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## The effect of real estate purchase subsidies on property prices

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# The Effect of Real Estate Purchase Subsidies on Property Prices

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## The Effect of Real Estate Purchase Subsidies on Property Prices\*

### Abstract

This paper assesses to which degree housing purchase subsidies are capitalized into property prices. Using a large-scale micro data set on German house prices, I exploit the introduction of a new subsidy scheme in the state of Bavaria. My difference-in-difference estimations at the Bavarian interstate border indicate that the prices of single-family homes increased by about 3.4% more in Bavarian border regions. This is consistent with a full capitalization of the subsidy. No effect is found for apartments, whose purchasers seldom qualify for the subsidy. A heterogeneity analysis confirms that the price effect is larger in segments of the real estate market with a higher exposure to the subsidy scheme. I also provide suggestive evidence that the subsidy scheme slightly stimulated construction activity. Overall, my results indicate that instead of making house purchases more affordable for families, the subsidy scheme led to a rise in house prices and mainly benefited sellers of properties.

JEL Code: H22, H24, H71, R31, R38

Keywords: Real estate market, housing subsidies, property prices

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# 1 Introduction

Rising rents and property prices have fueled a debate on the affordability of housing in Germany, as well as in other countries around the world. This has led to calls for housing subsidies, and to the introduction of numerous measures aiming to reduce housing costs. Amongst others, recent years have seen the introduction of rent control, of a temporary accelerated depreciation schedule for the construction of residential units, and of subsidies for the acquisition of property by owner-occupiers. While many previous initiatives to make housing more affordable targeted renters and poorer households, increasing attention has lately been put on the costs of acquiring real estate. Both the German federal and the Bavarian state government implemented housing purchase subsidies in 2018, aiming to reduce purchase costs for owner-occupiers.

Although intended to foster homeownership and to make the acquisition of property more affordable, in particular for families, housing subsidies may well exert adverse effects by driving up real estate prices. This would especially be the case if housing demand is driven up by the subsidy scheme while housing supply is rather inelastic. According to claims by the federal government, the federal subsidy is unlikely to lead to large windfall gains, and the government claims to perceive a lack of evidence on price effects of housing purchase subsidies (Deutscher Bundestag, 2019). However, several features of the subsidy design speak in favor of potentially large price effects. First, due to generous income thresholds, roughly three quarters of German families with minor children – and in the case of Bavaria three quarters of households regardless of family structure – would be eligible for subsidies when buying a property. Second, federal subsidy provisions are set to expire in 2020. This could in turn further stimulate housing demand between 2018 and 2020. With the German construction sector operating at its capacity limits, housing supply is however rather inelastic (Gornig et al., 2019). As the application window for the federal scheme is confined to three years, incentives for the construction sector to expand and develop additional capacity are limited. Contrary to claims by the government, one could thus expect a considerable pass-through into prices.

Against this background, this paper investigates to which degree direct housing subsidies are capitalized into home prices. My study is the first to assess the price effects of direct housing purchase subsidies that are not intended as a stimulus measure. For this purpose, I exploit that Bavaria, Germany's second largest federal state by population, introduced a much more extensive subsidy scheme than the federal scheme available in all states, with both broader eligibility criteria and higher benefits for Bavarian residents. I use this policy discontinuity at the Bavarian interstate border to assess the effect of subsidies on home prices, using a rich micro-dataset on German house prices. My findings indicate that in the second half of

2018, single-family home prices increased by roughly 3.4% more in Bavarian border regions than in neighboring regions of other states. These results are consistent with a full shifting of subsidies into the prices of single-family homes. In contrast, no effect can be observed for apartments. This is likely due to apartments seldom being bought by owner-occupiers who could claim the subsidy. Splitting the sample into houses with a comparatively high or low subsidization probability also points to heterogeneous effects: price effects tend to be larger in sectors of the real estate market with a larger exposure to the subsidy scheme. I also provide suggestive evidence that the subsidy scheme slightly stimulated construction activity of single-family houses, while possibly leading to a partial crowding-out of the construction of apartment buildings. Providing a clean identification of subsidy effects, my findings provide an important contribution to both the literature and the current policy debate at a time at which the affordability of housing is considered a key policy issue in many countries.

Evidence on housing purchase subsidies in other countries also suggests a significant capitalization into real estate prices.<sup>1</sup> While the German and Bavarian schemes grant flat-rate direct subsidies, other countries tend to subsidize the purchase of real estate through the tax code by granting mortgage interest deductions. Generally, most empirical evidence indicates that such tax subsidies do not increase the homeownership rate and are passed-through into property prices (see Bourassa et al., 2013 for a survey). In a general equilibrium model of the US housing market, Sommer and Sullivan (2018) show that eliminating the mortgage interest deduction would result in declining property prices, increasing homeownership and improved welfare. Hilber and Turner (2014) point out that a subsidy's effects on homeownership decisions and house prices depend on the elasticity of the housing supply: Homeownership only rises in areas with lax land-use regulations, whereas subsidies are capitalized into home prices in tightly regulated, rather inelastic housing markets. This house price effect might even result in an adverse effect on homeownership. Davis (2018) exploits the variation of US state-level tax legislation to assess capitalization effects of mortgage interest deductions on houses on both sides of the state border. His results indicate strong capitalization effects, with a one percentage point increase in the tax rate applied to mortgage interests leading to a 0.8 percent increase in house prices. Similarly, Berger et al. (2000) show a full capitalization of after-tax interest rate subsidies in Sweden. Using a Danish tax reform with a differential effect on mortgage interest deductions across tax brackets, Gruber et al. (2020) estimate long-term effects of housing tax subsidies. Their findings indicate zero effect on homeownership, but a sizable effect at the intensive margin as well as suggestive evidence that tax subsidies are capitalized into house prices.

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<sup>1</sup> A related body of research addresses the price effects of real estate transfer taxes, finding strong capitalization effects (see Dolls et al., 2019).

However, the institutional setup of a mortgage interest subsidy considerably differs from the German subsidy schemes. While the latter grant flat-rate direct subsidies to households below an income threshold, the size of a mortgage interest subsidy depends on both the price of a property and individual marginal tax rates. Due to the interaction between tax progressivity and the mortgage interest subsidy, high-income households with high marginal tax rates benefit the most from these subsidies.

Evidence on direct subsidies is much more scarce. Also, in contrast to the German setting, governments tend to resort to direct subsidy programs as a stimulus when the economy is weak. In the wake of the financial crisis, the United States introduced a homebuyer tax credit to counter dropping demand in the housing market (Dynan et al., 2013). While first designed with a repayment requirement, the tax credit was granted as a subsidy in 2009 and 2010. In 2009, first-time homebuyers up to a certain income threshold were eligible for a refundable tax credit of 10 percent of the purchase price, capped at 8,000 USD. For most claimants, this is equivalent to a flat-rate subsidy, as in the Bavarian case. In a general equilibrium model, Floetotto et al. (2016) show that such homebuyer tax credits temporarily increase home prices and transaction volumes, but lead to negative welfare effects. Dynan et al. (2013) exploit regional variation in housing markets, finding only a small and temporary effect on sales. However, as credits were available throughout the country and the housing market underwent rapid changes, identifying a control group for an empirical analysis on prices is difficult. Similarly, the UK subsidizes the acquisition of new built homes below a certain property value with an equity loan for up to 20% (40% for London) of the property value. Exploiting spatial discontinuities in the scope of the scheme, Carozzi et al. (2019) find strong capitalization effects in the supply-constrained London area, the size of which suggests an overcapitalization, but no effect on construction. In a region with rather elastic supply, the subsidy is instead shown to stimulate construction.

This paper proceeds as follows. Section 2 provides an overview of the subsidy schemes implemented in 2018. Section 3 describes the data sources used in my analysis. In section 4, I subsequently present my methodological approach. This encompasses a description of the border difference-in-difference design and of the analysis of geodata. Results are presented in section 5. Section 6 concludes.

## **2 Institutional Background**

While real estate prices were stagnating in Germany between 1995 and 2010, nominal prices have risen by roughly 50% in the last decade (Baldenius et al., 2019; Mense et al., 2019).

Following the debate on increasing home prices, both the German federal government and the state of Bavaria introduced housing purchase subsidies in 2018. As the Bavarian subsidy program is supplementary to the nation-wide subsidy program, overall housing purchase subsidies are much more extensive in Bavaria.

The Bavarian housing purchase subsidy (*Bayerische Eigenheimzulage*) constitutes an immediate subsidy of 10,000 euros and is paid to eligible households who purchase or build a house or apartment for personal residence after June 30, 2018. The aim of this subsidy is to encourage the acquisition of property, increase home ownership rates and create additional housing (*Bayerische Eigenheimzulagen-Richtlinien*, 2018). The subsidy is only granted to households who have resided in or been employed in Bavaria for at least one year. Income thresholds are rather generous. While singles with taxable incomes below 50,000 euros are eligible for the subsidy, the threshold increases to 75,000 euros for married couples and to 90,000 euros for households with one child. Each additional child increases this threshold by a further 15,000 euros. I.e., a family with two children would be eligible if their household income is below 105,000 euros. Overall, about three quarters of households meet these income requirements, and would potentially be eligible for the subsidy when purchasing or building real estate (see section 3.2).

In the same year, the German federal government implemented a housing subsidy program for families. In all states, families with at least one child can claim the federal child benefit for building (*Baukindergeld*) of 1,200 euros per child and year for a period of ten years. This subsidy is available nation-wide, independent of the Bavarian housing purchase subsidy. Income thresholds coincide with the Bavarian scheme. After the subsidy was enacted in May 2018, applications have been possible from September 18, 2018 onwards. While this time frame roughly corresponds to the Bavarian subsidy scheme, housing purchases and construction permits are retroactively eligible from January 1 onwards. However, this subsidy is only available for a limited time: The application window ends on December 31, 2023, while the building permit or purchase contract needs to be issued by December 2020.

In addition, Bavaria introduced a top-up of the federal child benefit of 300 euros per child and year (*Bayerisches Baukindergeld Plus*). This top-up has the same residency and employment requirements as the Bavarian housing purchase subsidy.

Table 1 indicates the maximum housing subsidy per household type in Bavaria and in other German states. Overall, eligibility conditions are broader and the average subsidy is much larger in Bavaria. Note also that the Bavarian housing purchase subsidy is paid up-front upon approval, whereas child benefits are paid over a period of ten years. This may have different implications for downpayment-constrained households as imminent payments may be more



readily considered by mortgage brokers<sup>2</sup>: Subsidy payments that banks consider equivalent to equity may lead to more favorable interest rate conditions.

Table 1: Scope of housing subsidies

	Bavaria			
	No children	One child	Two children	Three children
Bavarian purchase subsidy	10,000	10,000	10,000	10,000
Federal child benefit	0	12,000	24,000	36,000
Bavarian child benefit	0	3,000	6,000	9,000
Total subsidy	10,000	25,000	40,000	55,000
	Other states			
	No children	One child	Two children	Three children
Federal child benefit	0	12,000	24,000	36,000

Notes: This table indicates the maximum amount of housing subsidies in euros in Bavaria and in other German states.

A similar nation-wide scheme was abolished in 2006 due to its limited cost-effectiveness and its resulting windfall gains (Deutscher Bundestag, 2005). With a volume of 11.4 billion euros in 2004, the subsidy scheme had been one of the largest subsidy schemes at the time.<sup>3</sup> While the policy was widely criticized on the grounds of being costly and inequitable, leading to windfall gains and potentially driving up prices (see e.g. Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung (2003); Bundesamt für Bauwesen und Raumordnung (2002); Färber (2003)), studies on this scheme are only descriptive in nature.

As opposed to other countries such as the United States, mortgage interest on owner-occupied housing cannot be deducted from income taxes. Therefore, interaction effects between housing purchase subsidies and mortgage interest taxation do not need to be accounted for. However, the federal government has introduced a temporary accelerated depreciation schedule for the construction of new residential units. This reform enables an additional 5 percent depreciation rate, subject to an upper bound, on residential units for rent constructed between September 2018 and December 2021. While this measure does not directly affect owner-occupiers, it adds to the strain on the construction sector and might drive property prices.

<sup>2</sup> According to one of Germany's largest real estate platforms, the child benefit for building is not considered equivalent to equity by banks, also due to the long payment window: <https://ratgeber.immowelt.de/a/baukindergeld-2018-wer-es-bekommt-wie-viel-es-gibt-und-was-die-voraussetzungen-sind.html>

<sup>3</sup> As under current legislation, households with incomes below a certain threshold were eligible for the subsidy for the purchase or construction of an owner-occupied property. The subsidy was paid as a direct subsidy for a period of eight years, and consisted of a base subsidy tied to a property's acquisition costs and an additional child allowance. Until 2003, the construction of new properties was subsidized at twice the rate of the subsidy for purchases of existing homes. In 2004 to 2005, lower and uniform base subsidy levels were granted, while child supplements increased.

These reforms are implemented at a time of historically high capacity utilization in the construction sector (Gornig et al., 2019). As the application window of the child benefit for building and the accelerated depreciation schedule is confined to a period of three years, the incentive for construction companies to expand capacities are limited. Against this background, one could expect a substantial effect on property prices.

### **3 Data and Descriptive Statistics**

#### **3.1 Microdata on Real Estate Prices**

My empirical analysis is based on a large and detailed micro dataset on the German real estate market provided by the real estate consultancy firm F+B (see Dolls et al. (2019) for more details). The dataset encompasses property adverts from 140 different sources, ranging from online property portals to newspaper adverts and real estate agents. Data collection was conducted via web-scraping. The raw dataset was subject to data cleansing and consistency checks to ensure that properties listed concurrently in multiple sources are only included once.

The final dataset contains 307,517 houses and 273,786 apartments that were offered for sale within 50 km of the Bavarian interstate border in 2016 to 2018. While F+B provides data from 2005 onwards, I restrict the data to the years around the reform to ensure that the estimation of pre-reform postal code fixed effects are unbiased by further state-level policies, such as long-term infrastructure investments or increases in real estate transfer tax rates.

Table 2 shows sample means of property characteristics for houses and apartments in the border regions of Bavaria and of neighboring states, both for the full data set (within 50 km of the border) and the data used in my main specifications (within 25 km of the border). The main variable of interest is a property's final asking price per square meter. While F+B provides both the first and the final asking price, I focus on the latter as it is likely closer to the actual transaction price. As shown in Table 2, asking prices of houses in Bavaria amount to 299,742 euros on average, or 1,952 euros per square meter (281,645 and 1,825 euros, respectively, for the narrower sample). These are slightly lower than average asking prices in neighboring states. These price differences are at least partly driven by the slightly higher frequencies at which houses in other states are equipped with amenities, such as a garden or a balcony. My estimations employ postal code fixed effects to account for initial price level differentials, and some specifications account for amenities.

Table 2: Real estate data: Summary statistics

	Houses				Apartments			
	<50km		<25km		<50km		<25km	
	Bavaria	Other	Bavaria	Other	Bavaria	Other	Bavaria	Other
Asking price	299,742	348,419	281,645	324,619	240,083	288,001	234,306	283,982
Price per sqm	1,952	2,215	1,825	2,084	2,434	2,736	2,292	2,679
Area in sqm	157.3	158.7	157.6	158.3	104.2	105.4	108.0	105.9
Number of rooms	5.3	5.3	5.3	5.3	3.3	3.4	3.4	3.4
Balcony	36.6%	39.9%	36.3%	39.1%	43.3%	43.6%	43.2%	41.8%
Garden	39.1%	43.7%	38.3%	43.1%	27.1%	28.1%	27.8%	28.9%
Basement	49.3%	49.7%	49.5%	49.4%	49.2%	51.7%	48.3%	51.6%
Parking spot	55.4%	57.9%	56.0%	56.9%	72.4%	72.6%	72.7%	71.6%
Number of observations	109,485	198,032	65,653	85,458	84,356	189,430	46,706	80,115

Notes: This table shows summary statistics for houses and apartments within 50 km and 25 km of the Bavarian interstate border, 2016-2018. Other states encompass Baden-Württemberg, Hesse, Thuringia, and Saxony. Source: F+B and own calculations.

### 3.2 Income and Consumption Survey Data

I supplement my analysis with data from the German Income and Expenditure Survey (*EVS, Einkommens- und Verbrauchsstichprobe*) 2018. Conducted by the Federal Statistical Office every five years, the EVS constitutes a representative survey of German households. In the 2018 wave, the dataset encompasses 58,278 households. Amongst others, the survey contains data on incomes, homeownership and living conditions. This enables me to assess the household and property characteristics of households that meet eligibility requirements for the subsidy scheme.

Table 3 presents summary statistics by property type in the EVS data. The vast majority of households living in houses are owner-occupiers, whereas only about one fifth of households in apartments own their own property. Also, houses are more frequently inhabited by families with minor children. On average, houses in the EVS sample are a bit smaller than in the advert data, but more frequently equipped with a parking spot.<sup>4</sup>

<sup>4</sup> This may be due to different resale frequencies of property types, as well as to differing geographic scopes of both data sets. While Table 3 provides summary statistics on German households, Bavarian border regions are less urban than the German average. As homes in urban areas tend to be smaller, this might contribute to the difference between both data sets.

Table 3: EVS data: Summary statistics for households by property type

	Houses	Apartments
Owner-occupiers	83.4%	21.2%
Minor children	27.8%	14.7%
Area in sqm	129.8	73.8
Number of rooms	4.6	2.7
Parking spot	86.5%	49.8%
Number of observations	24,029	34,249

Notes: This table shows summary statistics for households in the EVS data, separately for households that reside in houses and households that reside in apartments. Source: EVS 2018 and own calculations.

Table 4 indicates the fraction of Bavarian households with incomes below the eligibility threshold. While eligibility is based on gross taxable income, EVS data provides binned net household incomes. Therefore, I first apply a tax-benefit calculator on household-type specific gross income eligibility thresholds. Households with incomes below the resulting net income threshold are then classified as eligible. I use linear extrapolation to determine the fraction of eligible households whose income lies in the same income bin as the eligibility threshold.<sup>5</sup>

Table 4: EVS data: Share of eligible households in Bavaria

	All households	Owner-occupiers
All Bavarian households	74.8%	66.3%
Singles	82.6%	74.0%
Childless couples	72.6%	69.1%
Households with one child	76.7%	67.3%
Households with two children	77.2%	73.6%
Households with three or more children	83.4%	81.6%
Number of observations	8,402	4,702
All German households	80.4%	69.3%
Number of observations	58,278	28,808

Notes: This table shows the fraction of Bavarian households and the fraction of German households in the EVS data that meet the Bavarian eligibility criteria for receiving housing purchase subsidies. These fractions are depicted for the overall sample of households and for the subset of owner-occupiers. Source: EVS 2018 and own calculations.

<sup>5</sup> Take an eligibility threshold of 4,600 euros per month, for example, which lies in the net income bin of 4,500 to 5,000 euros. In this case, calculations for Table 4 assume that 20% of households in this income bin are eligible. Results barely change, though, when either classifying all or no households in this income bin as eligible.

As shown in Table 4, about three quarters of households would be eligible for the subsidy when purchasing or building real estate. Amongst owner-occupiers, roughly two thirds of households meet the subsidy schemes' income criteria. This group might be more indicative of households who purchase a house.

### 3.3 Construction Permit Statistics

In addition to estimating the subsidy schemes' effect on property prices, I assess whether the availability of subsidies exerts a differential effect on construction activity. For this endeavor, I employ municipality-level administrative data on authorized residential construction projects (*Statistik der Baugenehmigungen*). This data set is based on a full census of residential construction projects for which either a construction permit was granted, or which required a notification of municipal authorities in lieu of an application for a construction permit.<sup>6</sup> The data set thus covers the universe of planned residential construction activity in the year formal approval was acquired. For ease of reference, I will refer to all cases as construction permits.

As larger cities issue much more construction permits than smaller municipalities, the number of residential construction permits varies between zero and several hundred permits per municipality and construction year. To account for differing municipality sizes, I scale construction activity in relation to the building stock. The latter is based on administrative data on the number of residential buildings in each municipality in 2017. Table 5 shows summary statistics on the number of construction permits for residential buildings, both in absolute terms and in relation to the overall municipal building stock.

Table 5: Construction permit data: Summary statistics

	Residential construction	Single-family houses	Multi-family houses
Total construction permits	9.8	7.3	2.5
Per 1000 buildings	6.7	5.4	1.3

Notes: This table shows the average annual number of municipal residential construction permits for municipalities in the vicinity of 25 km of the Bavarian interstate border, 2016-2018. Source: Statistical Offices of the Federal States and own calculations.

<sup>6</sup> Whether the construction of a property requires a construction permit depends on state laws as well as local building regulations and development plans.

## 4 Methodology

### 4.1 Estimation Strategy

I employ a border difference-in-difference approach to estimate the price effect of the real estate purchase subsidy. This approach assesses whether property price trends diverge after the introduction of the subsidy, while controlling for different local price levels and property characteristics. Allowing for differential regional time trends, the estimation strategy also accounts for changing local conditions that may impact real estate prices. I hence estimate the following equation:

$$\ln(p)_{i,c,t} = \beta \text{Subsidy}_{c,t} + X_i' \theta + \delta_c + \gamma_{a(c),t} + \epsilon_{i,c,t} \quad (1)$$

Subscript  $i$  indicates the respective property,  $t$  the month it was offered for sale, and  $c$  the postal code area the property is located in. As explained more thoroughly in section 4.2, postal codes are allocated to cross-border regions  $a(c)$  to capture regional trends. A property's log square meter price  $\ln(p)_{i,c,t}$  is used as dependent variable. The main variable of interest,  $\text{Subsidy}_{c,t}$ , is a dummy for properties posted in Bavaria after July 2018. A positive coefficient indicates that prices on the Bavarian side of the border have risen more than prices in neighboring regions after the implementation of the subsidy scheme. The specification accounts for postal code fixed effects  $\delta_c$ , which capture persistent differences in local property prices due to possibly unobserved factors, such as natural amenities, traffic accessibility, or school quality. Region-month fixed effects  $\gamma_{a(c),t}$  permit differential time trends across regions. Several specifications also control for property characteristics  $X_i$ , which encompass the number of rooms, a property's area in square meters, and the presence of amenities that may affect property prices. The latter include dummy variables for whether a property comes with a parking spot, a balcony, a garden or a basement.<sup>7</sup> Standard errors  $\epsilon_{i,c,t}$  are clustered at the postal code level to account for a possible spatial correlation in local property price shocks.

My main estimations focus on house prices as houses are predominately acquired by owner-occupiers, whereas apartments tend to be more frequently bought by investors (Petkova and

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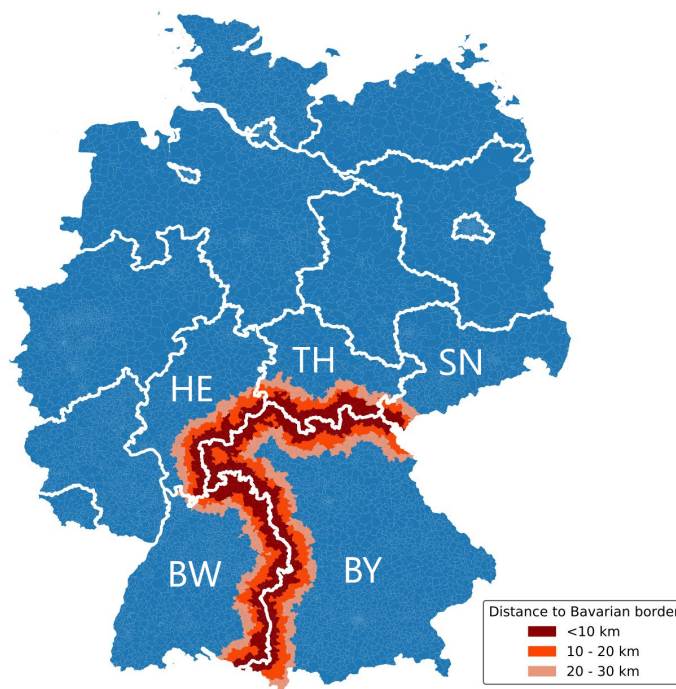
<sup>7</sup> I do not account for more subjective property characteristics, such as whether a property is described as modern, well-equipped or luxurious. These assessments might be partially driven by the market environment, such as sellers' market power, and might hence not be orthogonal to the reform. Likewise, I do not account for the construction year. This is the case as the construction year is missing for 19.8% of houses in the sample. Whether a seller discloses the construction year is however not random, and might be correlated with other conditions in the real estate market. Hence, either controlling for construction years, or excluding observations with missing construction years, might lead to a bias in the estimations.

Weichenrieder, 2017; Deutsche Bundesbank, 2018). This is also in line with EVS data, which show that a vast majority of residents of houses are owner-occupiers, while most households living in apartments are renters. As the subsidies are only granted to owner-occupiers, I expect much stronger price effects for houses. A further specification investigates whether this prediction holds and provides results on apartment prices.

## 4.2 Geographic Location Data

Each postal code is allocated to a distance band around the Bavarian interstate border according to the minimum distance between the postal code's centroid and the border. While postal codes in the immediate vicinity of the border are arguably subject to rather comparable time trends, trends may diverge more strongly the larger the distance to the border. This implies that there is a trade-off between the number of observations and, thus, estimation efficiency on the one hand, and unbiasedness on the other hand. For this reason, I estimate equation 1 for different distance bands around the interstate border. Figure 1 showcases the assignment of postal codes to distance bands.

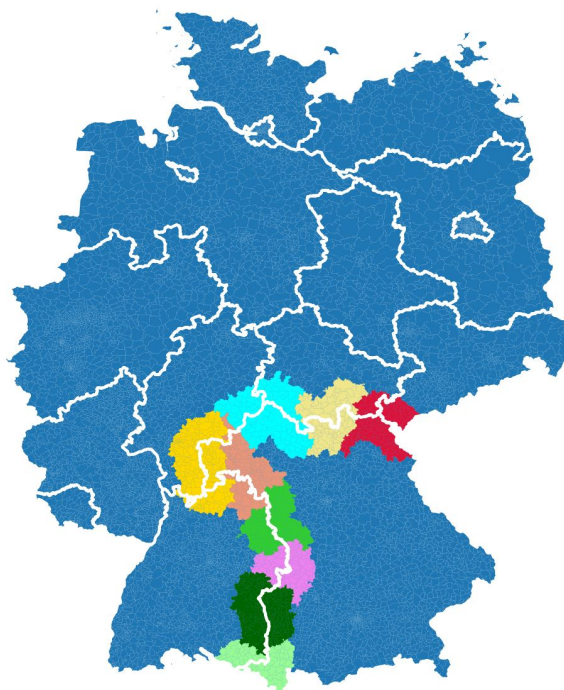
Figure 1: Postal codes in proximity of the Bavarian border



*Notes:* This figure shows postal codes in proximity to the Bavarian interstate border and their allocation to distance bands around the border. The border states are Bavaria (BY), Baden-Württemberg (BW), Hesse (HE), Thuringia (TH) and Saxony (SN).

As economic conditions may vary along the border over time, I subsequently segment border regions based on spatial planning regions (*Raumordnungsregionen*). A spatial planning region combines several NUTS-3 regions within a state according to regional structure and commuting patterns. These regions are commonly used for spatial observation and monitoring by German institutions, such as the German Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR), but are not endowed with administrative autonomy. As spatial planning regions are defined within states, I generate cross-border regions by matching postal codes in bordering states to the closest Bavarian region. As a first step, I assign Bavarian postal codes to their respective spatial planning region along the border. Subsequently, postal codes in neighboring states are matched to the closest Bavarian spatial planning region. This matching is based on the minimum geographic distance between the postal code's centroid and the border of the spatial planning region. Using rather wide distance bands includes some Bavarian postal codes in the sample that are located in a non-border spatial planning region. These postal codes are assigned to the closest spatial planning region that adjoins the border. Figure 2 shows which region postal codes are assigned to.

Figure 2: Matched regions in proximity of the Bavarian border



Notes: This figure shows the allocation of postal codes to cross-border regions, based on the proximity to spatial planning regions in Bavaria.



### **4.3 Accounting for Tax Reforms**

Other concurrent reforms may possibly exert a differential impact on real estate prices. Most notably, the neighboring state of Thuringia increased its real estate transfer tax (RETT) rate from 5.0 to 6.5% at the beginning of 2017. This presumably had an impact on real estate prices in Thuringia. As shown by Dolls et al. (2019), a one percentage point increase in the real estate transfer tax rate reduces house prices by 1.5-2%, and lowers apartment prices by 3-4%. While this reform predates the introduction of housing purchase subsidies by more than a year, it likely resulted in a downward shift in prices in the pre-period, which would not be adequately captured by postal code fixed effects and cross-border regional time trends. In consequence, the estimated price effect of the Bavarian real estate purchase subsidy might be biased. Two different strategies are used to address possible confounding effects of Thuringia's RETT increase. One set of specifications drops all properties in regions intersected by the Thuringian border. I.e., estimations exclude the three north-eastern regions of Figure 2. A second set of specifications retains all observations, but introduces dummies intended to capture differential price trends in Thuringia. As indicated by Dolls et al.'s event studies, house prices begin to decline in the quarter prior to RETT reforms, with most of the pass-through taking place within half a year of a tax increase. In line with these findings, I account for RETT effects with dummies in the state of Thuringia for the quarters during which one could expect a gradual pass-through into house prices – Q4, 2016, Q1 2017, and Q2 2017 – as well as a dummy variable for the time period in which house prices would be expected to have adjusted to the new price level, i.e., Q3 2017 to Q4 2018. However, the latter specification would not account for spillover effects of the Thuringian tax increase into border regions of Bavaria, Hesse and Saxony. In this setting, spillover effects are more of a concern than in case of the real estate purchase subsidy: While the subsidy requires prior residence or prior employment in the state of Bavaria, the RETT increase applies to all households regardless of their prior residence.

## **5 Results**

This section first presents estimated property price effects that result from the introduction of the subsidy scheme. I subsequently conduct several heterogeneity analyses, differentiate between properties with a high and a low subsidization probability, and assess the effects of the subsidy scheme on construction activity.

## 5.1 Real Estate Prices

I start my analysis by estimating equation (1). Table 6 shows results for houses in postal codes within 25 km of the Bavarian interstate border. Specification (1) does not allow for regionally differentiated trends and neither controls for the real estate transfer tax reform in Thuringia, nor for property characteristics. Regional time trends are added in specification (2). Coefficients are positive and significant in both specifications, albeit at a lower level than in subsequent specifications which account for a bias due to Thuringia's RETT reform: Estimated effects are larger when excluding border regions of Thuringia (specification (3)) or using dummy variables to control for the RETT reform (specification (4)). Controlling for property characteristics results in coefficients of respectively 0.0345 and 0.0264 in specifications (5) and (6). This indicates that in the second half of the year 2018, Bavarian house prices increased by roughly 2.6 to 3.4% more than house prices in neighboring states.

Table 6: Subsidy effects on asking prices of single-family houses

Dependent variable: log price per sqm						
	(1)	(2)	(3)	(4)	(5)	(6)
Subsidy	0.0211* (0.0098)	0.0287** (0.0129)	0.0410*** (0.0126)	0.0334*** (0.0126)	0.0345*** (0.0120)	0.0264** (0.0120)
PLZ FE	✓	✓	✓	✓	✓	✓
Time FE	Month	Month x region	Month x region	Month x region	Month x region	Month x region
Controls for Thuringia	✗	✗	Exclusion	Dummies	Exclusion	Dummies
Property controls	✗	✗	✗	✗	✓	✓
Max km to border	25	25	25	25	25	25
N	151,111	151,111	113,917	151,111	113,917	151,111

Notes: This table shows the differential effect of housing subsidies in Bavaria on house prices, estimated as in equation (1). The treatment dummy indicates properties listed in Bavaria between July and December 2018. Standard errors are clustered at the postal code level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Specifications that use dummy variables to capture differential price trends in Thuringia yield lower effects than specifications that exclude Thuringian border regions. This could either be due to a lower responsiveness of prices in the predominately rural north-eastern border region<sup>8</sup>, spillover effects between Thuringia and neighboring states, or the dummy variables not adequately capturing the timing of the pass-through of RETT reforms<sup>9</sup>. Hence, further robustness checks primarily focus on specification (5). With pre-subsidy house prices averaging 318,700 euros in the Bavarian border region (276,400 euros when including border regions with

<sup>8</sup> A robustness check in Table 10 however finds no differences in the pass-through for urban and rural regions.

<sup>9</sup> As opposed to other states' RETT reforms, Thuringia announced its tax increase more than a year in advance in mid-2015. This might conceivably lead to anticipation effects and diverging pass-through patterns.

Thuringia), findings would be consistent with a full shifting of the Bavarian real estate purchase subsidy into house prices: 10,000 euros correspond to 3.3% of 300,000 euros.

To verify that trends within cross-border regions are indeed comparable, I conduct a placebo test on a sample limited to the pre-reform years 2016-2017. In analogy to the baseline, this specification estimates whether price trends of houses available for sale in Bavaria in the second half of the year 2017 differ from bordering states. As indicated by Table 7, the placebo test yields no significant difference in the evolution of property prices, underlining the validity of my identification strategy.

Table 7: Placebo test for asking prices of single-family houses

Dependent variable: log price per sqm						
	(1)	(2)	(3)	(4)	(5)	(6)
Subsidy	-0.0027 (0.0116)	-0.0064 (0.0119)	0.0129 (0.0117)	-0.0032 (0.0119)	0.0050 (0.0111)	-0.0106 (0.0113)
PLZ FE	✓	✓	✓	✓	✓	✓
Time FE	Month	Month x region	Month x region	Month x region	Month x region	Month x region
Controls for Thuringia	✗	✗	Exclusion	Dummies	Exclusion	Dummies
Property controls	✗	✗	✗	✗	✓	✓
Max km to border	25	25	25	25	25	25
N	96,237	96,237	74,126	96,237	74,126	96,237

Notes: This table shows the results of a placebo test for differential trends in house prices in Bavaria. The placebo treatment dummy indicates properties listed in Bavaria between July and December 2017. Standard errors are clustered at the postal code level. Sample years: 2016 - 2017. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

As a robustness check, I conduct the estimation for different distance bands around the interstate border. Table 8 shows results that correspond to specification (5) in Table 6, i.e., estimations that exclude border regions with Thuringia and control for property characteristics. For a range between 15 and up to 40 km around the border, results are in line with each other and the coefficient on the subsidy dummy amounts to on average 0.035. This is again consistent with a full shifting of subsidies into property prices. However, coefficients gradually increase when the band around the border becomes more narrow. In particular, results are larger for a very narrow distance band of 10 km, although the coefficient of 0.0442 does not significantly differ from the coefficients for larger distances. Two factors might play a role here: First, even though restricted by prior residency and employment requirements, spillover effects across the border might exert effects on real estate prices on both sides of the border. This would be the case if households who used to live in neighboring states purchased houses in Bavaria

Table 8: Subsidy effects on asking prices of single-family houses for different distance bands to the interstate border

Dependent variable: log price per sqm						
	(1)	(2)	(3)	(4)	(5)	(6)
Subsidy	0.0240** (0.0096)	0.0300*** (0.0102)	0.0355*** (0.0114)	0.0358*** (0.0123)	0.0372*** (0.0135)	0.0442*** (0.0164)
PLZ FE	✓	✓	✓	✓	✓	✓
Time FE	Month	Month	Month	Month	Month	Month
	x region	x region	x region	x region	x region	x region
Controls for Thuringia	Exclusion	Exclusion	Exclusion	Exclusion	Exclusion	Exclusion
Property controls	✓	✓	✓	✓	✓	✓
Max km to border	50	40	30	20	15	10
N	227,475	183,380	134,451	92,593	77,410	55,401

Notes: This table shows the differential effect of housing subsidies in Bavaria on house prices. The treatment dummy indicates properties listed in Bavaria between July and December 2018. Standard errors are clustered at the postal code level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

in response to the reform, or if Bavarian households who would have otherwise considered moving to a neighboring state decided to remain in Bavaria. This effect attenuates with an increasing bandwidth around the border. Second, the common trend assumption might not hold up as well for the very narrow sample. Results of the 2017 placebo test for different distance bands point in this direction (Table A.1 in the Appendix): while coefficients are insignificant for all distance bands, they are larger for the 10 kilometer band around the border.

In contrast to houses, effects for apartments are insignificant and close to zero (see Table 9). This is also the case for various distance bands around the border, as shown in Table A.2 in the Appendix. The absence of any notable effect is consistent with expectations, given that owner-occupiers only constitute a small share of apartment residents, and investment decisions on rental properties remain unaffected by the reform. The subsidy scheme might also exert a counterbalancing effect on apartment prices: Some tenants of apartments may decide to purchase a house and vacate their rental apartment in response to the subsidy. With rental revenues decreasing, this could conceivably lead to a small downward shift in the demand for apartments.

Overall, these findings confirm the validity of the house price estimations: If results for house prices were driven by a spurious correlation with other policy changes, this would likely show up in all property prices.

Table 9: Subsidy effects on asking prices of apartments

Dependent variable: log price per sqm						
	(1)	(2)	(3)	(4)	(5)	(6)
Subsidy	0.0048 (0.0129)	0.0067 (0.0140)	-0.0025 (0.0140)	0.0053 (0.0140)	-0.0063 (0.0131)	0.0018 (0.0132)
PLZ FE	✓	✓	✓	✓	✓	✓
Time FE	Month	Month x region	Month x region	Month x region	Month x region	Month x region
Controls for Thuringia	✗	✗	Exclusion	Dummies	Exclusion	Dummies
Property controls	✗	✗	✗	✗	✓	✓
Max km to border	25	25	25	25	25	25
N	126,821	126,821	106,970	126,821	106,970	126,821

Notes: This table shows the differential effect of housing subsidies in Bavaria on apartment prices. The treatment dummy indicates apartments listed in Bavaria between July and December 2018. Standard errors are clustered at the postal code level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

## 5.2 Heterogeneity Analysis and Quantification of Effects

As shown by my previous analysis, the subsidy scheme's aggregate effect on house prices is consistent with a full capitalization into house prices. At an average pre-reform house price of 318,700 euros in Bavarian border municipalities (276,400 when Thuringian border regions are included in the sample), my preferred specification's coefficient of 0.0345 translates into a price increase of roughly 11,000 euros (see the upper panel of Table 10). Yet, one could conceivably expect differential effects across segments of the property market.

For once, findings by Hilber and Turner (2014) and Carozzi et al. (2019) suggest differential effects by the degree of urbanization. As building plots might be more readily available for development in rural areas, housing supply might be more elastic. This could result in a comparatively lower capitalization in house prices. I assess whether price responses differ by the level of urbanization by estimating separate treatment coefficients for rural and urban counties. Counties are classified in line with a categorization (*Siedlungsstrukturelle Kreistypen*) by the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR). However, treatment coefficients hardly differ between urban and rural counties (second panel of Table 10). This might be due to capacity constraints in the construction sector: In the short-run, housing supply might be fairly inelastic, even if developable land were readily available. As average house prices are higher in urban regions, a 3.5% price increase nevertheless translates into a higher price growth in absolute terms in urban compared to rural counties.

Second, I assess whether effects differ by house size. All estimations use a property's price per square meter as a dependent variable. All else equal, capitalization of flat-rate subsidies

Table 10: Subsidy effects on asking prices of single-family houses: Heterogeneous effects

Dependent variable: log price per sqm					
	(1)	(2)	(3)	(4)	(5)
	Subsidy	SE	Average area	Average price	Effect in euros
All	0.0345***	(0.0120)	157	318,702	10,995
Rural counties	0.0335**	(0.0155)	158	295,509	9,900
Urban counties	0.0354**	(0.0147)	160	347,101	12,287
Small houses	0.0362**	(0.0156)	112	250,939	9,084
Medium-sized houses	0.0425***	(0.0154)	146	298,222	12,674
Large houses	0.0244	(0.0162)	220	414,548	10,115

Notes: This table shows the differential effect of housing subsidies in Bavaria on house prices. The treatment dummy indicates properties listed in Bavaria between July and December 2018. Specifications are equivalent to column (5) of Table 6, i.e., encompass postal codes within 25 km of the interstate border, exclude border regions to Thuringia, and account for postal code fixed effects, control for property characteristics and include month x region fixed effects. Standard errors are clustered at the postal code level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

into prices per square meter should be larger for smaller houses. I split the sample into small, medium-sized and large houses, based on tertiles of the house size distribution. Treatment coefficients for all tertiles are jointly estimated. Results are depicted in the bottom panel of Table 10. Effects are positive for all house types and significant for small and medium-sized houses. Medium-sized houses exhibit the largest price growth, both in percentage and in absolute terms. However, coefficients might also capture a different effect: houses of different sizes may have a different propensity to be acquired by recipients of the subsidy. Average subsidies might also differ between house types as families are granted a higher subsidy due to the child supplement. For example, small houses with few rooms may not be attractive for families with children. In consequence, the subsidy scheme may have a comparatively lower impact on the demand curve for small houses.

## 5.3 Extension and Discussion

### 5.3.1 Analysis by Likelihood of Subsidization

While real estate adverts data is well-suited for an analysis of aggregate price effects of subsidy schemes, it does not provide any information on a property's buyer. Therefore, I cannot directly infer whether a property's purchaser is eligible for the Bavarian housing purchase subsidy or for additional child benefits for building. This complicates assessing how a differential scope of subsidies is capitalized into prices. In order to assess whether effects differ across subsidy levels, I instead impute subsidization probabilities based on EVS data. This allows

for a differential analysis of houses whose characteristics make them more or less likely to be acquired by beneficiaries of the subsidy scheme.

As a first step, I estimate a probit model for all houses in the EVS data. This estimates the probability that a house is inhabited by owner-occupiers whose incomes comply with eligibility requirements, taking account of house characteristics contained in both data sets.<sup>10</sup> The estimated coefficients are then used to predict subsidization probabilities in the real estate advert data. These predicted probabilities are indicative of how likely a house is to be subsidized, but should not be taken at face value.<sup>11</sup> Therefore, I only conduct a broad-level analysis with heterogeneous effects for houses that are more or less likely to be subsidized. For this purpose, I characterize the upper half of the probability distribution, i.e. houses with subsidization probabilities above the median, as houses with a high subsidization probability. More precisely, I define a dummy variable  $HP_i$  to indicate houses with a high subsidization probability. This dummy is equal to one if the subsidization probability exceeds the median, and zero otherwise. While individual probability predictions might be biased, houses in the upper half of the distribution should on average have a higher likelihood of being subsidized. To assess differential effects for the subset of houses with a high subsidization probability, I extend equation 1 with an interaction term between the treatment variable and an indicator for houses with a high subsidization probability ( $HP_i$ ):

$$\ln(p)_{i,c,t} = \beta_1 \text{Subsidy}_{c,t} + \beta_2 (\text{Subsidy}_{c,t} * HP_i) + \nu HP_i + X_i' \theta + \delta_c + \gamma_{a(c),t} + \epsilon_{i,c,t} \quad (2)$$

These estimations are then conducted for households that are eligible for different subsidy levels. I.e., I estimate several probit models with different dependent variables. I first assess overall eligibility for the Bavarian purchase subsidy scheme, and subsequently estimate the probability that a specific house is inhabited by a family that is also eligible for child supplements for at least one, two or three children. As families receive higher subsidies due to the

<sup>10</sup> Variables include a polynomial of a house's area in square meters and dummy variables for the number of rooms, a parking spot, and broad construction year categories as defined in the EVS data.

<sup>11</sup> One reason is that the categorization of houses might be prone to omitted variable bias: Both the size of houses and the share of households above income thresholds may be correlated with the regional price level. I.e., in areas with a higher initial price level, households with a given income may on average acquire smaller houses, and houses with given characteristics may on average be acquired by households with higher incomes. Lacking detailed geographic information in the EVS data, I cannot account for this correlation. Furthermore, housing choices might be endogenous to the subsidy scheme, with subsidies inducing the acquisition of larger homes (Gruber et al., 2020). Finally, while EVS constitutes a representative household sample, its results are not necessarily representative for the cross-section of advertised properties. As average housing tenure may be related to property characteristics, some property types might comprise a larger share of housing transactions than of the housing stock. The probability that a specific house is inhabited by an eligible household might thus differ from the probability that the house is acquired by the very same household.

Bavarian top-up of the federal child subsidy, this helps assessing capitalization across subsidy levels.

Table 11 presents results for the heterogeneity analysis. The coefficient on the interaction term shows to what extent the price effect for houses with a comparatively high exposure to the subsidy scheme differs from the remainder of houses in the sample. As before, the analysis includes regional time trends, excludes border regions of Thuringia, and controls for property characteristics. While the coefficient is positive for all subsidy schemes, it is only significant for the sample of houses that is most likely to be inhabited by eligible families with at least one, or by eligible families with two or more children. These findings confirm heterogeneous effects across property types, contingent on the exposure of properties to the subsidy scheme.

Table 11: Subsidy effects on asking prices of single-family houses: High and low subsidization probability

Dependent variable: log price per sqm				
	(1)	(2)	(3)	(4)
Subsidy	0.0255* (0.0135)	0.0217* (0.0130)	0.0254** (0.0129)	0.0294** (0.0129)
Subsidy * high subsidy probability	0.0177 (0.0138)	0.0319** (0.0138)	0.0235* (0.0138)	0.0142 (0.0132)
Eligibility criteria	overall	1+ child	2+ children	3+ children
PLZ FE	✓	✓	✓	✓
Time FE	Month	Month	Month	Month
	x region	x region	x region	x region
Controls for Thuringia	Exclusion	Exclusion	Exclusion	Exclusion
Property controls	✓	✓	✓	✓
Max km to border	25	25	25	25
N	113,917	113,917	113,917	113,917
R-squared, first stage	0.0335	0.0826	0.1029	0.1281
Average price, baseline	333,869	306,118	304,117	287,117
Effect in euros, baseline	8,514	6,643	7,725	8,441
Average price, high probability	290,900	335,945	339,146	368,919
Effect in euros, high probability	12,567	18,007	16,584	16,085

Notes: This table shows the differential effect of housing subsidies in Bavaria on house prices. The treatment dummy indicates properties listed in Bavaria between July and December 2018. Average prices refer to prices in Bavaria prior to July 2018. Standard errors are clustered at the postal code level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

I subsequently quantify price effects based on the average pre-subsidy prices of Bavarian houses in both subsamples. In all low-probability samples, prices increase by less than 10,000 euros on average. The subsidy is only partially capitalized in segments of the real estate market that are in comparatively lower demand by subsidy recipients. In contrast, subsidies are fully capitalized for homes that are frequently demanded by eligible families. For an average house in the high probability subsample, the price effect closely resembles the difference between



subsidies in Bavaria and in neighboring states. For example, a family with two children would receive up to 40,000 euros in subsidies in Bavaria, and up to 24,000 euros in other states. While subsidy levels differ by 16,000 euros, house prices increase by a just slightly larger amount in the corresponding high probability sample. This indicates that on average, families do not benefit from the subsidy scheme as it is fully capitalized into prices. Rather, the main beneficiaries are developers and existing homeowners that benefit from the appreciation in house prices. Subsidy recipients may however benefit from the reform if they choose to acquire properties that are less frequently bought by eligible households and, in particular, by eligible families.

### **5.3.2 Effects on Construction Activity**

Subsequently, I follow the same methodological approach as in my baseline estimation to assess the subsidy scheme's effects on construction activity: I regress the number of annual construction permits per 1000 existing buildings on a treatment dummy for Bavarian municipalities in 2018, while accounting for municipality and time fixed effects. Standard errors are clustered at the municipality level. As before, I allow for differential regional time trends and estimate specifications without border regions to Thuringia.

Several aspects distinguish these specifications from prior estimations. First, local administrative data on construction permits is only available on an annual basis. Therefore, I am only able to estimate a treatment effect for the year 2018, pooling construction permits granted under the subsidy scheme with construction permits granted in prior months of 2018. This attenuates explanatory power vis-a-vis a setting which distinguishes construction permits granted early in the year and once the subsidy scheme became effective. Note however that in the absence of anticipatory effects in the first half of the year, the estimated effect should capture the change in the number of construction permits following the introduction of the scheme. Second, while price effects estimations control for a property's postal code, data on construction permits is only available at the municipal level, which often, but not always coincides with postal code areas. Larger municipalities and cities encompass several postal codes. To ensure a high degree of similarity between price and construction permit data, I weigh each municipality with its number of postal codes that are located within the distance band around the Bavarian interstate border. Results are shown in Table 12. Analogous to Table 6, estimations are based on municipalities within 25 kilometers of the Bavarian interstate border.

Specifications (1)-(3) assess the effect of the subsidy scheme on overall residential construction activity. Akin to Table 6, specification (1) neither allows for regionally differentiated trends,

nor controls for the real estate transfer tax reform in Thuringia. Regional time trends are added in specification (2), while specification (3) additionally excludes border regions of Thuringia. Treatment effects are then decomposed into single family homes (specifications (4)-(6)) and houses with two or more apartments (specifications (7)-(9)). No significant effects can be observed for any specification. Note however that while the coefficients on overall construction activity and on single-family homes are positive, larger buildings with several units display a negative coefficient. While insignificant, these findings would be in line with the subsidy scheme slightly stimulating the construction of single-family homes, possibly accompanied by a partial crowding-out of multi-unit construction. As the construction sector has been operating at its capacity limits over the course of 2018, the latter could conceivably be related to price effects of the subsidy scheme on the construction sector.

Table 12: Subsidy effects on construction activity

Dependent variable: number of residential construction permits per 1000 buildings									
	All			Single-family houses			Multi-apartment houses		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Subsidy	0.266 (0.346)	0.184 (0.365)	0.381 (0.467)	0.381 (0.312)	0.326 (0.330)	0.524 (0.397)	-0.116 (0.106)	-0.142 (0.112)	-0.143 (0.162)
Municipality FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Time FE	Month	Month x region	Month x region	Month	Month x region	Month x region	Month	Month x region	Month x region
Controls for Thuringia	✗	✗	Exclusion	✗	✗	Exclusion	✗	✗	Exclusion
Max km to border	25	25	25	25	25	25	25	25	25
N	3,264	3,261	2,139	3,264	3,261	2,139	3,264	3,261	2,139

Notes: This table shows the differential effect of housing subsidies in Bavaria on construction activity. The treatment dummy indicates Bavarian municipalities in 2018. Standard errors are clustered at the municipality level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

## 6 Conclusion

This paper assesses the effects of direct housing subsidies on property prices. Intending to reduce purchase costs for owner-occupiers, both the German federal and the Bavarian state government introduced flat-rate direct housing purchase subsidies in 2018. Exploiting that Bavaria implemented a much more extensive subsidy scheme, I quantify capitalization effects in a difference-in-difference setting across the Bavarian interstate border. Based on a rich micro dataset on properties offered for sale, my results indicate that house prices increased by roughly 3.4% more in Bavarian border regions than in neighboring states. This is consistent with a full capitalization of the subsidy into the prices of single-family homes. In contrast, no

significant effect arises for apartment prices, which can be attributed to apartments being rarely inhabited by owner-occupiers.

These results indicate that subsidy recipients do not necessarily benefit from the subsidy scheme. Instead, the subsidy scheme leads to an upsurge in housing demand, which is capitalized into prices. While subsidy recipients in market segments with lower price appreciation might still gain individually, prices of properties that are most likely to be inhabited by eligible households rise by the full subsidy amount. Thereby, the subsidy scheme also affects households who do not receive the subsidy, but nevertheless face higher prices. Homeowners who acquired their properties in prior years gain the most from the reform due to the appreciation of house values. On aggregate, the subsidy scheme thus redistributes from prospective towards preexisting home owners.

My results are consistent with the literature on real estate subsidies: While the German direct subsidy design substantially differs from other countries' subsidization through the tax code, substantial capitalization effects are well in line with the literature.

These findings are of high importance for the policy debate. My results show that due to the significant capitalization of subsidies into property prices, the recently introduced subsidy schemes fail to deliver on its promise to make housing more affordable.

While my results capture short-term effects, future research might address long-term effects on house prices and construction activity. As housing supply might be more elastic in the medium and long-run, long-term capitalization effects may plausibly differ from my findings.

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## Appendix

Table A.1: Placebo test for asking prices of single-family houses for different distance bands to the interstate border

Dependent variable: log price per sqm						
	(1)	(2)	(3)	(4)	(5)	(6)
Subsidy	0.0051 (0.0089)	0.0059 (0.0096)	0.0077 (0.0107)	0.0006 (0.0120)	0.0056 (0.0129)	0.0231 (0.0146)
PLZ FE	✓	✓	✓	✓	✓	✓
Time FE	Month	Month	Month	Month	Month	Month
	x region	x region	x region	x region	x region	x region
Controls for Thuringia	Exclusion	Exclusion	Exclusion	Exclusion	Exclusion	Exclusion
Property controls	✓	✓	✓	✓	✓	✓
Max km to border	50	40	30	20	15	10
N	148,462	119,950	87,957	60,019	50,207	35,935

Notes: This table shows the results of a placebo test for differential trends in house prices in Bavaria. The placebo treatment dummy indicates properties listed in Bavaria between July and December 2017. Standard errors are clustered at the postal code level. Sample years: 2016 - 2017. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Table A.2: Subsidy effects on asking prices of apartments for different distance bands to the interstate border

Dependent variable: log price per sqm						
	(1)	(2)	(3)	(4)	(5)	(6)
Subsidy	-0.0008 (0.0107)	-0.0082 (0.0112)	-0.0100 (0.0124)	-0.0053 (0.0141)	-0.0093 (0.0156)	-0.0139 (0.0185)
PLZ FE	✓	✓	✓	✓	✓	✓
Time FE	Month	Month	Month	Month	Month	Month
	x region	x region	x region	x region	x region	x region
Controls for Thuringia	Exclusion	Exclusion	Exclusion	Exclusion	Exclusion	Exclusion
Property controls	✓	✓	✓	✓	✓	✓
Max km to border	50	40	30	20	15	10
N	228,503	177,544	127,145	83,664	68,160	46,871

Notes: This table shows the differential effect of housing subsidies in Bavaria on apartment prices. The treatment dummy indicates apartments listed in Bavaria between July and December 2018. Standard errors are clustered at the postal code level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .