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Market Break or Simply Fake? Empirics on the Causal Effects of Rent Controls in Germany

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Market break or simply fake?
Empirics on the causal effects of rent controls in Germany

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Abstract

Rising rents in German cities have led to an intense debate about the need for tighter rent controls in housing markets. In June 2015, the so-called *rental brake* was introduced, which imposes upper bounds for rents in new contracts, in order to immediately slow down the increase of rents in tight housing markets. Since then, 11 federal states made use of this instrument. We take advantage of this intra-country variation and test whether the regulation had a causal effect on rents and house prices in the short run. We apply a standard difference-in-differences setup that allows us to study the effects of the rental brake on the underlying price trend in neighboring treated and non-treated postal-code districts. We ground our analysis on a large sample of online advertised rental dwellings and find that, contrary to the expectations of the policy makers, the rental brake has, at best, no impact in the short run. At worst, it even accelerates rent increases both in municipalities subject to the rental brake and in neighboring areas. We further conclude, based on our estimates on the development of dwelling prices, that investors expect on little impact on future rental income.

Keywords: Housing policy; rental housing; Germany; rent controls; rental brake.

JEL classification: K23; N9; R30.

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1. Introduction

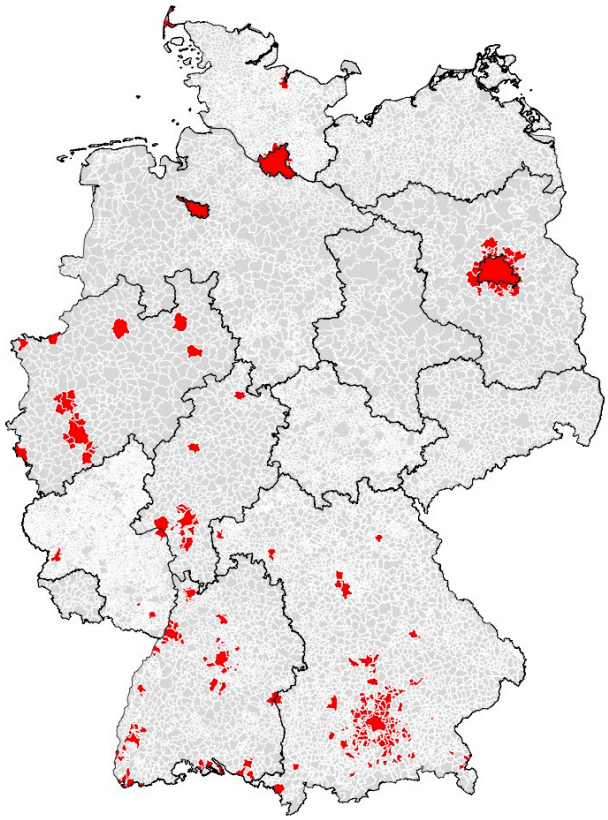
Housing market regulation and, in particular, rent controls are subject to longstanding debate amongst scholars: almost every textbook on housing and real estate economics addresses these issues (see, e.g. McDonald and McMillen, 2010; O'Sullivan and Irwin, 2007)— most likely because housing markets are subject to substantial regulatory interventions in almost every market economy around the world. In situations of tight housing markets, affordability is also a major concern of politicians during election campaigns. For example, Harry S. Truman won the race for the White House in 1948 by highlighting that resolving housing shortages would be a key action point in his electoral program, his *Fair Deal* (Von Hoffman, 2000). Affordable housing remains a vibrantly debated topic: in the light of sharply increasing rents in urban areas in Germany, the Social Democrats succeeded in launching a discussion around the need for stricter rent controls in the German Bundestag elections in 2013 (Knaup et al., 2013). Housing also played a major role in the 2015 UK general elections, with every party setting up an agenda to slow down rent increases and to stimulate construction of affordable homes (Kelly, 2015).

In general, rent controls are intended to mitigate the consequences of short-run rigidity of housing supply and cyclical construction activity. By leveling rents, segregation and increasing inequality should be avoided (Arnott, 1995). So-called *first-generation* rent controls imposed rent ceilings or even temporarily frozen rents. *Second-generation* controls, implemented since the mid 1960s, are more flexible by allowing rents to increase, for example, in line with the consumer price index (Turner and Malpezzi, 2003). The extensive economic literature almost unanimously opposes these regulations—even the more flexible forms—finding them to be inefficient instruments at fighting the effects of housing market shortages (Arnott, 1995; Glaeser and Luttmer, 2003). Available studies suggest that rent controls cause immediate reductions to the market value of rental housing (Early and Phelps, 1999; Fallis and Smith, 1985; Marks, 1984), depress refurbishment, reduce maintenance (Kutty, 1996; Andersen, 1998; Olsen, 1988b; Moon and Stotsky, 1993; Sims, 2007), slow construction activity (McFarlane, 2003; Glaeser and Luttmer, 2003), and induce inefficient allocation of flats (Glaeser and Luttmer, 2003; Arnott and Igarashi, 2000), while—in the short run—having ambiguous effects on rents (Nagy, 1997; Early, 2000; Fallis and Smith, 1984; Smith, 1988). Furthermore, the targeted groups only partially benefits (Linneman, 1987; Ault and Saba, 1990; Glaeser, 2003). These results are mainly grounded on theoretical models that—depending on the viability of the assumptions—provide, at best, ambiguous results on the effects of rent controls, as some authors criticize in this context (Arnott, 1995; Olsen, 1988a,b).

Surprisingly, there is only little empirical evidence on the effects of rent controls, in particular the impact on controlled rents and prices. Most available studies lack an adequate empirical design (for example, Ambrosius et al., 2015, ground their analysis simply on correlations of rent levels and other variables in regulated and unregulated markets) to really disentangle the effects of rent caps on the underlying trend

of rent dynamics from the housing market cycle or other factors. Most likely robust empirical evidence is missing because quasi-experimental setups or adequate data to analyze the development of prices and rents are hard to find: rent controls are in many countries introduced at the national or state level, while housing markets are of local nature, with data on the community or postal-code level needed. As of June 2016, to our knowledge, there is only one empirical study that draws causal inferences. Sims (2007) uses a difference-in-differences setup and finds that rent controls had only a little effect on construction activity, but shift dwellings from rental to owner-occupied status. Rent controls also led to a deterioration in the quality of rental units. Further, Sims (2007) finds that rent controls reduced rents substantially but had only little impact on the price of the non-controlled rental housing stock.

Figure 1: Municipalities with *Rental brake* in Germany, as of June 2016



In this context, the 2015 introduction of a *rental brake* in Germany[1] in Germany constitutes an excellent test case to provide more empirical evidence on the effects of rent controls. In March 2015,

[1]The 2015 German rental brake (*Mietpreisbremse*) is a new regulation that imposes an upper bound on rent increases in new rental contracts.

the German Bundestag passed a law that allowed the federal states to impose rent caps in order to immediately slow down the increase of rents in tight housing markets. Since then, 11 federal states made use of this instrument and introduced the *rental brake* in a number of municipalities. The spatial distribution is depicted in Figure 1.

This specific case has only been rarely studied. Deschermeier et al. (2016), p. 19, conclude, based on descriptive comparisons of advertised rents vs. typical local rents in the Berlin and Cologne housing markets, that the "new rent regulation is rather a rent freeze than a limitation of rental price increases." Thomschke and Hein (2015) analyze the effects on regulated rents based on difference-in-differences regressions. They compare the development of advertised rents in Berlin, a regulated market, to six other unregulated metropolitan housing markets, Cologne, Düsseldorf, Frankfurt, Hamburg, Munich, and Stuttgart. The authors find that rent controls in Berlin indeed had a decelerating effect on rent development. However, the authors acknowledge that the chosen empirical setup can be heavily contested. Hein and Thomschke (2016) descriptively analyze the dynamics of advertised rents in six cities (Berlin, Cologne, Düsseldorf, Frankfurt am Main, Hamburg, and Munich), concluding that the rental brake was ineffective in combating the rent increases.

Our study focusses on the short-run effects of the *rental brake*. Specifically, we are interested in the question of whether the regulation is effective in slowing down rent increases. In this context, a natural thing to look at is the development of rents in new rental contracts. Moreover, investor/landlord expectations about the effectiveness of the regulation should be capitalized in house prices. Thus, if the regulation effectively levels rent increases, then house prices in both the rental segment and available to use dwellings should also be negatively affected. Other consequences, like, for example, the impact on new construction, maintenance, or the allocation of flats among household groups can only be studied in the long run. To check whether the politically intended slowdown of rent increases can be interpreted as a causal effect of the regulation, we take advantage of intra-country variation of neighboring regulated and unregulated municipalities. We apply a standard difference-in-differences setup that allows us to study the effects of the *rental brake* on the underlying price trend in directly neighboring treated and non-treated postal-code districts. We ground our analysis on a large sample of online advertised apartments for rent/sale and find that, contrary to the expectations of policy makers, the *rental brake* has at best no impact in the short run. At worst, it even accelerates rent and prices increases in municipalities subject to the *rental brake* and in neighboring areas.

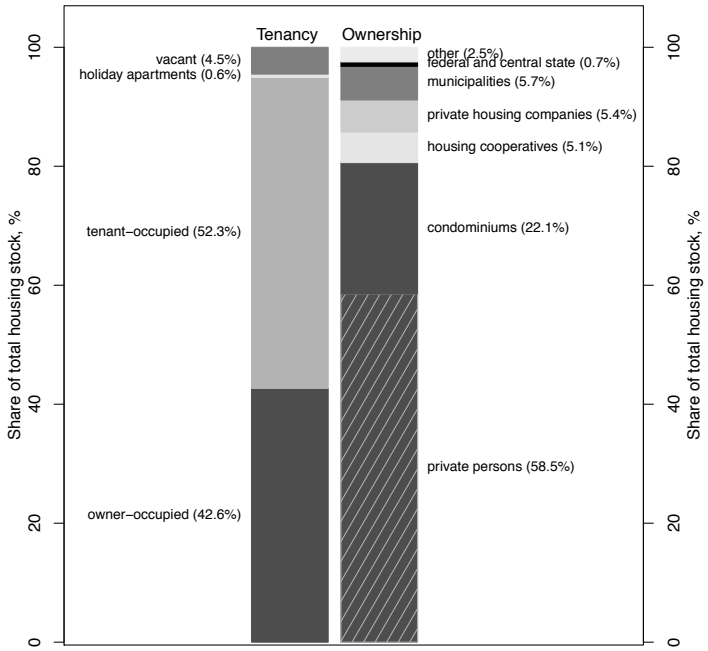
The remainder of this paper is structured as follows: in the next section we present stylized facts about recent developments of the German housing market and outline the institutional setting of rent controls. In section 3, we present our empirical strategy, describe the data used and the results obtained from our regression analysis. In the final section, we discuss our results.

2. Institutional setting and stylized facts

2.1. The German housing market

The German housing market is characterized by a relatively low homeownership rate and, thus, a large share of tenant households (see Figure 2). According to official data (Federal Statistical Office, 2013), housing expenses—including rental payments, heating, and maintenance—of German households account for approximately 34% of their total expenditures. The net rent (27% of all expenses) is the largest component of private consumption, the next being transportation at just 14%. Thus, changes in rental expenditures have immediate impact on the well-being of a large proportion of the German population, especially in urban areas.

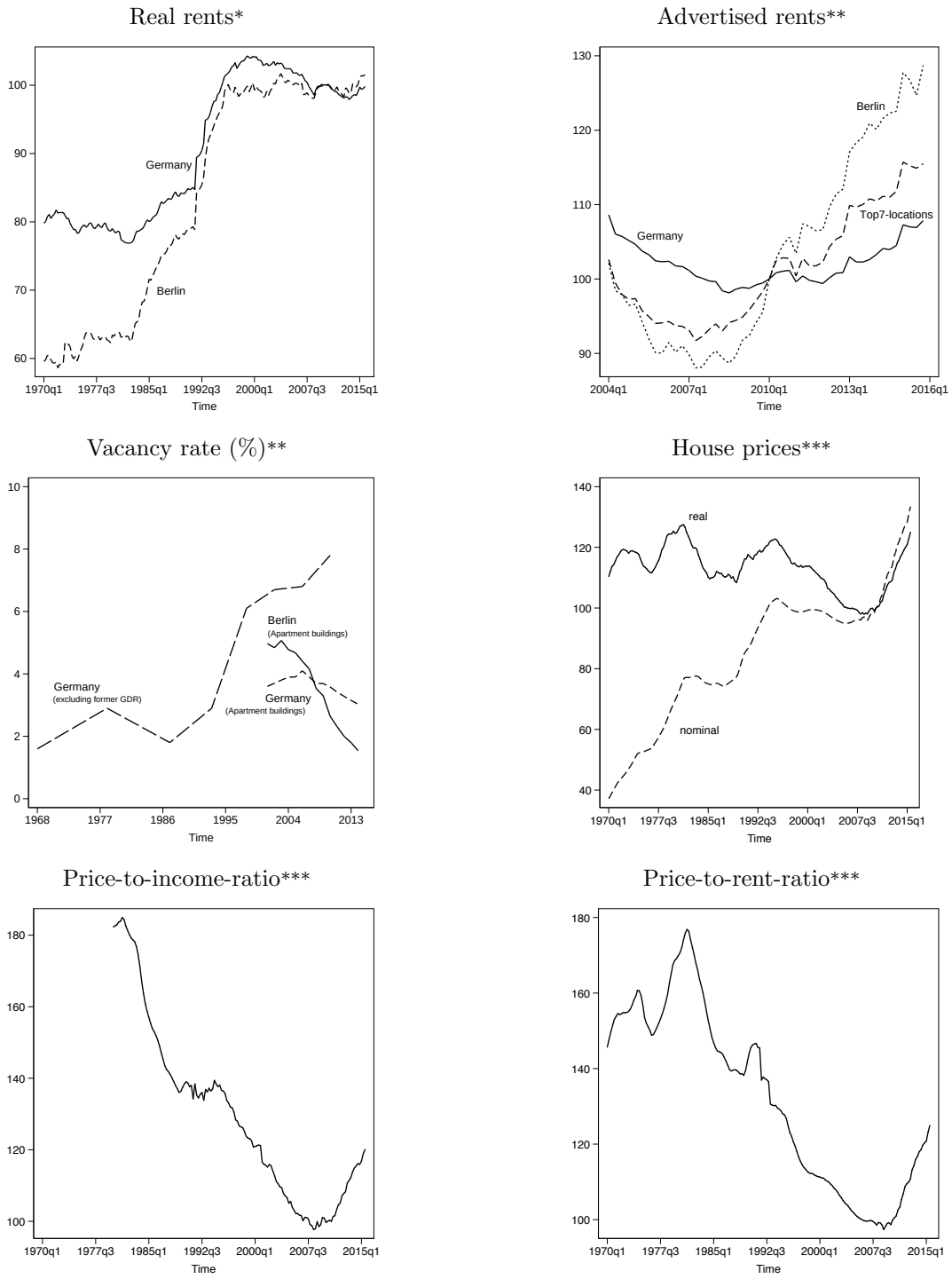
Figure 2: Investors in the German housing market



Source: Statistische Ämter des Bundes und der Länder (2014).

Between 1995 and 2010, the situation at the German housing market was relaxed. Low birth rates, outmigration from city centers to the periphery and high construction activity in the 1990s contributed to this development. However, in 2010, a new trend started. Urban agglomerations became more attractive. Thanks to an inflow of migrants from smaller settlements and from abroad, the population of large German cities began to expand quickly. The result was a housing shortage, putting pressure on rents for new contracts (see Figure 3) and growing discontent of tenants.

Figure 3: Development of house prices, rents, and disposable income



Source: *Federal Statistical Office (*Statistisches Bundesamt*), Statistical Office for Berlin-Brandenburg (*Amt für Statistik Berlin-Brandenburg*); calculations by the authors; Index 2010=100; **empirica ag; ***OECD.

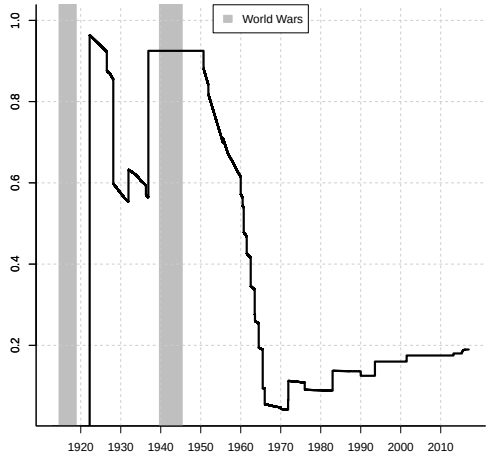
This development is well reflected in figures on house prices and rents. After 15 years of stagnation, house prices started to increase rapidly. Since 2010, real house prices increased by 25% and are fast approaching the all-time high observed in the early 1980s (see Figure 3), which can at least partly be explained by the extremely loose monetary policy of the European Central Bank. Rents—as a reflection of demand-side market fundamentals—also increased on average over 2010–2015, but did not experience as much momentum as did house prices. The rent increases are particularly driven by the development of new rental contracts in metropolitan areas like Berlin, Munich, Hamburg, Cologne, Düsseldorf, Stuttgart, and Frankfurt (Top7-locations). Here, the advertised rents increased by roughly 20% between 2008 and 2016; in Berlin actually by 40%.

The development also translates into substantially increasing price-to-income and price-to-rent ratios. Investors are obviously willing to take more risk and affordability of homes has decreased in recent years. However, as rents and disposable income of households have—historically—increased faster than house prices, both ratios are still well below the long-run average.

2.2. Rent controls in Germany

Rent controls in Germany have a long history. First introduced in the early 1920s, many regulations often rudimentary, were in place for decades. Figure 4 depicts the changes of rent controls between 1914 and 2015 as an index of regulatory intensity.[2]

Figure 4: Index of rent controls, 1913–2015



[2]The index was constructed by Kholodilin (2015) and is based on a systematic analysis of the corresponding German legislation between 1913 and 2015. Legal acts (laws and ordinances), principally at the federal level, are used to develop the measure. Since 1970, the legislation of federal states is also taken into account. The respective regulations are represented as dummy variables, summed up, and scaled to vary between 0 and 1. In addition, the scope of these restrictions (e.g., rent controls encompass only housing completed before 1948) is accounted for, so that the index reflects the effective degree of regulation. Thus, the higher the index the stronger are rent controls imposed by the state.

It is apparent that regulation of rental housing is a preferred policy option in times of extremely tight housing markets, e.g., war time. The early, first-generation, rent controls, introduced after World War I in response to a huge housing shortage, were considered as temporary measures. Rents for existing dwellings were frozen at the levels of 1914. However, with the exception of a short period of loosened regulation in the early 1930s, rents were frozen until the late 1960s. In some major cities —like Berlin, Hamburg, and Munich—rents were frozen even longer.

So-called second-generation rent controls were put in place in 1972. Instead of freezing rents at some fixed level, the rents were loosely anchored to some proxy of a market rent.[3] In 1982, rent increases were restricted by the so-called *capping limit*. It represents a cap on increasing the rent within an existing contract[4].

2.3. Regulatory interventions since 2010

In 2013, German federal states were empowered to determine areas, where a sufficient supply of rental dwellings under reasonable conditions is particularly endangered and where the capping limit (see above) could be further lowered to 15% rent increase within 3 years (4.8% annually). Thus, it introduced an opportunity for region-specific capping limits. Since then, 11 out of 16 German federal states took advantage of this option, identifying municipalities, where it is applicable, see Table 1 and Table 2.

Table 1: Capping limits regulations by federal states

Federal state	Regulation	Validity period	Regulated/all municipalities
Baden-Württemberg	KappungsgrenzenVO Baden-Württemberg	2015/07-2020/06	44/1101
Bavaria	WohnungsgebieteVO	2012/07-2022/06	90/2056
Bavaria	KappungsgrenzesenkungsVO	2013/05-2018/05	90/2056
Bavaria	MieterschutzVO	2016/01-2020/07	90/2056
Bavaria	WohnungsgebieteVO	2012/07-2022/06	90/2056
Bavaria	Zweite KappungsgrenzesenkungsVO	2013/07-2015/12	90/2056
Berlin	Kappungsgrenzen-VO	2013/05-2018/05	1/1
Brandenburg	VO zur Senkung der Kappungsgrenze	2014/09-2019/08	30/419
Bremen	Kappungsgrenzen-VO	2014/09-2019/08	1/2
Hamburg	KappungsgrenzenVO	2013/09-2018/08	1/1
Hesse	Hessische KappungsgrenzenVO	2014/10-2019/10	29/426
North Rhine-Westphalia	KappungsgrenzenVO	2014/06-2019/05	59/396
Rhineland Palatinate	KappungsgrenzenVO	2015/02-2020/02	4/2306
Sachsen	Kappungsgrenzen-VO	2015/07-2020/06	1/468
Schleswig-Holstein	Schleswig-Holsteinische KappungsgrenzenVO	2014/12-2019/11	15/1116

In 2015, the German government introduced the *rental brake*. Like the capping limit it is a regulation for local markets: federal states may identify municipalities or areas within municipalities with a tight housing market (*angespannter Wohnungsmarkt*). Typically the rental brake is implemented on the

[3]The so-called typical local rent (*ortstübliche Miete*) was defined as a four year average of the rent paid within a municipality or similar municipalities for dwellings of comparable type, size, equipment, quality, and location.

[4]Initially, it was allowed to raise rent at most by 30% within 3 years, which corresponds to 9.1% annually. In 1993, the limit was lowered to 20% within 3 years (6.3% in a year).

municipal level. For a maximum of five years, a municipality or part of it can be declared as a tight housing market if at least one of the following four criteria is met: 1) local rents grow faster than at the national average; 2) the local average rent-to-income ratio is significantly higher than the national average; 3) population grows, whereas new housing construction does not create enough dwellings; or 4) vacancy rate is low, while demand is high. The *rental brake* regulates rents in new contracts. Here, rents are not allowed to exceed the typical local rent by more than 10%.[5] There are two exceptions from the law. First, rents are freely negotiable for contracts of newly built dwellings (housing completed after October 1, 2014) and all contracts to follow. Moreover, rents are unregulated in the first contract after a substantial refurbishment of an existing dwelling.

Table 2: *Rental brake* regulations by federal states

Federal state	Regulation	Validity period	Regulated/all municipalities
Baden-Württemberg	MietpreisbegrenzungsVO	2015/10-2020/09	68/1101
Bavaria	MietpreisbremseVO	2015/08-2020/07	144/2056
Bavaria	MieterschutzVO	2016/01-2020/07	9/2056
Berlin	MietenbegrenzungsVO	2015/06-2020/05	1/1
Brandenburg	MietpreisbegrenzungsVO	2016/01-2020/12	31/419
Bremen	Mietenbegrenzungs-VO	2015/12-2020/11	1/2
Hamburg	MietpreisbegrenzungsVO	2015/07-2020/06	1/1
Hesse	MietenbegrenzungsVO	2015/11-2019/06	16/426
North Rhine-Westphalia	MietpreisbegrenzungsVO	2015/07-2020/06	22/396
Rhineland Palatinate	MietpreisbegrenzungsVO	2015/10-2020/10	3/2306
Schleswig-Holstein	MietpreisVO	2015/12-2020/11	12/1116
Thuringia	MietpreisbegrenzungsVO	2016/04-2021/01	2/913

Compared to regulations in other countries, the measures introduced in Germany differ to some extent, as they concentrate on new rental contracts. Commonly, rents in existing rental contracts are regulated. For example, in the United States, many regions implement so-called base rents. Their development is in some areas—similar to the German capping limits system—regulated to grow at a fixed annual rate. In other regions, rents are tied to the increase of the US-wide or local consumer price index. Yet, for instance, in New York City, annual rent increase rates are determined by local authorities, which may sometimes even freeze rents (see, for an overview of rent controls in the USA Ambrosius et al., 2015; Gilderbloom, 2009). Thus, the common heading of "rent controls" can signify sometimes very different settings, which are hard to compare.

Since implementation of the corresponding federal law in Germany, eleven federal states made use

[5]As the value of the typical local rent is not observable, it can only be approximated using one of three methods: 1) a so-called *Mietspiegel*, that is, a survey of typical rents in the region or similar region conducted or recognized by the municipality or by representatives of landlords' and tenants' associations, which should be updated every two years; 2) report by a sworn expert; or 3) rents in three dwellings of other landlords. The Mietspiegel is considered to be the most objective and affordable way of determining the typical local rent. However, apart from many methodological drawbacks (for a detailed discussion, see, Lerbs and Sebastian, 2015), the major pitfall is that a *Mietspiegel* is simply not available for many municipalities subject to the rental brake.

of it (as of June 2016, see Table **??**). Two years after its introduction, capping limits cover more than one-fourth of the housing (28.5%) in 338 municipalities, benefiting 22.5 million inhabitants. The *rental brake* covers 26.4% of dwellings in 308 municipalities with a total of 20.7 million inhabitants. At least one regulation is valid in 382 municipalities representing 30% of the national housing stock. Both of them are in force in 264 municipalities (25% of German dwellings). The municipalities subject to both regulations are significantly larger (around 67,000 vs. 7,000 inhabitants) and have a substantially lower homeownership rate (29% vs. 43%) compared to the national average. Thus, the regulation concentrates on urban areas, where rent and house price increases have gained strong momentum since 2011 (see section 2.1).

3. Empirical analysis

In the empirical analysis, we address the short-run effects of rent regulation on regulated rents and prices of dwellings in regulated markets. To disentangle the general price trend from the effects of regulation, we follow a difference-in-differences approach, as proposed, for example, by Sims (2007). We ground our analysis on advertised rents and prices, which allows us to study the potential effects of the *rental brake* on a spatially highly disaggregated level. Moreover, this approach allows us to compare the development of regulated rents with adequate counterfactual dynamics, namely with the development of unregulated rents in a neighboring postal-code district. In the following, the data used, the identification, and the empirical setup are described in greater detail.

3.1. Data, sample restrictions, and identification

Data sources and data quality. The data used in this study are advertised rents and prices for dwellings from three large online real estate market places: *Immonet*, *Immowelt*, and *Immobilienscout24*. Although no perfect substitute for transaction data, asking price data are shown to reliably capture price trends (Lyons, 2013; Dinkel and Kurzrock, 2012). There can be significant differences between the transaction price and a first offer, but the literature also points out that systematic mis-pricing can be very costly to sellers of real estate (Knight et al., 1994; Knight, 2002; Merlo and Ortalo-Magné, 2004). Similar arguments apply to landlords who face a higher vacancy risk when the initial price is too high. The gap is greater in declining and smaller in increasing markets (Henger and Voigtländer, 2014). While this suggests that turning points of the market cannot be described adequately by indices based on asking prices, this cannot be observed in empirical applications (Lyons, 2013). House prices in the German cities under consideration grew constantly, at least since 2011. Importantly, there are no turning points of the market in the sample period. It is therefore likely that asking prices and rents are reliable proxies for transaction values in our case.

Sample and covariates. The sample covers the period from July 2011 through March 2016, allowing us to examine the initial phase of introduction of the *rental brake* throughout 2015. A long list of housing characteristics (like, for example, the type and size of the dwelling, number of bathrooms, balcony, fitted kitchen, etc.) and their quality (e.g., past refurbishments etc.) is included as well as information on the postal code of the dwelling. The variables are often used controls in hedonic studies, see, e.g., Malpezzi (2003) and Cheshire and Sheppard (1995). As an important feature for the present analysis, it is indicated whether dwellings offered for sale are available to use or rented out. Summary statistics for the three subsamples of dwellings i) offered for rent and sale; ii) *available to use*; and iii) *rented out*, can be found in Tables 5 through 7.

In addition to the characteristics of the dwellings, the postal code information was used to map observations to municipalities in order to add the *rental brake* information and other covariates. This mapping is ambiguous. Because postal code districts cover about 40,000 inhabitants, it is likely that a postal code district contains several municipalities in rural areas, whereas larger cities constitute a municipality, but there may be many postal codes within these cities. The second case is not problematic. In the first case, we completely exclude the postal code whenever there were municipalities with *and* without a rental brake among the matches. In other cases, the postal code was included and the average of the covariates in all matched municipalities was calculated. Specifically, we included the percentage population change in the municipality from 2011 to 2013 (pct_pop_change_2011_13), the employment change from 2008 to 2013 (pct_empl_change_2008_13), as well as the share of unemployed (2014, pct_unemp_2014) and unemployed of ages 15 to 25 (2014, pct_youth_unemp_2014) in terms of the total population in that municipality in 2013. The data are provided by the Federal Statistical Office (*Stastistisches Bundesamt*) and the Federal Employment Agency (*Bundesagentur für Arbeit*). These variables are useful as controls for local economic trends.

Sample restrictions and identification. To identify the causal effects of the *rental brake*, we restrict our sample. As the regulation does not tackle dwellings that are rented out for the first time after construction or substantial refurbishment, we exclude all flats with a building age of less than two years. Furthermore, three variables indicate whether the flat is new, rented out for the first time, or is in a "new condition." Observations of these types are also excluded from the sample.

We further restrict the remaining sample to one group of ads for dwellings (as treatment group) that are located in postal code districts subject to the *rental brake* and are directly neighboring a region where the market is unregulated. As control group, we use the observations from the neighboring unregulated districts. Thus, we exclude all observations from postal code districts that are not neighboring a counterfactual (i.e., city centers or rural areas). The underlying intuition is, that directly neighboring regions constitute a single market or are at least strongly interconnected. Thus, they should, under unregulated

conditions, follow a common price trend. Therefore, a deviation from the common trend in the regulated district after the treatment can be interpreted as a causal effect of the regulation.

Given these restrictions, around 57.5% of all rental flats (54.8%: flats available to use, 60.6%: rented out flats) are located in rental brake municipalities. The numbers for capping limits (caplim) are very similar (54.4%, 50.6%, and 56.3%, respectively). In total, there are 312,771 rental flats, 165,550 available to use flats, and 34,171 rented out flats in the restricted sample.

3.2. Empirical strategy

The goal of this study is to identify short-term effects of the *rental brake* on growth rates of rents and prices in controlled municipalities. The *rental brake* was introduced by the federal government, but is implemented by state governments, which are free to select individual municipalities to be regulated. In contrast to other schemes (Sims, 2007), all rental units in a controlled municipality are subject to the *rental brake*—except for newly constructed or modernized dwellings. For that reason, (most) variation takes place at the level of municipalities, not at the level of individual units (i.e., within an area).

In order to minimize inter-group variation between controlled and uncontrolled municipalities, we chose to focus on postal code districts in *rental brake* municipalities that border with postal code districts from an uncontrolled municipality. We then compare the change in the monthly growth rate of rents (prices) in *rental brake* postal code districts—the treatment group—and adjacent postal code districts from an uncontrolled municipality—the control group—that is due to the introduction of the *rental brake*. This is a difference-in-differences strategy that asks whether the *rental brake* affected the growth rate of rents in treated relative to non-treated similar units. Figure 5 shows the spatial distribution of treatment and control units, where grey lines indicate postal code borders.

Finally, as outlined in section 2.3, a second regulation of rents in existing rental contracts was recently introduced, which might bias our estimates. The tightening of the capping limit might incentivize landlords in the respective regions to further increase advertised rents compared to unregulated regions and thereby to fasten the increase of rents in new contracts. Many times, markets with a tightened capping limit are also subject to the *rental brake*. Thus, it needs to be controlled for this potential bias. In an alternative specification, we also consider an effect of the capping limit on the general price trend.

In a regression framework, the strategy translates into the following estimating equation:

$$\log R_i = x_i\beta + \gamma_0 t + \gamma_1(d_i^{\text{rb municipality}} \times t_i) + \gamma_2(d_i^{\text{rb active}} \times t_i) + \gamma_3(d_i^{\text{rb municipality}} \times d_i^{\text{rb active}} \times t_i) + \eta_i, \quad (1)$$

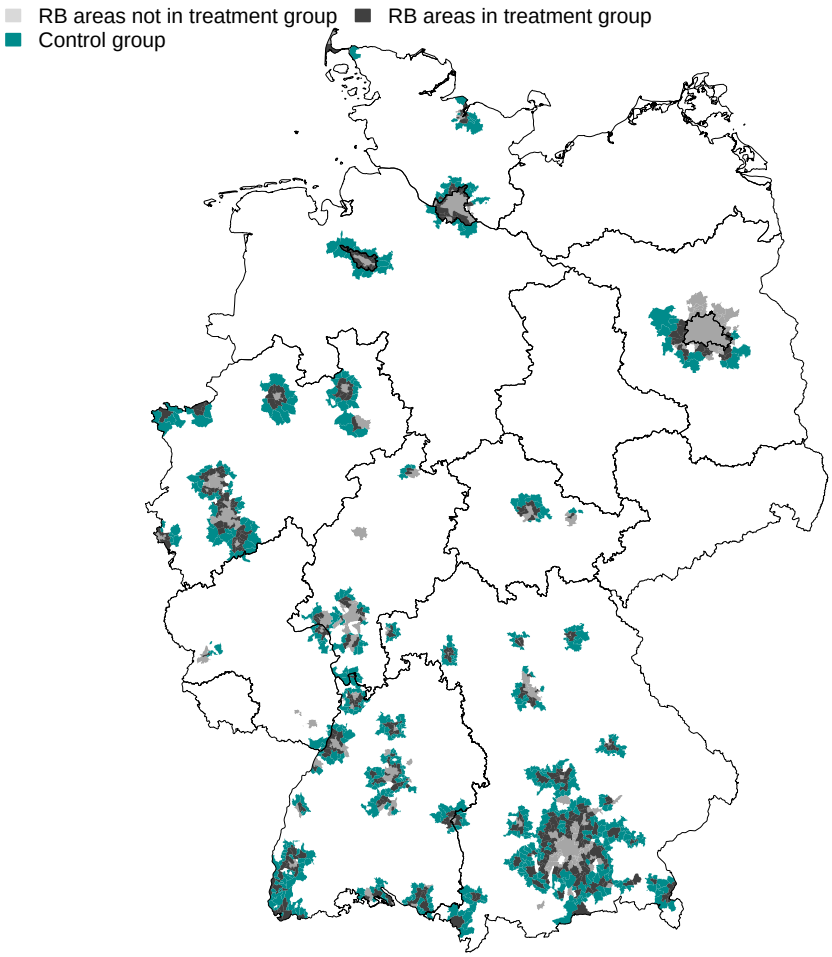
where $\log R_i$ is the logged net rent per square meter of dwelling i, x_i is a vector of housing and location characteristics as described in Table 5, and t is a monthly time trend. We apply the same framework to

the development of house prices (P_i):

$$\log P_i = x_i\beta + \gamma_0 t_i + \gamma_1(d_i^{\text{rb municipality}} \times t_i) + \gamma_2(d_i^{\text{rb active}} \times t_i) + \gamma_3(d_i^{\text{rb municipality}} \times d_i^{\text{rb active}} \times t_i) + \eta_i, \quad (2)$$

The two dummy variables, $d_i^{\text{rb municipality}}$ and $d_i^{\text{rb active}}$, refer to the *rental brake*. $d_i^{\text{rb municipality}}$ takes on the value 1, if observation i is located in a *rental brake* municipality (the treatment group). $d_i^{\text{rb active}}$ is equal to 1, if the *rental brake* is active (treated). This can either be in i-th municipality, if i is from a *rental brake* municipality, or in an adjacent municipality of a *rental brake* municipality, if i is a control observation. The interaction of both dummies captures the effect of the *rental brake* relative to the development of rents in adjacent municipalities that are not subject to the *rental brake*.

Figure 5: Treatment and control units



In the estimation, we allow the time trend to adjust four times: in March 2015, when the federal law

came into force; in May 2015, one month before the regulation could be put in force, according to the federal law; when the *rental brake* was switched on in the respective municipality; and three months after its activation. However, this does not change qualitatively the empirical strategy implied by eqations (1) and (2).

η_i is an error term that is not identically distributed. We account for local dependencies within postal code districts and calculate postal code clustered standard errors. Furthermore, the regression includes district dummies and interaction terms of these dummies with $d_i^{\text{rb municipality}}$ for all cases where *rental brake* municipalities and non-*rental brake* municipalities are present within a single district. Estimation of equation (1) was done by ordinary least squares (OLS).

4. Results

Table 3 displays regression results for the most important variables. The six estimated models have high explanatory power, as indicated by the adjusted R^2. For the rental model, the R^2 is 0.839, which is a fairly high value, given that the regression does not control for local price effects below the level of municipalities. Moreover, as there are 312,771 observations in the regression, coefficients are estimated very accurate. The same applies for prices, where the model of for available to use dwellings (R^2=0.828, N=155,058) and rented out flats (R^2=0.828, N=31,736) show high explanatory power and, again, very accurate estimates for the control variables. In all three models, almost all control variables are highly significant. Naturally, standard errors are larger in the third model, due to the smaller number of observations.

4.1. The effects on rents

The coefficients of main interest are presented in Table 3. The monthly trend is allowed to change four times: The first two instances are March 2015, when the *rental brake* law was passed (Mar15), and May 2015 (May15), one month before the law became effective on June 1, 2015. The other two depend on the introduction of the *rental brake* in the specific municipality (see also Figures 1 and 4). The trend is allowed to adjust the month the *rental brake* becomes active (rb_active) and once again three months after that date (rb_active_3plus_months). Please, note that these dates differ from municipality to municipality.[6] In total, this yields a base trends for all municipalities, an interaction term that captures the difference from this trend for all *rental brake* municipalities, and eight interaction terms (four for the *rental brake* municipalities and four for the control municipalities).

The base trend for rents is 0.00235, indicating a 0.235% monthly increase in rents on average in the municipalities of the control group. In *rental brake* municipalities, the average monthly rate is slightly

[6]The first three dummies capture temporary effects whereas the last dummy is equal to one after the respective date through the end of the sample period.

Table 3: Regression results: treatment effects

	log rent		*log listing price*			
			available to use		*rented out*	
	(1)	(2)	(3)	(4)	(5)	(6)
			a) baseline			
trend	0.00235***	0.00218***	0.00516***	0.00506***	0.00432***	0.00432***
	(0.00007)	(0.00010)	(0.00016)	(0.00018)	(0.00025)	(0.00026)
rb:trend	0.00026*	−0.00044	0.00075***	0.00066	0.00166***	0.00094
	(0.00011)	(0.00026)	(0.00022)	(0.00039)	(0.00033)	(0.00054)
trend:Mar15	−0.00017*	−0.00007	−0.00001	−0.00006	−0.00026	−0.00015
	(0.00008)	(0.00008)	(0.00016)	(0.00016)	(0.00035)	(0.00037)
trend:May15	0.00017**	0.00029***	−0.00028	−0.00024	0.00070**	0.00062*
	(0.00006)	(0.00007)	(0.00015)	(0.00016)	(0.00027)	(0.00028)
trend:rb_active	0.00007	0.00017*	−0.00019	−0.00009	0.00064*	0.00058
	(0.00006)	(0.00007)	(0.00014)	(0.00015)	(0.00031)	(0.00032)
trend:rb_active_3plus_months	0.00006	0.00019*	−0.00050*	−0.00035	0.00056	0.00052
	(0.00006)	(0.00008)	(0.00020)	(0.00023)	(0.00033)	(0.00035)
			b) treatment effects			
rb:trend:Mar15	0.00016	0.00019	−0.00048*	−0.00043	0.00066	0.00151*
	(0.00011)	(0.00018)	(0.00022)	(0.00034)	(0.00045)	(0.00070)
rb:trend:May15	0.00007	0.00011	−0.00007	−0.00004	−0.00038	−0.00044
	(0.00010)	(0.00017)	(0.00020)	(0.00034)	(0.00035)	(0.00064)
rb:trend:rb_active	−0.00005	0.00047*	0.00005	−0.00007	−0.00084*	−0.00049
	(0.00009)	(0.00018)	(0.00020)	(0.00036)	(0.00040)	(0.00060)
rb:trend:rb_active_3plus_months	0.00001	0.00060**	0.00035	0.00015	−0.00060	0.00089
	(0.00009)	(0.00019)	(0.00026)	(0.00049)	(0.00042)	(0.00061)
			c) capping limit			
trend:caplim		0.00136***		0.00113		0.00006
		(0.00039)		(0.00078)		(0.00103)
trend:Mar15:caplim		−0.00081**		0.00055		−0.00144
		(0.00028)		(0.00078)		(0.00143)
trend:May15:caplim		−0.00109***		−0.00023		0.00189
		(0.00022)		(0.00046)		(0.00103)
trend:rb_active:caplim		−0.00082***		−0.00107		0.00140
		(0.00018)		(0.00055)		(0.00143)
trend:rb_active_3plus_months:caplim		−0.00104***		−0.00142*		0.00057
		(0.00023)		(0.00070)		(0.00113)
			d) rental brake and capping limit (interaction)			
rb:trend:caplim		−0.00035		−0.00091		0.00077
		(0.00047)		(0.00086)		(0.00114)
rb:trend:Mar15:caplim		0.00066*		−0.00056		0.00036
		(0.00033)		(0.00085)		(0.00158)
rb:trend:May15:caplim		0.00092**		0.00015		−0.00170
		(0.00029)		(0.00058)		(0.00121)
rb:trend:rb_active:caplim		0.00011		0.00110		−0.00173
		(0.00026)		(0.00066)		(0.00154)
rb:trend:rb_active_3plus_months:caplim		0.00021		0.00146		−0.00217
		(0.00030)		(0.00085)		(0.00126)
R^2	0.83956	0.83987	0.82711	0.82719	0.82354	0.82366
Adj. R^2	0.83941	0.83971	0.82681	0.82687	0.82201	0.82208
Num. obs.	312769	312769	165550	165550	34170	34170
RMSE	0.16457	0.16442	0.23840	0.23835	0.22034	0.22029

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

higher by 0.026 percentage points, or 0.312 percentage points per year.[7] This suggests that there are indeed differences between *rental brake* municipalities and their non-brake neighbors in terms of rent increases, but these differences are rather small.

Two of the four interaction terms (Mar15, May15, rb_active, and rb_active_3plus_months) with the base trend are statistically significant, pointing to a temporary decrease in the growth rate of rents in *rental brake* and control municipalities, beginning in March 2015, followed by a movement in the opposite direction from May 2015 up to the point where the *rental brake* was installed in the corresponding *rental brake* municipality. However, the effect is very small (±0.017 percentage points).

Turning to the *rental brake* municipalities, none of the four interaction terms are significant. Note that estimation precision is extremely high. This means that the monthly growth rate of rents was similar in *rental brake and* control group municipalities shortly before the implementation of the *rental brake*, after the law passed, and even after the *rental brake* was "activated" in the specific municipality. In other words, it seems that the *rental brake* did not alter rent dynamics the way it was intended to do.

Column (2) includes further interaction terms with the trend variable to the model that allow different trends for municipalities with and without capping limits. Tighter capping limits were introduced in 2013 and, thus, preceded the *rental brake* by two years. There is a strong correlation between the spatial distribution of both regulations, see Table 4. Therefore, if a municipality is already subject to lower capping limits, it is likely that it will be subject to the *rental brake* as well. As a result, landlords might use this knowledge to set rents as high as possible.

Table 4: Capping limits and *Rental brake* by observations

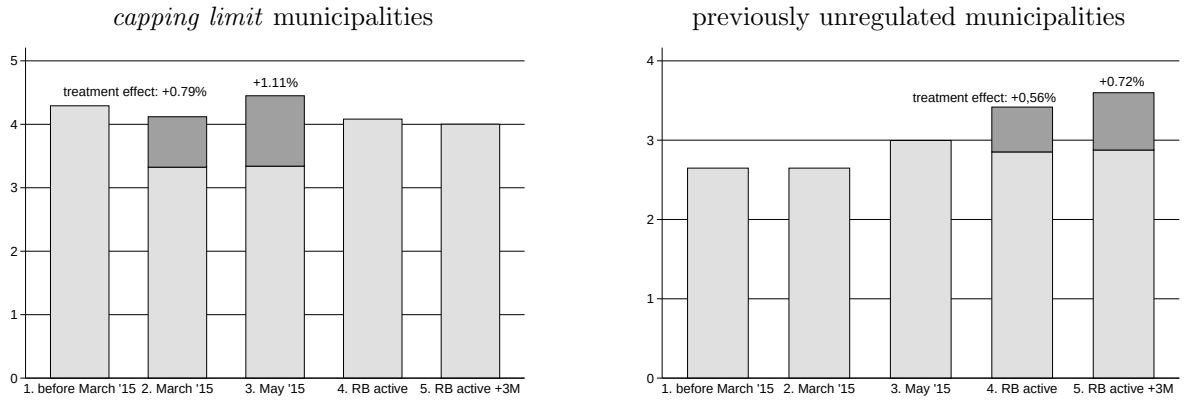
		a) rental		b) sale/available		c) sale/rented out	
		rental brake					
		no	yes	no	yes	no	yes
capping	no	117,099	25,589	68,154	13,548	12,313	2631
limit	yes	15,788	154,293	6641	77,207	1145	18,081

It must be noted that the overlap of the *rental brake* and capping limits is large, which reduces identifying variation for municipalities with capping limits, but no *rental brake* (and vice versa). The base trend changes only slightly. The model suggests that *rental brake* municipalities without a capping limit did not experience stronger monthly rental growth rates than control municipalities, whereas capping limit municipalities had significantly larger monthly rent growth (0.355%, compared to 0.219%). Furthermore, this difference became smaller throughout the year 2015, by approximately 0.1 percentage points. There seems to be a small, but persistent, *positive* effect of the *rental brake* after activation as well as a small positive temporary effect on *rental brake* municipalities with capping limits (see Figure 6).

[7] Please note that these numbers refer to postal code areas that are located at the borders of *rental brake* municipalities. For example, rent increases may have been different in the centers of large cities.

Comparing the two models, there are some municipalities (those without capping limits and with *rental brake*) that did not experience stronger rent increases than non-*rental brake* municipalities nearby. Controlling for these exceptions, the model suggests that the *rental brake* has the adverse effect of spurring rent increases. From the perspective of landlords and absent effective fines, this is an expected result because the *rental brake* never obliges landlords to lower rents. If a former tenant had paid a certain amount, he is always allowed to charge this amount to the next tenant. As long as enforcement is expected at some date in the future, it will be optimal for landlords to increase offered rents and trade-off higher vacancy risk against lower exposure to the *rental brake*.

Figure 6: Effects of the *rental brake* on regulated rents*



*annualized growth rates

4.2. Effects on the growth rate of flat prices

As the name suggests, the *rental brake* targets the rental housing market segment. Thus, it can be expected to alter price trends for rented-out dwellings. But it also might have effects on prices of flats that are available to use. Landlords with vacant dwellings can choose freely whether to sell or let the flat. Among other aspects, this decision depends on prospective rental income streams. As the *rental brake* reduced potential income in the future, the introduction might have led to an increased (short-term) supply of dwellings for sale that are available to use that might have a negative effect on the growth rate of house prices. In order to investigate these questions, we next estimate equation (2) for both segments, rental and available to use, separately.

Flats available to use. Columns (3) and (4) of Table 3 contain the estimation results for flats available to use. In general, the development of prices—the base trend—is more than twice as large as the base trend from the rental regression. Prices increased by approximately 0.516% per month during the past four and a half years in control municipalities, and even by 0.591% in *rental brake* municipalities. The interaction

terms suggest that the base rate decreased slightly for both groups toward the end of the sample period. The *rental brake* did not seem to have much effect. This picture does not change substantially once capping limits are considered (column (4)). The only notable result is a negative effect in capping limit municipalities toward the end of the sample period. The trend in *rental brake*-capping limit municipalities is not affected separately.

Rental flats. Obviously, there is a much closer connection between the *rental brake* and the prices of rental flats. Regression results are reported in columns (5) and (6) of Table 3. In column (5), the price trend is only slightly smaller than the corresponding trend for flats available to use, pointing to a stark contrast between rent and price development in the last last four years within the rental segment. On average, prices increased faster in *rental brake* municipalities. The *rental brake* influenced price growth only temporarily. Relative to the trend in the control group, the monthly growth rate of prices in the treatment group was lowered by 0.08 percentage points in the two months after activation. The temporary effect is not statistically significant, but negative and of the same size. This points to a mild reaction of landlords to the *rental brake*. Column (6), which includes capping limits, does not yield any additional insights. Almost all interaction terms are insignificant, probably because of insufficient identifying variation between municipalities regulated by a capping limit and a *rental brake*, see Table 4.

Overall, there are few signs of a reaction by landlords to the *rental brake*. While rents and prices of condominiums are largely unaffected, price growth of rented-out flats slowed down at least temporarily after the *rental brake* was activated. If at all, the *rental brake* accelerated rent growth. The prudent reaction of landlords who are affected by the *rental brake* suggests that they do not expect a significant reduction of rental income streams in the future (relative to the situation before the *rental brake*).

4.3. Control variables

Most control variables are significant and show the expected signs for both, the rental and the price models. Results are reported in Tables 8 and 9.

Rental model. In the rental model, building age is negatively correlated with rents and the year of construction categories exhibit a reasonable pattern. Relative to the base category, year of construction between 2011 and 2015, rents decrease steadily, reaching the bottom if year of construction falls within the years 1966 to 1975 (-0.194). After this, the pattern is stable in the pre-war years and rents are somewhat higher again for buildings constructed between the two world wars (-0.152) or before 1919 (-0.091).

A higher floor reduces net rent, probably because building height is not accounted for separately. Quality indicators (second bathroom, garden use, built-in kitchen, elevator, floor heating, renovated con-

dition, high or luxury quality, parquet flooring, air condition) all increase net rents. The only exceptions are the presence of a balcony (significantly negative) and a loggia (insignificant).[8]

If parking is available, net rents increase, and this relationship is stronger in densely populated areas. A notable exception are the two parking variables duplex and underground parking, both of which do not consume space since they are built into the ground. In line with theoretical expectations, their main effects are positive and significant, but the interaction with population density is insignificant and small.

Price models. Most control variables have similar signs. A notable exception is the presence of an elevator, where the main effect is insignificant, but the interaction term with floor is significantly negative. The interaction term might capture tall apartment buildings where elevators are standard. Furthermore, interaction effects of population density and parking lots are largely insignificant, potentially because parking might not be included in the flat's price in urban areas.

There is a much larger effect of year of construction in the sales models compared to the rental model. While the patterns are similar, effect sizes are roughly two- to threefold. This suggests that rents decrease less strongly as buildings deteriorate than do sales prices (cf. columns (1) and (3)). As a consequence, investment in retrofitting becomes less attractive for landlords unless they want to sell the dwelling. A similar conclusion follows from the comparison of the condition variables. If a dwelling needs renovation, this depresses sales prices much more (by roughly 12%) than rents (by roughly 6%). A similar bias can be observed when looking at the quality indicators. Rent premia for luxury objects are smaller than sales price premia, while the opposite holds for low-quality objects. Altogether, these observations can be explained quite well by the "landlord-tenant dilemma", i.e., information asymmetries between landlords and tenants (see, e.g. Schleich and Gruber, 2008).

5. Conclusion

This paper investigates the short-run effects of the German *rental brake* that was introduced in 2015. The spatially disaggregated intra-country variation is used to assess these effects in a standard difference-in-differences approach. The paper tested whether the monthly growth rate of rents and prices between July 2011 and March 2016 was altered upon activation of the *rental brake* by comparing municipalities subject to the *rental brake* to adjacent non-brake municipalities. In this context, the paper is among the first to empirically assess the causal effects of rent regulation on house prices and rents, i.e., whether the regulation of rents in new rental contracts helped to slowdown rent and house price increases, as intended by policy makers.

[8] One reason behind the negative balcony coefficient might be that the balcony and terrace variables overlap as some observations indicate that "balcony or terrace" are available. In these cases, both variables are set to 1. Thus, part of the balcony effect is captured by the terrace coefficient. The latter is significantly positive and ten times larger in absolute value than the balcony coefficient.

Based on the empirical results, we can draw two main conclusions. First—in contrast to the expectation of policy makers—the *rental brake* appears to have no effect on the underlying general price trend. Comparing the price development in regions with and without such regulation reveals, that, temporally, the introduction of the *rental brake* even accelerates rent increases. Thus, in the short run, the *rental brake* appears ineffective or even counterproductive in leveling the price increases of new rental contracts.

Second, landlords do not seem to care much about the new regulation in the long run. Beside the fact that the general trend of increasing rents appears unbroken, the prices of rental dwellings and dwellings that are available to use are also only slightly affected. In other words, as prices are of forward looking nature, investors even do not expect to be affected by the regulation in the medium or the long run.

Overall, we do not find evidence for the effectiveness of a regulation of new rental contracts, which supports the main strand of the literature opposing against rent regulations. It appears that in the present context, the institutional setting of the *rental brake* is incomplete. Specifically, as the *rental brake* refers to a "market rent" to set rent level in new contracts, a robust statistical reference value is needed for all market segments. There is evidence that in many regulated regions such basic information is absent. In this light, it appears logical that the regulation is ineffective. Further, new tenants are on their own when concluding new contracts. In case of an overcharged rent advertisement, prospect tenants have no instrument to force the landlord to adjust his offer before signing the contract—tenants have to sue the landlord afterwards. In this context, tenants run the serious risk of loosing the trial because it is legal to demand a rent that has been agreed upon in the previous contract—even if this was overcharged compared to the "market rent." In this light, it also appears reasonable that investors obviously do not expect to be bothered by the regulation in the future.

These results hold important implications for policy makers. In general, to design an effective instrument, regulations need a complete institutional environment. In the *rental brake* context, it is the statistical foundations for the "market rent"that urgently need to be developed. However, providing a robust empirical basis is data-demanding and complicated. As an alternative, one could more generally refer to the development of the consumer price index (possibly excluding its housing cost component), which is usually available on a regionally disaggregated level and, moreover, is available at short notice. Finally, to make the instrument effective, it is absolutely essential to strengthen tenants' options to enforce their rights.

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Appendix

Table 5: Summary statistics for rental flats

	Mean	St. Dev.	Min	Max	Description
rent	591.8	270.3	100.4	3495.0	*monthly net rent*
area	75.5	28.6	15.4	295.0	*living area*
yc	1977.56	25.19	1802	2014	*year of construction*
building_age	30.95	24.61	2	212	*time since (re-)construction*
rooms	2.69	0.97	1	7	*Number of rooms*
floor_NA	0.29	0.45	0	1	*floor number not indicated*
floor	1.18	1.55	-1	34	*floor number*
elevator	0.15	0.36	0	1	*elevator access*
second_bathroom	0.18	0.39	0	1	*two or more bathrooms*
garden_use	0.18	0.39	0	1	*access to garden*
built_in_kitchen	0.37	0.48	0	1	*equipped w/ built-in kitchen*
floor_heating	0.08	0.27	0	1	*dwelling has floor heating*
self_cont_heating	0.06	0.24	0	1	*dwelling has self-contained heating*
central_heating	0.65	0.48	0	1	*dwelling has central heating*
cond_renovated	0.15	0.36	0	1	*renovated dwelling*
cond_needs_renov	0.01	0.08	0	1	*dwelling is in poor condition*
qual_luxury	0.01	0.10	0	1	*very high quality*
qual_high	0.16	0.37	0	1	*high quality*
qual_low	0.01	0.08	0	1	*low quality*
type_regular	0.51	0.50	0	1	*regular dwelling*
tpye_top_floor	0.14	0.34	0	1	*dwelling is on top floor*
type_ground_floor	0.17	0.37	0	1	*dwelling is on ground floor*
type_terraced	0.02	0.14	0	1	*dwelling has a terrace*
type_souterrain	0.01	0.11	0	1	*dwelling is below ground floor*
type_maisonette	0.06	0.23	0	1	*dwelling spans two floors*
type_loft_studio	0.00	0.05	0	1	*dwelling is loft or studio*
type_penthouse	0.01	0.09	0	1	*dwelling is a penthouse apartment*
type_apartment	0.01	0.07	0	1	*dwelling is an apartment*
parquet_flooring	0.04	0.18	0	1	*dwelling has parquet flooring*
air_condition	0.00	0.04	0	1	*dwelling has air conditioning*
garage	0.10	0.30	0	1	*garage parking available*
carport	0.01	0.12	0	1	*carport parking available*
duplex	0.01	0.09	0	1	*duplex parking available*
undergr_parking	0.12	0.33	0	1	*underground parking available*
any_parking	0.33	0.47	0	1	*any parking available*
rooftop_terrace	0.02	0.13	0	1	*dwelling has a rooftop terrace*
balcony	0.52	0.50	0	1	*dwelling has a balcony*
terrace	0.36	0.48	0	1	*dwelling has a terrace*
winter_garden	0.01	0.08	0	1	*dwelling has a winter garden*
loggia	0.02	0.15	0	1	*dwelling has a loggia*
heating_gas	0.31	0.46	0	1	*heating fuel is natural gas*
heating_fluid_gas	0.00	0.02	0	1	*heating fuel is fluid gas*
heating_oil	0.08	0.28	0	1	*heating fuel is light oil*
heating_night_storage	0.00	0.06	0	1	*heating by electricity w/ night storage*
heating_electricity	0.02	0.14	0	1	*heating by electricity wo/ night storage*
heating_solar	0.00	0.05	0	1	*heating by solar energy*
heating_heat_pump	0.00	0.04	0	1	*heating by heat pump*
heating_wood_pellets	0.00	0.05	0	1	*heating by pellet combustion*
heating_geothermal	0.00	0.07	0	1	*geothermal heating*
heating_district	0.05	0.21	0	1	*district heating*
heating_small_district	0.00	0.01	0	1	*small district heating*
heating_coal	0.00	0.03	0	1	*heating by coal combustion*
brokers_commission	0.41	0.49	0	1	*commission payment required*
deposit	0.37	0.48	0	1	*renter pays deposit*
rb	0.58	0.49	0	1	*rental brake municipality*
caplim	0.54	0.50	0	1	*capping limit municipality*

Table 6: Summary statistics for flats available to use

	Mean	St. Dev.	Min	Max	Description
listing_price	162039.6	109703.0	25200.0	2250000.0	*sales price*
area	80.6	31.3	16.0	299.0	*living area*
yc	1979.91	20.57	1802	2014	*year of construction*
building_age	29.61	20.65	2	212	*time since (re-)construction*
rooms	2.89	1.04	1	7	*Number of rooms*
floor_NA	0.41	0.49	0	1	*floor number not indicated*
floor	1.20	1.81	-1	45	*floor number*
elevator	0.19	0.40	0	1	*elevator access*
second_bathroom	0.20	0.40	0	1	*two or more bathrooms*
garden_use	0.16	0.37	0	1	*access to garden*
built_in_kitchen	0.40	0.49	0	1	*equipped w/ built-in kitchen*
floor_heating	0.07	0.25	0	1	*dwelling has floor heating*
self_cont_heating	0.04	0.21	0	1	*dwelling has self-contained heating*
central_heating	0.59	0.49	0	1	*dwelling has central heating*
cond_renovated	0.10	0.30	0	1	*renovated dwelling*
cond_needs_renov	0.03	0.18	0	1	*dwelling is in poor condition*
qual_luxury	0.01	0.09	0	1	*very high quality*
qual_high	0.11	0.32	0	1	*high quality*
qual_low	0.01	0.10	0	1	*low quality*
type_regular	0.54	0.50	0	1	*regular dwelling*
tpye_top_floor	0.08	0.28	0	1	*dwelling is on top floor*
type_ground_floor	0.14	0.34	0	1	*dwelling is on ground floor*
type_terraced	0.02	0.14	0	1	*dwelling has a terrace*
type_souterrain	0.00	0.07	0	1	*dwelling is below ground floor*
type_maisonette	0.07	0.26	0	1	*dwelling spans two floors*
type_loft_studio	0.00	0.05	0	1	*dwelling is loft or studio*
type_penthouse	0.01	0.12	0	1	*dwelling is a penthouse apartment*
type_apartment	0.00	0.06	0	1	*dwelling is an apartment*
parquet_flooring	0.04	0.19	0	1	*dwelling has parquet flooring*
air_condition	0.00	0.05	0	1	*dwelling has air conditioning*
garage	0.12	0.33	0	1	*garage parking available*
carport	0.01	0.12	0	1	*carport parking available*
duplex	0.01	0.11	0	1	*duplex parking available*
undergr_parking	0.18	0.38	0	1	*underground parking available*
any_parking	0.36	0.48	0	1	*any parking available*
rooftop_terrace	0.02	0.15	0	1	*dwelling has a rooftop terrace*
balcony	0.51	0.50	0	1	*dwelling has a balcony*
terrace	0.33	0.47	0	1	*dwelling has a terrace*
winter_garden	0.01	0.10	0	1	*dwelling has a winter garden*
loggia	0.04	0.19	0	1	*dwelling has a loggia*
heating_gas	0.29	0.45	0	1	*heating fuel is natural gas*
heating_fluid_gas	0.00	0.02	0	1	*heating fuel is fluid gas*
heating_oil	0.09	0.28	0	1	*heating fuel is light oil*
heating_night_storage	0.00	0.05	0	1	*heating by electricity w/ night storage*
heating_electricity	0.02	0.13	0	1	*heating by electricity wo/ night storage*
heating_solar	0.00	0.03	0	1	*heating by solar energy*
heating_heat_pump	0.00	0.02	0	1	*heating by heat pump*
heating_wood_pellets	0.00	0.04	0	1	*heating by pellet combustion*
heating_geothermal	0.00	0.05	0	1	*geothermal heating*
heating_district	0.05	0.21	0	1	*district heating*
heating_small_district	0.00	0.01	0	1	*small district heating*
heating_coal	0.00	0.03	0	1	*heating by coal combustion*
brokers_commission	0.69	0.46	0	1	*commission payment required*
rb	0.55	0.50	0	1	*rental brake municipality*
caplim	0.51	0.50	0	1	*capping limit municipality*

Table 7: Summary statistics for rented out flats

	Mean	St. Dev.	Min	Max	Description
listing_price	126866.2	72545.3	25200.0	1542350.0	*sales price*
area	66.7	25.5	16.0	290.0	*living area*
yc	1981.37	19.90	1820	2014	*year of construction*
building_age	27.83	19.54	2	194	*time since (re-)construction*
rooms	2.46	0.97	1	7	*Number of rooms*
floor_NA	0.29	0.45	0	1	*floor number not indicated*
floor	1.41	1.85	-1	30	*floor number*
elevator	0.23	0.42	0	1	*elevator access*
second_bathroom	0.15	0.36	0	1	*two or more bathrooms*
garden_use	0.16	0.37	0	1	*access to garden*
built_in_kitchen	0.34	0.47	0	1	*equipped w/ built-in kitchen*
floor_heating	0.05	0.21	0	1	*dwelling has floor heating*
self_cont_heating	0.05	0.22	0	1	*dwelling has self-contained heating*
central_heating	0.74	0.44	0	1	*dwelling has central heating*
cond_renovated	0.08	0.27	0	1	*renovated dwelling*
cond_needs_renov	0.02	0.14	0	1	*dwelling is in poor condition*
qual_luxury	0.00	0.07	0	1	*very high quality*
qual_high	0.11	0.31	0	1	*high quality*
qual_low	0.01	0.12	0	1	*low quality*
type_regular	0.53	0.50	0	1	*regular dwelling*
tpye_top_floor	0.11	0.32	0	1	*dwelling is on top floor*
type_ground_floor	0.18	0.38	0	1	*dwelling is on ground floor*
type_terraced	0.02	0.13	0	1	*dwelling has a terrace*
type_souterrain	0.01	0.08	0	1	*dwelling is below ground floor*
type_maisonette	0.05	0.22	0	1	*dwelling spans two floors*
type_loft_studio	0.00	0.03	0	1	*dwelling is loft or studio*
type_penthouse	0.01	0.07	0	1	*dwelling is a penthouse apartment*
type_apartment	0.00	0.07	0	1	*dwelling is an apartment*
parquet_flooring	0.02	0.15	0	1	*dwelling has parquet flooring*
air_condition	0.00	0.03	0	1	*dwelling has air conditioning*
garage	0.09	0.28	0	1	*garage parking available*
carport	0.01	0.11	0	1	*carport parking available*
duplex	0.02	0.14	0	1	*duplex parking available*
undergr_parking	0.22	0.41	0	1	*underground parking available*
any_parking	0.37	0.48	0	1	*any parking available*
rooftop_terrace	0.01	0.11	0	1	*dwelling has a rooftop terrace*
balcony	0.59	0.49	0	1	*dwelling has a balcony*
terrace	0.39	0.49	0	1	*dwelling has a terrace*
winter_garden	0.01	0.09	0	1	*dwelling has a winter garden*
loggia	0.04	0.19	0	1	*dwelling has a loggia*
heating_gas	0.32	0.47	0	1	*heating fuel is natural gas*
heating_fluid_gas	0.00	0.01	0	1	*heating fuel is fluid gas*
heating_oil	0.08	0.27	0	1	*heating fuel is light oil*
heating_night_storage	0.00	0.04	0	1	*heating by electricity w/ night storage*
heating_electricity	0.02	0.13	0	1	*heating by electricity wo/ night storage*
heating_solar	0.00	0.02	0	1	*heating by solar energy*
heating_heat_pump	0.00	0.02	0	1	*heating by heat pump*
heating_wood_pellets	0.00	0.02	0	1	*heating by pellet combustion*
heating_geothermal	0.00	0.04	0	1	*geothermal heating*
heating_district	0.05	0.22	0	1	*district heating*
heating_small_district	0.00	0.01	0	1	*small district heating*
heating_coal	0.00	0.03	0	1	*heating by coal combustion*
brokers_commission	0.70	0.46	0	1	*commission payment required*
rb	0.61	0.49	0	1	*rental brake municipality*
caplim	0.56	0.50	0	1	*capping limit municipality*

Table 8: Regression results: housing characteristics

	log rent	*log listing price*	
		available	*rented out*
	(1)	(3)	(5)
log(area)	0.686 (0.009)***	0.937 (0.013)***	0.852 (0.019)***
yc_1918	−0.091 (0.011)***	−0.331 (0.031)***	−0.293 (0.042)***
yc_1919_45	−0.152 (0.008)***	−0.380 (0.027)***	−0.360 (0.036)***
yc_1946_55	−0.185 (0.007)***	−0.437 (0.021)***	−0.443 (0.034)***
yc_1956_65	−0.189 (0.006)***	−0.433 (0.020)***	−0.451 (0.031)***
yc_1966_75	−0.194 (0.006)***	−0.441 (0.021)***	−0.471 (0.030)***
yc_1976_85	−0.179 (0.006)***	−0.341 (0.020)***	−0.365 (0.030)***
yc_1986_90	−0.154 (0.007)***	−0.276 (0.019)***	−0.297 (0.030)***
yc_1991_95	−0.141 (0.005)***	−0.246 (0.019)***	−0.249 (0.028)***
yc_1996_00	−0.116 (0.006)***	−0.187 (0.019)***	−0.193 (0.029)***
yc_2001_05	−0.082 (0.006)***	−0.103 (0.020)***	−0.099 (0.029)***
yc_2006_10	−0.041 (0.005)***	−0.065 (0.019)***	−0.069 (0.031)*
building_age	−0.000 (0.000)***	−0.001 (0.000)***	−0.001 (0.000)***
rooms	0.031 (0.002)***	0.004 (0.003)	0.025 (0.005)***
floor_NA	0.010 (0.002)***	−0.011 (0.003)***	−0.011 (0.005)*
floor	−0.006 (0.001)***	−0.008 (0.001)***	−0.007 (0.002)***
elevator	0.013 (0.004)**	−0.001 (0.006)	−0.022 (0.008)**
floor:elevator	−0.001 (0.001)	−0.004 (0.002)**	−0.008 (0.002)***
second_bathroom	0.028 (0.002)***	0.014 (0.003)***	0.019 (0.007)**
garden_use	0.016 (0.002)***	0.031 (0.003)***	0.042 (0.006)***
built_in_kitchen	0.046 (0.002)***	0.046 (0.002)***	0.033 (0.004)***
floor_heating	0.040 (0.003)***	0.053 (0.005)***	0.047 (0.010)***
self_cont_heating	−0.017 (0.004)***	−0.000 (0.006)	−0.013 (0.011)
central_heating	−0.007 (0.002)**	0.006 (0.003)*	−0.001 (0.005)
cond_renovated	0.022 (0.002)***	0.036 (0.003)***	0.016 (0.008)*
cond_needs_renov	−0.059 (0.007)***	−0.128 (0.005)***	−0.127 (0.015)***
qual_luxury	0.130 (0.010)***	0.156 (0.013)***	0.205 (0.032)***
qual_high	0.052 (0.002)***	0.057 (0.003)***	0.086 (0.006)***
qual_low	−0.079 (0.006)***	−0.102 (0.009)***	−0.115 (0.019)***
type_regular	−0.010 (0.002)***	0.016 (0.002)***	−0.009 (0.005)
tpye_top_floor	−0.020 (0.003)***	0.012 (0.004)**	−0.003 (0.007)
type_ground_floor	−0.018 (0.002)***	0.013 (0.004)***	−0.018 (0.007)**
type_terraced	0.002 (0.004)	0.043 (0.007)***	0.005 (0.013)
type_souterrain	−0.102 (0.005)***	−0.173 (0.015)***	−0.164 (0.019)***
type_maisonette	0.024 (0.003)***	0.031 (0.005)***	0.012 (0.009)
type_loft_studio	0.073 (0.010)***	0.056 (0.024)*	0.128 (0.042)**
type_penthouse	0.106 (0.006)***	0.163 (0.010)***	0.141 (0.025)***
type_apartment	0.028 (0.008)***	0.022 (0.018)	−0.062 (0.024)**
parquet_flooring	0.048 (0.003)***	0.057 (0.006)***	0.062 (0.020)**
air_condition	0.069 (0.010)***	0.066 (0.020)***	0.076 (0.058)
garage	0.011 (0.005)*	0.072 (0.008)***	0.048 (0.014)***
carport	−0.008 (0.008)	0.060 (0.017)***	0.085 (0.032)**
duplex	0.010 (0.009)	0.023 (0.015)	0.015 (0.019)
undergr_parking	0.024 (0.006)***	0.063 (0.010)***	0.060 (0.014)***
any_parking	0.000 (0.004)	0.037 (0.007)***	0.029 (0.011)**
rooftop_terrace	0.048 (0.003)***	0.050 (0.007)***	0.056 (0.015)***
balcony	−0.003 (0.001)*	0.004 (0.002)	0.018 (0.004)***
terrace	0.017 (0.001)***	0.022 (0.002)***	0.019 (0.004)***
winter_garden	0.028 (0.008)***	0.048 (0.015)**	0.040 (0.019)*
loggia	−0.006 (0.005)	−0.036 (0.006)***	0.001 (0.011)
heating_gas	0.009 (0.002)***	0.009 (0.003)**	0.001 (0.005)
heating_fluid_gas	−0.077 (0.021)***	−0.074 (0.044)	−0.010 (0.076)
heating_biogas	−0.106 (0.089)	−0.072 (0.015)***	
heating_oil	−0.003 (0.002)	−0.011 (0.004)*	−0.012 (0.007)
heating_night_storage	−0.076 (0.007)***	−0.075 (0.018)***	−0.082 (0.035)*
heating_electricity	−0.020 (0.005)***	−0.065 (0.010)***	−0.035 (0.017)*
heating_solar	0.015 (0.009)	0.031 (0.024)	0.099 (0.082)
heating_heat_pump	0.020 (0.009)*	−0.079 (0.049)	−0.077 (0.051)
heating_wood_pellets	−0.004 (0.009)	−0.057 (0.044)	0.052 (0.051)
heating_geothermal	0.016 (0.008)*	0.003 (0.015)	0.053 (0.043)
heating_district	−0.027 (0.006)***	−0.021 (0.008)**	−0.018 (0.010)
heating_small_district	−0.003 (0.022)	0.045 (0.026)	−0.098 (0.085)
heating_cogeneration	0.072 (0.037)	−0.026 (0.049)	−0.205 (0.058)***
heating_coal	−0.113 (0.016)***	−0.103 (0.029)***	−0.072 (0.072)
brokers_commission	0.046 (0.003)***	0.045 (0.003)***	0.016 (0.005)***
deposit	0.008 (0.002)***		

Note: District fixed effects are omitted in all tables.

Results for the caplim models are omitted because control variables are hardly affected by the inclusion of caplim interaction terms. They are available on request.

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 9: Regression results: locality characteristics

	log rent	*log listing price*	
		available	*rented out*
	(1)	(3)	(5)
pop_density	−87.320 (31.525)**	−158.157 (42.104)***	−127.949 (45.638)**
pct_pop_change_2011_13	0.695 (0.335)*	1.165 (0.513)*	1.019 (0.551)
pct_unemp_2014	0.437 (0.997)	0.382 (1.737)	−1.630 (1.972)
pct_youth_unemp_2014	−35.353 (9.514)***	−72.117 (14.301)***	−40.716 (16.017)*
pct_empl_change_2008_13	0.185 (0.125)	0.477 (0.185)*	0.349 (0.205)
pop_density:log(area)	33.443 (7.509)***	55.032 (9.219)***	50.211 (10.332)***
pop_density:garage	20.009 (3.922)***	−0.535 (6.784)	3.086 (10.173)
pop_density:carport	25.882 (7.578)***	−20.602 (16.929)	−19.918 (27.212)
pop_density:duplex	2.387 (6.064)	−7.404 (10.203)	−4.198 (12.721)
pop_density:undergr_parking	3.728 (5.106)	−12.270 (6.965)	−15.797 (9.970)
pop_density:any_parking	14.757 (3.573)***	1.628 (5.641)	−7.566 (8.168)

Note: District fixed effects are omitted in all tables.

Results for the caplim models are omitted because control variables are hardly affected by the inclusion of caplim interaction terms. They are available on request.

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$