0.00622)
City / Metropolitan area (Dummy)	-0.00449	-0.00667	-0.0478***	0.0308*	0.0291*	0.00104
	(0.0120)	(0.0116)	(0.00539)	(0.0187)	(0.0170)	(0.00745)
West / East Germany (Dummy)	0.833***	-0.193	-0.0269***	-0.00209	-2.421***	0.00843
(1 = West, 0 = East)	(0.0523)		(0.00554)		(0.0931)	(0.00677)
Socioeconomic variables:						
Population density	-0.0335***	-0.0351***	-0.0640***	-0.0207***	-0.0135***	-0.0185***
	(0.00507)	(0.00484)	(0.00221)	(0.00469)	(0.00431)	(0.00221)
Population growth	-0.0817	-0.0892	0.230***	0.313**	0.311**	0.321**
	(0.0906)	(0.0898)	(0.0828)	(0.156)	(0.149)	(0.140)
Primary income per capita	-0.0142***	-0.0139***	0.00554***	0.000283	-0.000780	-0.00106**
	(0.00230)	(0.00213)	(0.000414)	(0.00156)	(0.00150)	(0.000456)
Students	-1.785***	-1.690***	0.0874**	-0.943***	-0.592**	-0.0251
	(0.259)	(0.219)	(0.0352)	(0.344)	(0.295)	(0.0453)
Unemployment rate	4.437***	3.389***	0.954***	2.610**	2.279**	-0.0603
	(0.759)	(0.626)	(0.168)	(1.101)	(0.894)	(0.226)
Social assistance recipients	0.000882**			0.000839		
	(0.000414)			(0.00150)		
Construction completions	0.0475	-0.0515***	-0.0486***	-0.0265	-0.0515	-0.0536***
	(0.0296)	(0.0198)	(0.00971)	(0.0651)	(0.0468)	(0.0162)
Constant	15.06***	15.37	14.76***	21.10***	17.77	17.41***
	(0.103)	(297.3)	(0.0828)	(0.156)	(2,914)	(0.132)
Observations	1,866,538	2,073,603	2,073,603	907,729	1,042,939	1,042,939
R-squared	0.417	0.409	0.408	0.421	0.416	0.415
YEAR FE	YES	YES	YES	YES	YES	YES
DISTRICT FE	YES	YES		YES	YES	
Observation period	2011-2019	2010-2019	2010-2019	2011-2019	2010-2019	2010-2019

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Subsamples - Micro data analysis - Rent-price ratio and rent brake - Division by building permits

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Few building permits			Many building permits		
Treatment municipality ($municip\_reg_m$)	-0.00963*	-0.0139***	0.000762	-0.0262***	-0.0267***	-0.0124***
	(0.00572)	(0.00536)	(0.00369)	(0.00634)	(0.00595)	(0.00403)
Rent brake * reg ($municip\_reg\_applied_{mq} * object_{reg_i}$)	-0.0389***	-0.0393***	-0.0297***	-0.0976***	-0.102***	-0.106***
	(0.00628)	(0.00619)	(0.00590)	(0.00611)	(0.00600)	(0.00558)
Rent brake * unreg ($municip\_reg\_applied_{mq} * object_{unreg_i}$)	0.0533***	0.0581***	0.0658***	0.185***	0.190***	0.180***
	(0.00798)	(0.00789)	(0.00761)	(0.00653)	(0.00641)	(0.00595)
Object-specific variables:						
Base yield	0.854***	0.858***	0.866***	0.907***	0.909***	0.917***
	(0.00179)	(0.00166)	(0.00151)	(0.00274)	(0.00260)	(0.00228)
Year of construction	-0.00920***	-0.00860***	-0.00828***	-0.00563***	-0.00565***	-0.00547***
	(5.36e-05)	(4.94e-05)	(4.80e-05)	(4.90e-05)	(4.73e-05)	(4.64e-05)
Living space	-0.0105***	-0.0109***	-0.0106***	-0.00670***	-0.00697***	-0.00684***
	(9.17e-05)	(8.53e-05)	(8.34e-05)	(9.49e-05)	(9.00e-05)	(8.78e-05)
Number of rooms	-0.0115***	-0.0114***	-0.0182***	0.0118***	0.00821***	0.00694***
	(0.00247)	(0.00231)	(0.00226)	(0.00255)	(0.00242)	(0.00239)
Basement (Dummy)	-0.000347	-0.00453	-0.00702**	-0.00251	-0.00298	-0.00523*
	(0.00307)	(0.00285)	(0.00283)	(0.00293)	(0.00277)	(0.00274)
Balcony (Dummy)	0.181***	0.188***	0.188***	0.138***	0.143***	0.141***
	(0.00348)	(0.00329)	(0.00328)	(0.00369)	(0.00354)	(0.00353)
Object condition (1 = new; 10 = demolition)	-0.00176**	0.00174***	0.00254***	0.0360***	0.0368***	0.0368***
	(0.000701)	(0.000656)	(0.000653)	(0.000635)	(0.000603)	(0.000599)
Region specific variables:						

Urban area (Dummy)	-0.0487***	-0.0387***	-0.0578***	-0.0492***	-0.0483***	-0.0551***
(Regional centers)	(0.0119)	(0.0113)	(0.00511)	(0.0108)	(0.0103)	(0.00624)
City / Metropolitan area (Dummy)	-0.0179	-0.0210*	-0.0542***	0.0331*	0.0269	0.0131*
	(0.0117)	(0.0111)	(0.00534)	(0.0191)	(0.0185)	(0.00745)
West / East Germany (Dummy)	1.061***	1.041***	0.0235***	0.0394	0.0454	0.0372***
(1 = West, 0 = East)	(0.0692)	(0.0665)	(0.00551)		(58.16)	(0.00588)
Socioeconomic variables:						
Population density	-0.0379***	-0.0338***	-0.0802***	-0.00234	-0.000274	-0.0181***
	(0.00472)	(0.00443)	(0.00244)	(0.00512)	(0.00486)	(0.00205)
Population growth	-0.0194	-0.0689	0.148	0.209*	0.167	0.476***
	(0.0966)	(0.0952)	(0.0913)	(0.124)	(0.120)	(0.111)
Primary income per capita	-0.0154***	-0.0164***	0.00512***	-0.00414***	-0.00531***	0.00185***
	(0.00246)	(0.00227)	(0.000442)	(0.00144)	(0.00136)	(0.000414)
Students	-1.951***	-1.898***	0.134***	-0.175	-0.0815	0.192***
	(0.268)	(0.226)	(0.0352)	(0.312)	(0.282)	(0.0439)
Unemployment rate	4.568***	3.457***	1.109***	6.705***	5.502***	1.390***
	(0.785)	(0.654)	(0.178)	(0.991)	(0.751)	(0.222)
Social assistance recipients	0.00148**			-0.000934**		
	(0.000625)			(0.000439)		
Construction completions	-0.127***	-0.220***	0.0808***	0.0235	0.0298	-0.147***
	(0.0482)	(0.0360)	(0.0154)	(0.0314)	(0.0285)	(0.0115)
Constant	18.90***	18.94	17.72***	11.50	11.48	11.33***
	(0.120)	(99.99)	(0.0974)			(0.0936)
Observations	1,685,629	1,905,183	1,905,183	1,088,638	1,211,359	1,211,359
R-squared	0.396	0.387	0.386	0.417	0.415	0.414
YEAR FE	YES	YES	YES	YES	YES	YES
DISTRICT FE	YES	YES		YES	YES	
Observation period	2011-2019	2010-2019	2010-2019	2011-2019	2010-2019	2010-2019

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Subsamples - Micro data analysis - Rent-price ratio and rent brake - Division by building permits with lag = 4 quarter

VARIABLES	(80)	(81)	(82)	(84)	(85)	(86)
	Few building permits. Lag: 4 quarter			Many building permits. Lag: 4 quarter		
Treatment municipality ($municip\_reg_m$)	-0.0146**	-0.0170***	0.00293	-0.0206***	-0.0254***	-0.00904**
	(0.00578)	(0.00533)	(0.00367)	(0.00627)	(0.00576)	(0.00389)
Rent brake * reg ($municip\_reg\_applied_{mq} * object_{reg_i}$)	-0.0360***	-0.0398***	-0.0413***	-0.0985***	-0.103***	-0.119***
	(0.00636)	(0.00626)	(0.00596)	(0.00620)	(0.00603)	(0.00557)
Rent brake * unreg ($municip\_reg\_applied_{mq} * object_{unreg_i}$)	0.0827***	0.0879***	0.0826***	0.186***	0.193***	0.174***
	(0.00796)	(0.00786)	(0.00757)	(0.00655)	(0.00638)	(0.00597)
Object-specific variables:						
Base yield	0.858***	0.862***	0.869***	0.908***	0.911***	0.919***
	(0.00174)	(0.00162)	(0.00147)	(0.00284)	(0.00261)	(0.00231)
Year of construction	-0.00841***	-0.00797***	-0.00768***	-0.00643***	-0.00639***	-0.00616***
	(5.00e-05)	(4.63e-05)	(4.51e-05)	(5.31e-05)	(5.08e-05)	(4.95e-05)
Living space	-0.0101***	-0.0105***	-0.0102***	-0.00683***	-0.00722***	-0.00710***
	(8.76e-05)	(8.15e-05)	(7.99e-05)	(0.000100)	(9.33e-05)	(9.07e-05)
Number of rooms	-0.0120***	-0.0129***	-0.0200***	0.0131***	0.00812***	0.00725***
	(0.00241)	(0.00224)	(0.00220)	(0.00263)	(0.00245)	(0.00241)
Basement (Dummy)	0.000563	-0.00266	-0.00542**	0.00193	-0.00180	-0.00444
	(0.00298)	(0.00275)	(0.00273)	(0.00300)	(0.00281)	(0.00277)
Balcony (Dummy)	0.180***	0.186***	0.186***	0.132***	0.139***	0.138***
	(0.00339)	(0.00319)	(0.00318)	(0.00380)	(0.00361)	(0.00360)
Object condition	-0.000866	0.00272***	0.00346***	0.0359***	0.0372***	0.0372***
(1 = new; 10 = demolition)	(0.000682)	(0.000635)	(0.000631)	(0.000651)	(0.000612)	(0.000607)
Region specific variables:						
Urban area (Dummy)	-0.0616***	-0.0465***	-0.0586***	-0.0321***	-0.0340***	-0.0341***
(Regional centers)	(0.0118)	(0.0111)	(0.00510)	(0.0108)	(0.0101)	(0.00618)

City / Metropolitan area (Dummy)	-0.00348	-0.00450	-0.0463***	0.0171	0.0114	-0.0105
	(0.0116)	(0.0111)	(0.00536)	(0.0199)	(0.0178)	(0.00732)
West / East Germany (Dummy)	3.112	0.926***	0.0100*	0.132	0.0158	0.0313***
(1 = West, 0 = East)	(759.1)	(0.0633)	(0.00551)			(0.00589)
Socioeconomic variables:						
Population density	-0.0374***	-0.0363***	-0.0758***	-0.0120**	-0.00354	-0.0202***
	(0.00478)	(0.00448)	(0.00242)	(0.00511)	(0.00460)	(0.00200)
Population growth	-0.104	-0.119	0.191*	0.110	0.0809	0.287***
	(0.110)	(0.108)	(0.103)	(0.0911)	(0.0889)	(0.0828)
Primary income per capita	-0.0162***	-0.0158***	0.00611***	-0.00336**	-0.00336**	0.00213***
	(0.00257)	(0.00233)	(0.000436)	(0.00149)	(0.00140)	(0.000399)
Students	-2.021***	-1.778***	0.191***	0.0764	0.130	0.0920**
	(0.269)	(0.222)	(0.0353)	(0.325)	(0.286)	(0.0434)
Unemployment rate	4.579***	3.326***	1.339***	5.626***	4.591***	1.301***
	(0.767)	(0.643)	(0.173)	(0.998)	(0.776)	(0.217)
Social assistance recipients	0.00154***			-0.000684		
	(0.000593)			(0.000477)		
Construction completions	0.0124	-0.123***	0.0305**	-0.0350	-0.0545	-0.136***
	(0.0381)	(0.0254)	(0.0131)	(0.0378)	(0.0333)	(0.0111)
Constant	16.75	16.54***	16.47***	12.95	12.90	12.73***
	(1,182)	(0.104)	(0.0914)	(131.3)	(40.44)	(0.100)
Observations	1,746,251	1,984,633	1,984,633	1,035,728	1,188,929	1,188,929
R-squared	0.399	0.390	0.388	0.426	0.426	0.425
YEAR FE	YES	YES	YES	YES	YES	YES
DISTRICT FE	YES	YES		YES	YES	
Observation period	2011-2019	2010-2019	2010-2019	2011-2019	2010-2019	2010-2019

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 9: Subsamples - Micro data analysis - Rent-price ratio and rent brake - Division by building permits with lag = 8 quarter

VARIABLES	(88)	(89)	(90)	(92)	(93)	(94)
	Few building permits. Lag: 8 quarter			Many building permits. Lag: 8 quarter		
Treatment municipality ($municip\_reg_m$)	-0.0116**	-0.0147***	0.00696**	-0.0194***	-0.0265***	0.00277
	(0.00566)	(0.00503)	(0.00345)	(0.00604)	(0.00532)	(0.00371)
Rent brake * reg ($municip\_reg\_applied_{mq} * object_{reg_i}$)	-0.0536***	-0.0579***	-0.0673***	-0.103***	-0.102***	-0.117***
	(0.00560)	(0.00550)	(0.00519)	(0.00711)	(0.00690)	(0.00631)
Rent brake * unreg ($municip\_reg\_applied_{mq} * object_{unreg_i}$)	0.103***	0.115***	0.101***	0.177***	0.179***	0.159***
	(0.00716)	(0.00704)	(0.00678)	(0.00732)	(0.00711)	(0.00650)
Object-specific variables:						
Base yield	0.860***	0.866***	0.872***	0.913***	0.911***	0.917***
	(0.00167)	(0.00153)	(0.00140)	(0.00296)	(0.00240)	(0.00211)
Year of construction	-0.00786***	-0.00746***	-0.00721***	-0.00743***	-0.00679***	-0.00652***
	(4.72e-05)	(4.31e-05)	(4.21e-05)	(5.77e-05)	(5.10e-05)	(4.97e-05)
Living space	-0.00974***	-0.0101***	-0.00985***	-0.00731***	-0.00847***	-0.00825***
	(8.69e-05)	(7.87e-05)	(7.70e-05)	(9.56e-05)	(8.49e-05)	(8.26e-05)
Number of rooms	-0.0113***	-0.0129***	-0.0193***	0.0108***	0.00400*	0.00127
	(0.00236)	(0.00214)	(0.00210)	(0.00258)	(0.00231)	(0.00228)
Basement (Dummy)	0.000624	-0.00330	-0.00581**	0.00500	-0.00115	-0.00358
	(0.00288)	(0.00258)	(0.00256)	(0.00305)	(0.00273)	(0.00269)
Balcony (Dummy)	0.175***	0.184***	0.184***	0.133***	0.157***	0.154***
	(0.00329)	(0.00303)	(0.00303)	(0.00391)	(0.00355)	(0.00354)
Object condition (1 = new; 10 = demolition)	0.00156**	0.00665***	0.00726***	0.0318***	0.0322***	0.0321***
	(0.000664)	(0.000597)	(0.000594)	(0.000657)	(0.000596)	(0.000592)
Region specific variables:						
Urban area (Dummy) (Regional centers)	-0.0436***	-0.0366***	-0.0490***	-0.0537***	-0.0442***	-0.0624***
	(0.0114)	(0.0103)	(0.00500)	(0.0108)	(0.00981)	(0.00588)

City / Metropolitan area (Dummy)	-0.0121	-0.0155	-0.0496***	0.0307*	0.00618	-0.0200***
	(0.0117)	(0.0108)	(0.00527)	(0.0165)	(0.0144)	(0.00671)
West / East Germany (Dummy)	0.947***	0.902***	0.00376	-0.0708	0.00644	0.0364***
(1 = West, 0 = East)	(0.0575)	(0.0545)	(0.00523)	(21.65)		(0.00558)
Socioeconomic variables:						
Population density	-0.0433***	-0.0356***	-0.0670***	-0.0160***	-0.0136***	-0.0294***
	(0.00483)	(0.00426)	(0.00213)	(0.00469)	(0.00418)	(0.00199)
Population growth	0.0115	-0.0273	0.313***	0.158*	0.118	0.385***
	(0.0917)	(0.0895)	(0.0851)	(0.0885)	(0.0862)	(0.0819)
Primary income per capita	-0.0180***	-0.0172***	0.00507***	5.78e-05	-0.00346***	0.00379***
	(0.00256)	(0.00224)	(0.000411)	(0.00152)	(0.00123)	(0.000387)
Students	-2.080***	-1.850***	0.174***	-0.481	-0.438*	0.253***
	(0.256)	(0.208)	(0.0351)	(0.328)	(0.253)	(0.0394)
Unemployment rate	4.608***	3.616***	0.989***	4.194***	4.790***	1.324***
	(0.754)	(0.608)	(0.163)	(1.012)	(0.707)	(0.196)
Social assistance recipients	0.00153***			0.00279***		
	(0.000577)			(0.000535)		
Construction completions	0.0542*	-0.0633***	-0.00802	-0.142***	-0.0250	-0.0723***
	(0.0319)	(0.0197)	(0.0105)	(0.0367)	(0.0211)	(0.0106)
Constant	16.27***	15.51***	15.50***	14.94	13.83	13.50***
	(0.109)	(0.0976)	(0.0853)	(58.10)		(0.101)
Observations	1,816,561	2,158,836	2,158,836	1,030,984	1,373,259	1,373,259
R-squared	0.402	0.392	0.390	0.445	0.438	0.437
YEAR FE	YES	YES	YES	YES	YES	YES
DISTRICT FE	YES	YES		YES	YES	
Observation period	2011-2019	2010-2019	2010-2019	2011-2019	2010-2019	2010-2019

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

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