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Abstract

With the increasing concerns that accompany the rising trends of house sharing economies, regulators impose new laws to counteract housing supply scarcity. In this paper, I investigate whether the ban on short-term entire house listings activated in Berlin in May 2016 had any adverse effects from a household finance perspective. More specifically, I derive short-term rental income and counter-factually compare it with long-term rental income to find that the ban, by decreasing the supply of short-term housing, accelerated short-term rental income but did not have any direct effect on long-term rental income. Commercial home-owners therefore would find renting on the short-term market to be financially advantageous.

Keywords: Airbnb, housing markets, sharing economy regulation, short-term rental markets

JEL classification: D31, R30, R31

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1 Introduction

In the recent years, most Berliners have gotten acquainted with increasing rental prices. Although the rising trend of housing prices in the last decade can be fundamentally justified (Kajuth (2017); Kholodilin and Michelsen (2017))[1], the latter years introduced another factor of potential price acceleration in the form of the sharing economy for housing. With housing becoming more expensive or affordable due to changes in the elemental factors of demand and supply, sharing economy websites like Airbnb, Wimdu or 9flats are a contributing factor for providing supply deficiencies in the housing market, as they remove dwellings from the long-term rental market for the purpose of renting to interim tenants but not to the city's residents. This effect is especially profound in large cities such as Berlin, i.e. cultural metropolises and touristic destinations where high demand drives accounts for a higher short-term rental income for commercial home-owners[2].

The economic and social effects of booming STR economies are still to a large extent uncharted territory. The convenience and supplementary income that they may provide to short-term tenants and commercial home-owners respectively, can be counteracted by welfare dis-utilities and housing market gentrification. Policy intervention, which has so far come in many forms, as I discuss in the following section of the paper, aims for welfare equilibrium. Due to the recent nature of the housing sharing economy, policy making does not have a standard prior and consequently, it is of great importance to investigate its outcomes.

To counteract an ever increasing supply of housing of short-term rental (STR for the remainder of the thesis) housing units, Berlin's city senate introduced in May 2016 the "Zweckentfremdungsverbot" (law against misappropriation of housing space). This regulation threatened anyone who offers an entire flat[3] for rent with the intent of generating profit. Any commercial exploitation had to be sanctioned with a special permit from the city. However, after a sharp decline in the offerings, flat owners continued to supply short-term rental properties, even amidst an active ban and potential fines.

Following the debate on short-term renting, its costs and accompanying benefits (Guttentag (2015); Coldwell (2017); Ioannides et al. (2018)), this paper investigates the effects of Berlin's ban of Airbnb listings on the housing market from a household finance perspective. In contrast to the existing empirical literature on the effects of Airbnb on rental prices, I look into how the regulation can accelerate landlords' incentives to rent their housing units on the short-term rental market. The question I pose is whether regulation

[1] https://www.immobilienscout24.de/content/dam/is24corporate/documents/unternehmen/Publikationen/2014/Immobilienreport_2014_IS24.pdf

[2] A landlord who does not reside in their residence, but offers it on the rental market.

[3] The regulation was targeted against those who rent an entire flat (more than 50% of the property), not a spare room in their apartment.

on the short-term rental market amplified STR financing incentives of commercial home-owners, therefore inducing adverse effects on the rental market. Did the consequent decreased supply of STR offerings on the market, increase short-term rental income? From a household finance perspective, a commercial home-owner observing accelerating STR incomes would find that renting her housing unit through the sharing economy to be financially beneficial in comparison to long-term renting. The first order effect should be an acceleration in STR income. Higher premiums on STR rentals should then impose pressure in long-term rental prices as well, which would eventually be the exact opposite of what the regulation intended.

Figure 1 visually illustrates evidence of such behaviour. The STR/LTR[4] is the short-term rental income from renting a housing unit on the short-term rental market divided by the counterfactual long-term rental income generated by renting in the long-term rental market. I observe that, in anticipation of the ban, short-term rental income to long-term rental income ratio sharply decreased from 2.75 to 1.25. This is possibly due to cancellations in line with legal conformity. In the post regulation period though, quite a few commercial home-owners[5] disobeyed the regulation and this contributed to an accelerating supply of STR housing. This could be explained by two potential mechanisms. Either the regulation was able to curb rental price hikes, or landlords were therefore able to absorb the forfeited income from others, explaining the increase in their STR income. The Data section of the paper describes how I construct this ratio in detail.

– Figure 1 here –

Short-term renting might be a substitute for renting in the long-term, but there are a few crucial differences between the two. First and foremost, the STR market is geographically selective. Housing units available for short-term renting are usually concentrated around the city centers, close to their financial, historical and touristic areas as Figure 3 in the Appendix illustrates. These areas are usually occupied by offices and buy-to-let properties, therefore home-ownership rates should be lower than in a city's outskirts. Nevertheless, home-ownership rates differ within high-concentration STR postal code areas as I show in the following section. I therefore investigate heterogeneous effects of the regulation with regard to home-ownership rates. I test the following hypotheses: First, neighborhoods with higher home-ownership rates should provide a buffer against such effects, as the rental market is a smaller portion of the total housing stock. Second, neighborhoods with saturated, high amount of STR dwellings should not be drastically affected as well, as market clearance is accounted from the superfluous supply of STR housing units. The results can be suggestive of different types as well as levels of regulations to be imposed across several areas within the city, as short-term rental markets are

[4]Long-term rental income.

[5]Homeowners who rent their apartment on the short-term market.

selective to gentrified and booming areas.

From a theoretical perspective, the recent literature aims to provide perspectives on the collaborative economy, including STR platforms such as Airbnb (Dredge and Gyimóthy (2017); Gyódi (2017); Hatzopoulos (2018)). Jefferson-Jones (2015) and Lee (2016) provide a background on how sharing economies for housing can influence house prices, whereas other papers propose regulations measures (Miller (2014); Gurran and Phibbs (2017); Nieuwland and van Melik (2018)).

On the empirical side, only a handful of papers deal with identifying the effects of STRs on house price accelerations (Horn and Merante (2017), Koster et al. (2018) and Garcia-López et al. (2019)). Barron et al. (2018) investigate the effects of nearby presence of Airbnb listings on rental prices in the US using Google trends as an instrument, to find a 1% increase in Airbnb listings leads to a 0.018% increase in rents and a 0.026% increase in house prices. Segú (2018) investigates the effect of the beginning of the economic activity of Airbnb on rental prices, using the dwelling's distance to the beach as an instrument, to find that a 4% increase in rents. Franco et al. (2019) implement a differences-in-differences analysis between the two major cities in Portugal, namely Lisbon and Porto, to find an overall increase in property values of 34% and 10.9% for rents due to the short-term lease regulatory reform.

This paper contributes to the empirical literature of the sharing economy market for housing by combining data on STR and LTR markets and looking on adverse effects of STR regulation from a household finance perspective. I aim to derive and combine short-term rental income and compare it with the counterfactual long-term rental income in order to investigate into financing decisions made from the landlords after such regulation. The perspective of the paper diverges from the aforementioned empirical literature, as I aim to show whether Berlin's regulatory framework on the STR market induced increasing incomes for non-conforming landlords. Furthermore, I aim to provide evidence of the interdependence between short-term and long-term rental markets as well as investigate potential spillovers on other sub-segments of the STR market.

Arguably, these effects can migrate from rentals to sales, fluctuating not only rents but also housing sales prices. Investors, observing the ever-increasing demand for short-term rentals might find that investing in new construction and acquisition of real estate can yield positive returns. Vice versa, and in line with Kim et al. (2017), where they find that quota regulation depreciated the value of non-resident owned properties and decreased their demand, I also investigate whether the regulation had any effect in house price acceleration.

The empirical evidence suggest that the regulation on the short-term rental market in Berlin accelerated STR income cumulatively by 50%, whereas I find no direct effects on long-term rental income. Furthermore, I illustrate that saturated markets were a mitigating factor of STR income acceleration, as postal code areas with high home-

ownership rates were able to provide a buffer against such movements in STR income. I furthermore find that STR income growth induces an acceleration of LTR prices after one quarter but the effect is rather minuscule. Nevertheless, using the regulation as an instrument for the supply of STR housing, I find that an increase on STR supply by 1%, increases long-term rental prices by around 6 euros. Investigating migration patterns from one sub-division of the STR market to the other, namely, from entire apartments to rooms which satisfy the less than 50% of the housing unit rule, an increase in the supply of rooms to rent on the STR market is observed and a marginally insignificant decline on their income. Regarding spilovers on the house prices, I find that the ever-accelerating housing market of Germany's capital was quite inelastic towards the decreasing supply of STR housing due to the regulation.

2 Regulatory Background

Regulation on STR markets is not a rare spectacle for the larger and most touristic cities around the world. As large metropolitan areas and urban centers suffer from the lack of available housing units, several laws have been implemented in order to control supply. In order to understand the motives and targets of these regulations, I provide a birds-eye view on the different policies and the regulatory background for the ban of short-term listings on the German capital, which served as the most austere regulation so far.

The most common regulation on the house sharing economy is a days per year quota. In Paris, since December 2017, regulators gave an allowance to citizens who want to sublet their home on an online platform if they register with the cities authorities in order to ensure that their property is not rented for more than 120 days per year. In Barcelona, since May 2018 online platforms are forced to provide regulators access to their online data, in order to make prosecution easier for dwellings that are rented for more than 31 days a year. Since January the 1st, 2019 in Amsterdam, landlords can offer houses on the STR market for up to 30 days a year. In London, since March 2015 an STR income tax has been introduced. On the other side of the Atlantic, in New York and San Fransisco, apartments could not be rented for more than 30[6] and 90[7] days respectively.

Due to the strict rental laws applied in Berlin (long-term rental income is staggered and can only exceed the local comparative rent by a maximum of to 10%(In German, *Mietpreisbremse*)[8]), as well due to the high demand for housing experienced in the German capital, short-term renting became a good alternative for landlords.

According to Airbnb publicly available metadata, Berlin currently has around 22

[6]In June 2018, the city passes law to disclose host information. In January 2019, the is upheld.

[7]However, San Francisco decided to crack down further in 2015, forcing all Airbnb hosts to register with the city via an onerous process.

[8]https://www.stadtentwicklung.berlin.de/wohnen/mieterfibel/de/m_miete1.shtml

thousand active rental offerings [9], while 47% of these rentals are entire houses or flats[10]. Whereas the percentage of offerings might not seem that high from a first glimpse, the total number of long-term rental flats are dispersed all across Berlin, whereas short-term listings are more likely to be located Figure 4 and Figure 3 in the Appendix show the dispersion and density of dwellings for each market respectively.

Starting in May 2016, Germany's capital banned landlords from renting apartments through short-term rental online platforms such as Airbnb. The law targeted online listings where more than 50% of the house or apartment was offer for short-term rent. There are two main subsegments of the STR housing market. Commercial home-owners can choose to offer an entire dwelling or sublet a room. The regulation targeted only entire dweelings for short-term rent. Although the supply of STR housing is endogenous to house and rental price acceleration due to reverse-causality, the new law that came into place specifically mentioned that its target is to reduce STR supply, suggesting an exogenous shock to rental price fluctuations. Nevertheless, I perform a series of tests in the empirical results section in order to potentially account for biased results due to endogeneity.

The law was announced two years before its activation, giving a window for preparation both for city's officials and commercial home-owners alike. The penalty for breaking the law was a substantial €100,000 fine, levied on the landlords. Figure 2 below illustrates the relative effectiveness of the regulation in reducing the supply of short-term rental units.

– Figure 2 here –

With the ban activated in May 2016, I observe a big decline in the number of offered listings on the STR market. Nevertheless, the regulation did not manage to eradicate the supply of entire apartments listed online. Demand for cheaper short-term housing in Berlin remained inelastic and quite a few landlords did not abide with the new law. The inability of Berlin's authorities to track and fine the non-conforming landlords imposed enforcing barriers, and not long after, commercial home-owners re-entered the sharing economy rental market, essentially barring the supply of the long-term rental market once again.

Although the focus of this paper is only on the ban on the STR market of entire housing units, it is worth mentioning that two years afterwards, due to the regulation's enforcing inability, Berlin's authorities lifted it, imposing a new set of rules. The city's assembly decided, that, under certain conditions, landlords will be allowed once more to rent out their own home without restrictions, and to rent out second homes for up to 90

[9] 1.1% of the 1.9 million flats in Berlin. (https://www.statistik-berlin-brandenburg.de/BasisZeitreiheGrafik/Zeit-Gebaeude_Wohnen.asp?Ptyp=400&Sageb=31000&creg=BBB&anzwer=7).

[10] Source: http://insideairbnb.com/berlin/

days a year. The new guidelines nonetheless impose some pretty firm prerequisites on vacation rentals and far more stringent penalties. All landlords seeking to rent out their home will only be allowed to do so if they get a general permit from their borough, even if they intend only to rent their property out for occasional short stays. While landlords applying for a permit at their primary residency will likely be approved, second home owners may face a more rigorous process. Landlords who leave an apartment vacant, meanwhile, will need a special permit from the borough to do so after three months of vacancy without having a permanent tenant registered, cutting the current vacancy grace period in half. Most strikingly, the maximum penalty for breaking the rules has been multiplied by five, to a potential fine of €500,000.

3 Data

In order to research the effects of the regulatory ban of short-term rental housing units on household financial decisions and eventually rental prices, I combine data on online adverts from the largest platform on short-term listings, namely Airbnb, with data on long-term rental prices. Furthermore, I want to assess the disperse effects that the regulation on STR might have across different areas of the Berlin, so regional variables at the district level are collected.

Firstly, I use granular (postal-code) information on short-term listings from InsideAirbnb[11] spanning from October 2015 up to May 2017[12]. The data contain information such as the price, listing identifier, number of bed and bathrooms, type of housing, postal code, monthly date and cleaning fee. Square meters are also provided but on their majority are missing (98.88%). Auxiliary to this dataset, a calendar dataset illustrates the listing identification, daily date, price and whether the listing was rented out. The price of each listing is aggregated on a monthly level, thus allowing for calculation of the monthly income from each exact online advert. On the next step, I merge the two aforementioned datasets and include information such as income per listing per month (STR income) and days rented, which can serve as a proxy for demand. Prices are reported in US dollars, so in order to make them comparable, historical daily exchange rates from US dollars to Euro are used. The dataset contains 883,090 observations on short-term Berlin adverts on Airbnb, but since 57.21% of the observations do not contain postal code information, the final Airbnb sample consists of around 380,000 observations.

The second strand of data in use is information from Immobilienscout24.de, Germany's largest online platform of housing units for either rent or sales. The dataset is reduced to postal-code level information on Berlin's housing market for rentals which

[11] http://insideairbnb.com/get-the-data.html

[12] The Airbnb data span span from: October 2015 - February 2016; April 2016 - May 2017 and April 2018 - July 2019. I use only the first and second rendition of the data until May 2017, since I do not want the effects to interfere with potential anticipation effects from the lift of the ban in May 2018.

are available from January 2007 up to May 2017[13]. Firstly, I use data provided by the RWI in Essen which span from January 2007 to October 2017. We append the collected data on a monthly basis from the website using web-scraping techniques in order to extend the dataset's time-frame. The data entail granular information on all residential dwellings (apartments and houses), which were offered for sale or for rent on the website. The advantages of the data lie within the high volume of observations (approximately 33 million observations for the whole of Germany), the geographical information (in 98.5% of the data we observe each listing's postal code) and the plethora of qualitative traits of dwellings, which allow the construction of elaborate quality adjusted hedonic regional house price indices. Eventually, since the analysis focuses on the rental market for apartments in Berlin, I reduce the data to around 1,7 million observations.

One shortfall of the data is that asking are collected but not transaction prices. However, Dinkel and Kurzrock (2012) show for rural areas in Rhineland-Palatine that besides a slight price markup there are no systematic differences between asking and transaction prices. Furthermore, I observe asking prices for both the STR market as well as the LTR market, so continuity ensures comparability between the two datasets.

In order to control for cross-sectional discrepancies among districts, I furthermore include yearly district information on new building permits, new construction and total over-night stays as well as number of guests, which should capture regional effects and touristic attractiveness. I also use a cross-sectional, time-invariant variable of population among postal codes, as population weighted regressions can be implemented to account for the size of each district. These data derive from the statistical office of Berlin and Brandenburg[14].

The first step of the data entails matching STR online adverts with long-term rental dwellings based on their location and characteristics. Short-term listings come with fixed cleaning cost. There is no need to deduct this fixed cost since it bears the renter and not the landlord. In other words, it will not affect her STR income. In what can be referred as a short-term spread, the difference between income from short-term renting and renting is a measure of the intensity of the market towards the short-term option. The larger the spread is, short-term renting should become a more attractive option for a commercial home-owner. I match dwellings from both markets on information on their postal code, date, number of bedrooms and bathrooms. I include only STR adverts of entire apartments, as advertised rooms for rent have intrinsic differences with entire apartments. With the number of characteristics being limited, one STR listing can be matched with multiple LTR adverts. The deriving dataset matches 44.67% between the two datasets, accounting to 1,4 million observations, between January 2016 and November

[13]The data span until August 2019, but for the analysis I reduce the information so that it matches the Airbnb dataset.

[14]https://www.statistik-berlin-brandenburg.de/

2018, which is an imposed limitation of the Airbnb data.

Since there is a break in the data between May 2017 and April 2018, I do not use data later than May 2017. The final dataset includes 559,998[15] pairwise information between STR and LTR listings from January 2016 to May 2017, or else 5 months of information before the ban and 12 months afterwards.

Table 1 provides the summary statistics of the data, before and after the STR regulation was activated. The means, standard deviations, number of observations and a t-test between the two samples(before and after the regulation) is illustrated to test if there are statistically significant differences in the variables of interest before and after the ban on short-term housing.

– Table 1 here –

Furthermore, Table A.3 in the Appendix describes the variables in use, their sources and unit of measurement.

4 Empirical Identification and Results

4.1 Effects on the STR to LTR ratio

In the first stage of the analysis, I investigate the effects of the regulation of Berlin's STR markets on the generated incomes from both the short-term and long-term market. My hypothesis suggests that the ban, which aimed to reduce the supply of STR housing units increased income for landlords who disobeyed the law. Therefore, I construct a measure of STR attractiveness from the landlord perspective, namely the STR to LTR income ratio.

The accelerated income as Figure 5 in the Appendix illustrates, does not derive from increased prices, but from increasing demand. That is due to the "booking lag", i.e. the fact that bookings on the STR market are likely to be made several months in advance, so prices could not be adjusted in response to higher demand. Individual bookings which were canceled due to the ban, probably migrated to other adverts who remained online, thus effectively, increasing the days that the remaining listings were rented and consequently, the landlord's STR income. Figure 6 illustrates the average rental days per short-term apartment before and after the ban. Even though that especially the anticipation of the ban curbed demand, the increase in short-term rental income can be mainly explained by the fact that the apartments who stayed in the market were occupied at an higher rate, and were therefore able to yield higher incomes. Such effect could have negative connotations for the development of rental prices in the surrounding region as well. As people observe accelerating STR incomes, landlords might be willing to either

[15] I drop the bottom and top 1% of the STR to LTR ratio across all dates and postal codes.

jump in the STR market until it gets saturated, or charge a price mark-up for new rentals, in order to account the premium of the STR market.

In order to test the first hypothesis, I calculate growth variables for each postal code region in Berlin. As Figure 1 descriptively suggests, the STR to LTR ratio levels dropped in anticipation of the regulation, but an upward trend followed right afterwards. In order to extract meaningful empirical evidence, I aggregate the sample from individual listings to postal codes per month and then decompose the ratio to STR and LTR income. The reasoning is that I aim to understand which is the driving force of potential changes in the ratio. My hypothesis suggests that the change should originate from changes in STR income first, and that in the medium to long-term rental prices can also grow, in response to the success of STRs in the market.

My second hypothesis states that, the effects of the regulation in STR saturated markets, should be diminished. That is, the STR to LTR ratio in areas like these could still grow, but at a lower pace, as there was already an overflow of STR listings in the pre-regulation period. Since the overflowing supply reduces, there is still slack to meet demand and incomes should accelerate at a lower pace. Furthermore, a decline in rental prices might be observed, since STR migration to the long-term rental market should be easier than in less dense and non-gentrified areas. The empirical methodology in the first approach is of the following:

$$SLgrowth_{p,t} = \alpha_y + \alpha_q + \beta Bnb\_ban_t + \gamma Supply_{p,t} + \delta Controls_{r,y} + \epsilon_{p,t} \qquad (1)$$

where $SLgrowth$ is the short-term to long-term income ratio, where p and t denotes postal code and monthly date respectively. Bnb_ban is a time dummy which is equal to one from May 2016 and onwards. $Supply$ is the logarithmic transformation of the number of STR listings in each postal code and date. This variable serves as a control for the supply of STRs and also investigates whether increased supply mitigates the adverse effects of the regulation. I furthermore include year α_y and quarterly α_q dummies to account for time trends and seasonality. Date fixed effects are not included, as they are collinear with the regulation Bnb_ban time dummy variable. I finally cluster standard errors by district[16], in order to account for cross-sectional autocorrelation. Berlin is split into administrative areas[17]. These account to 24 unique areas in the sample. According to Cameron et al. (2008), clustering at the area level would induce upward bias in the statistical significance of the estimates. I therefore cluster on an area sub-level (Districts). There are in total 59 districts in the sample. Areas and districts are illustrated in Table A.4 in the Appendix. Postal codes in the same district are likely to experience similar trends with regard to their rental markets, both in the long as well as the short-term. Table 2 illlustrates the

[16]Districts are derived from the first four digits of each postal code.

[17]*Ortsteile or Bezirke* in German

results.

– Table 2 here –

The results in Table 2 support the first hypothesis, that the ban accelerated the growth of STR income. In Columns 1,3 and 4, I examine the effects on the STR to LTR ratio growth, STR income growth and LTR income growth respectively. The results indicate that throughout the period of the ban, the ratio increased by 52,3% (Results in Column 1). As a follow-up, I decompose the ratio to observe that this result derives mainly from the effects of the regulation on the STR market. The ban cumulatively increased STR income by 60,6% whereas there were marginally no effects on the LTR income growth. Nevertheless, the coefficient for LTR income growth is positive, subtly indicating that the ban did not manage to reduce rental hikes. In Columns 2,4 and 6 I include an STR supply control, to investigate the follow-up hypothesis of mitigating effects for regions where STR supply is high. The results suggest that a 1% increase in the levels of STR supply, reduces the ratio growth rate by 0,2%. This means that in areas above the 80% percentile of the STR supply distribution, STR grew around 16% less than in other regions with scarcer supply. The effect is more profound on the STR market as can be observed in Column 4, whereas in Column 6, the coefficient suggests that for 1% increase in the STR supply levels, rental income growth declined by 0,007%. In districts above the 80% percentile LTR rental income decreased by 0,5% showing minor evidence that in areas where a lot of STR listings existed, there was a larger migration from the STR to the LTR market after the ban and thus, a slight decrease in rental income from the landlord's perspective. This effect can also be observed on Figure 7, as the regulation manages, in the short-term, to inflate short-term rental income, but has a rather minimal effect on long-term rental prices within one year after its activation. The analysis is supplemented by including the STR listings number weighted by population, in order to scrutinize the findings on STR supply and consequently, that postal code areas with a bigger number of STR listings experience slower STR growth. Table A.2 in the Appendix illustrates that a 1% increase in the supply of STR housing per capita in the post period contributes to the deceleration of SL growth and STR growth by 0,7% and 0,9% respectively.

On the follow-up hypothesis, I test whether higher level of home-ownership rates are able to negate the acceleration of of the STR to LTR ratio. Due to the lack of data on home-ownership rates at the postal code and monthly level in Germany, I use supply indicators as a home-ownership proxy. This variable is constructed by dividing the number of housing units for sale, houses and apartments over the total stock of housing both for sale and rent. The ownership proxy is constructed as follows:

$$Ownership\_rate_p = \frac{\#\ of\ listings\ for\ sale_p}{\#\ total\ housing\ stock_p} \tag{2}$$

I consider that the supply of housing among regions is directed towards satisfying demand. In densely populated central areas of big cities, home-ownership rates are low, because tenants are usually commuting workers and university students. Therefore, in central areas it is more likely that advertised online adverts are directed towards the rental market. Home-ownership rates should therefore be lower in comparison to other areas where apartments or houses for sale are more frequently advertised, in order to satisfy demand. I want to investigate whether areas with higher home-ownership rates provide a buffer against increasing STR income. In order to empirically test this, I include the home-ownership proxy in an empirical estimation similar to the previous one and its interaction with the ban, while controlling for the supply of STRs, yearly trends and seasonality. The empirical methodology to assess the effect of home-ownership rates on mitigating STR to LTR income growth is of the following:

$$\begin{aligned} SLgrowth_{p,t} = \alpha_y + \alpha_q + \beta Bnb\_ban_t + \gamma Ownership\_rate_p + \delta Bnb\_ban_t \times Ownership\_rate_p \\ + \eta Supply(inln)_{p,t} + \iota Controls_{r,y} + \epsilon_{p,t} \end{aligned} \tag{3}$$

where variables are constructed in line with Equation 1. *ownership_rate* is a time and postal code varying home-ownership proxy, illustrated in Equation 2. Standard errors are clustered by district. Table 3 illlustrates the results.

– Table 3 here –

The results in Table 3 show that postal code areas with high home-ownership rates, were able to mitigate the effects of the regulation. Similarly with the results on Table 2, the effect is positive and significant for STR income growth. Areas where home-ownership rates are high, are usually in he city's outskirts and therefore demand for STRs is quite lower. Arguably, since demand is lower, STR landlords do not have enough leverage to push prices upwards,nor do they expect to see an increase in demand even after the ban was activated. The interaction term of the regulation and home-ownership rates across postal codes indicates whether commercial home-owners in areas with high levels of home-ownership experienced a lower increase in their STR growth. In the pre-ban period, I observe no cross-sectional differences. In the post period though, areas with high ownership rates indeed experienced a smaller increase in the SL ratio and STR growth, with no effect on LTR growth. For example, a postal code region where 80% of the home-ownership proxy is satisfied, i.e. 80% are home-owners, was able to mitigate the short to long-term rental income growth by around 8%.

The empirical analysis suggests that the regulation on the short-term rental market in Berlin induced an increase in STR income growth, all the meanwhile, not being able to

reduce rental prices (in the analysis it is denoted as long-term rental income). The ban on STRs increased the income for landlords who decided to remain in the market and exploit an environment of steady seasonal demand but decreased supply. Furthermore, I illustrate that saturated postal code areas were a mitigating factor of STR income acceleration, as well as areas with high home-ownership rates which where able to provide a buffer against such movements in STR income. Therefore commercial home-owners in these areas were more likely to offer their dwelling on the long term market than in the short term.

4.2 Effects on the Long-term Rental Market

Whereas I observe that the regulation did not manage to curb the growth rates of long-term rental prices within one year after its activation, I additionally investigate whether the increase in STR income had any second order effects on the long-term rental market.

As observed in Figure 8 LTR prices were on an increasing trend and continued to grow before and after the ban with no observable differences in trends. Under the findings in Table 2, landlords could ask for a price mark-up on their long-term rental prices.

The empirical methodology to assess the effect of STR growth rates on LTR growth is the following:

$$LTRgrowth_{p,t} = \alpha_y + \alpha_q + \beta Bnb\_ban_t + \gamma STRgrowth_{p,t-3} + \delta Ownership\_rate_{p,t} + \epsilon_{p,t} \quad (4)$$

Firstly, since I do not require data on the STR market in order to investigate whether the ban had any effect on LTR growth, I am able to extend the sample period to one year before the ban and two years afterwards. Secondly, in order to look at the effects of STR growth on the LTR market as a second order effect, I include quarterly lags of STR growth. These lags are arbitrarily defined, under the assumption that LTR prices timely react to STR growth, but not long afterwards. Table A.1 illustrates different sets of lags, in order to scrutinize the choice of a quarterly lag. Table 4 below illustrates the findings.

–Table 4 here–

In the first two columns, I duplicate the findings in Table 2 as I extend the period of analysis to one year before and two years after the activation of the ban. The findings suggest that the ban did not manage to curb the observed acceleration of rental income on the long-term market. Furthermore, I find supportive evidence of interdependence between growth in the STR and LTR markets, but the effect is rather marginal. I find that a quarterly lagged 1% increase in the STR income growth rate increases LTR prices by 0,002%. The effect is not profound, but as I observe in Table A.1, LTR and STR

growth rates are positively correlated during the first quarter. Eventually the findings are slightly supportive of the second order effect hypothesis.

4.3 Spillovers on the Short-term Rental Market for Rooms

Berlin's regulation on the STR market intended to reduce the supply of housing on the short-term market and migrate these housing units to the long-term market. Unfortunately, I do not observe specific listings migrating from one market to the other, but I can investigate whether the decreased supply of STR units was accompanied by an increase in the supply of STR listings for rooms, which could be a substitute segment of the short-term housing market for landlords.

Figure 9 illustrates a hike in the supply of rooms to rent right after the ban, supporting the hypothesis that STR commercial home-owners who obliged to the new regulation preferred to offer less than 50% of their apartment on the STR market instead of migrating to the LTR market. If this assumption holds, then the regulation, did not manage to effectively increase the supply of LTR housing units. Also observed in the graph, rental rooms income had a slight increase, but not comparable to the one observed on STRs of entire apartments.

In line with the empirical identification of the regulatory effects on STR income for entire apartments Equation 1, I look into the progression of income growth for short-term rented apartments. Table 5 illustrates the results.

– Table 5 here –

I find no statistically significant effects of the regulation on the STR income for rooms. I although find a borderline significant negative relationship between the ban and room income. This might be due to the increased supply of STR room units. These effects are supportive of the hypothesis, but due to lack of significance, the findings cannot be conclusive. From a financing decision perspective though, the findings imply that there are no substitution effects between the two sub-categories of STR housing.

4.4 Spillovers on the Long-term Sales Market

Along Kim et al. (2017), where the authors find a value depreciation of non-tenant occupied dwellings following a regulation on the sharing economy for housing, I investigate whether the ban on STR housing units spilled-over the sales market for apartments. The regulation might have induced divesting in the sharing economy for housing, potentially decreasing the growth rate of house prices. In a similar identification fashion as in Table 4, I include long-term sales price growth as the dependent variable.

– Figure 8 here –

The results indicate that the sales market was inelastic to changes in the regulatory framework of STRs, as well as their supply and STR income growth. The visual evidence in Figure 8 show an ever increasing upward trend of sales prices for apartments, with no distinct differences between the period before or after the regulation was introduced. This explains the fact that I do not find any significant effects as well as is suggestive that sales prices, were experiencing high levels of growth that a regulation on STRs was not able to abate.

5 Robustness Checks

Although the regulation specifically mentions that its target was to reduce the supply of STR listings, suggesting an exogenous shock to rental price fluctuations, I perform a series of tests in order to potentially account for biased results due to endogeneity. The endogeneity may arise from two main factors. First, a second order intent of the regulators was to apply downward pressure to rental price hikes, by increasing the LTR housing stock, implying endogeneity to rental price growth. The second channel of endogeneity would be reverse causality between STR supply and LTR rental prices. Selective STR markets are usually condensed in gentrified, booming areas. Vice-versa, rental prices in areas where there are a lot of sharing economy housing units accelerate due to scarce supply.

5.1 Instrumental Regression

In order to tackle endogeneity, I first perform an instrumental variable regression, where I use the regulation as an instrument for STR housing supply on LTR rental prices. The first and second stage of the regression is as follows:

$$LTR_{p,t} = a + \beta \hat{Supply}_{p,t} + \gamma X_{r,y} + \epsilon_{p,t}$$

$$Supply_{p,t} = \alpha_y + \alpha_q + \delta Bnb\_ban_t + \upsilon_{p,t}$$

Table 7 illustrates the results.

– Table 7 here –

The results in Table 7 indicate the positive relation between STR housing supply and LTR rental levels and growth. In Columns 1 and 2, I find that if the supply of STR housing increases by 1%, then rental prices by around 5.6 euros. In Columns 3 and 4, I investigate the effects of increases in STR housing supply on rental price acceleration. I observe that a 1% increase in STR supply increases long-term rental price growth by 1,3%. The Kleibergen-Paap F-test for all tests has a value of more than 40, which indicates statistical instrument validity. Furthermore, the fact that I do not find any

causal evidence in Table 2 between the regulation and long-term rental prices (which is interchangeably used as income as well) supports the exclusion restriction, that the regulation has an effect on rental prices only through the supply of STR housing units. The results are supportive of the findings in Duso et al. (2020), where the authors find that proximity of housing units to STR dwellings increases its rental price.

5.2 Generalized Method of Moments Regression

Another commonly used method of tackling endogeneity is a GMM Arellano-Bond estimator. Lagged values of the dependent variables are therefore used as instruments, to control for endogeneity. Usually, researchers use up to two lags of the dependent variable as these "internal instruments" (Schultz et al. (2010) and Wintoki et al. (2012) [18].).

Table 8 illustrates the GMM estimator results, where I include 2 lags of the dependent variable. Whereas the results on rental price levels indicate a much smaller relation deriving from increases in the supply of STR housing, a 1% increase in the supply of STR supply increases long-term rental price growth by 1,5%, 0,2 basis points more than the results indicated in Column 4 of Table 7.

– Table 8 here –

These results aim to supplement the findings in Table 4, where I find that an increase in STR income has a small and marginally significant effect on LT rental income growth. Since I use the terms long-term rental income and prices interchangeably, Table 7 suggests that an increase in STR supply applies pressure to rental prices. The regulation shortly managed to decrease STR supply which indicates that rental prices would decelerate. The cumulative findings though suggest that rental prices where quite inelastic in response to this decrease in STR supply, which mostly derives from the minuscule inflow of new LTR housing units right after the regulation.

6 Conclusion

This paper aims to shed light onto potential adverse effects of the regulation on the STR market on household financing incentives. Using the case of Berlin for identification, where a partial ban was implemented and then lifted after two years due to its inability to control the supply of STRs on the market, I investigate whether the ban increased STR income for those who stayed in the market even after the regulation was activated, thus creating higher incentives for landlords to rent their dwelling on the short-term rental market. The regulation aimed to reduce the supply of STRs to zero, by funneling new

[18] A comprehensive analysis of how a GMM estimator can deal with endogeneity bias can be found in Ullah et al. (2018)

housing units into the long-term rental market and by the means of increasing supply, mitigating an accelerating trend of rental prices.

Due to the fact that demand was staggered and that the enforcing authorities failed to impose fines to non-conforming landlords, those who remained experienced an increase in their STR income up to 50%. This increase deemed the STR market more attractive from a financial point of view, and consequently failed to decrease long-term rental income. Furthermore, I show that areas with high levels of STR supply as well as high home-ownership rates are able to dampen STR income acceleration. The first can be explained by excessive STR supply in the first case, or else a lemon scenario, where STR units who were not generating income due to overflowing supply, could leave the market without creating any significant difference in the supply demand equilibrium. Secondly, in a diverse scenario, areas with high home-ownership rates are likely to provide a buffer to STR acceleration, since demand in these areas should be lower, as I explain in the main body of the paper.

These results provide evidence that regulators who want to contain the negative externalities of the STR market, have to consider the heterogeneous effects across spatial units. The STR market is endogenous to rental hikes and is more likely to be a larger part of the total number of housing units in cultural, historical and financial centers. Imposing a city-wide regulation might not only have little effect, but might also hurt landlords who use the sharing economy to generate income in areas where there STR market is small enough to meet demand, and therefore does not have enough capacity to push rental prices upwards.

I furthermore find that STR growth has a positive effect on pushing LTR prices after one quarter but the effect is rather minuscule. On the other side, there seems to be no significant relation between the regulation on STRs, or STR supply on apartment sales price growth. Investigating migration patterns from one sub-division of the STR market to the other, namely, from entire apartments to rooms which satisfy the less than 50% of the housing unit rule, I observe an increase in the supply of rooms to rent on the STR market and a marginally insignificant negative growth rates on their income.

As suggested in the introduction, a second order effect of the regulation could be that rental prices, in response to accelerating STR income, impose a mark-up on new contracts. The evidence on the short-term are not suggestive of such behavior, but possibly these effects incubate for a longer period of time. These findings provide a ex-post overview of the realized outcomes of a regulation on the STR market. With the empirical research on the sharing economy for housing being relatively new, further analysis of the effects of STR regulation is important both from a financial and social perspective.

Table 1: Summary statistics

	Full Sample						Pre Ban Period			Post Ban Period			T-test(Pre-Post)	
	Mean	Std.Dev.	25th	Median	75th	N	Mean	Std.Dev.	N	Mean	Std.Dev.	N	Delta	p-value
Listing summary statistics														
STR income	1590.99	1210.67	547.00	1554.00	2252.00	559998	1768.95	1146.19	144290	1529.22	1226.24	415708	239.73***	(0.00)
LTR income	797.57	379.66	540.00	712.61	964.00	559998	755.97	381.56	144290	812.00	377.93	415708	-56.03***	(0.00)
STR/LTR ratio	2.25	1.77	0.75	1.98	3.24	559998	2.66	1.82	144290	2.10	1.73	415708	0.55***	(0.00)
Bathrooms	1.02	0.13	1.00	1.00	1.00	559905	1.02	0.14	144231	1.02	0.13	415674	0.00	(0.18)
Bedrooms	1.15	0.39	1.00	1.00	1.00	558335	1.16	0.39	143650	1.15	0.39	414685	0.01***	(0.00)
Cleaning fee	32.12	17.03	20.00	30.00	40.00	417387	32.10	16.21	109448	32.13	17.31	307939	-0.04	(0.56)
Postal code summary statistics														
STR/LTR growth	0.22	1.88	-0.2	-0.0	0.2	2170	0.04	2.20	307	0.24	1.82	1863	-0.20	(0.08)
STR income growth	0.21	1.82	-0.1	0.0	0.2	2170	0.03	1.91	307	0.24	1.80	1863	-0.21	(0.06)
LTR income growth	0.03	0.22	-0.1	0.0	0.1	2170	0.01	0.17	307	0.03	0.23	1863	-0.02	(0.27)
Sales/Total	0.44	0.20	0.3	0.4	0.6	2615	0.48	0.21	642	0.43	0.20	1973	0.04***	(0.00)
Rentals/Total	0.56	0.20	0.4	0.6	0.7	2615	0.52	0.21	642	0.57	0.20	1973	-0.04***	(0.00)
STR Supply	40.47	58.30	5.0	16.0	45.0	2472	41.01	57.98	615	40.29	58.42	1857	0.72	(0.79)

This table shows descriptive statistics for the main characteristics of online adverts both on the STR and LTR market. The second panel of the table illustrates aggregated postal code level summary statistics, namely, the growth variables of STR and LTR income, as well as the growth of their ratio. There are 186 unique postal codes in the dataset. We show full sample statistics and distinguish between pre and post ban period. In the last two columns we perform a t-test of the mean differences between the two periods and report the first difference and its statistical significance. STR supply refers to the amount of online adverts on average by date across all postal codes. Cleaning fee is in euros.

Table 2: The effects of the regulation on short and long-term income growth

	(1)	(2)	(3)	(4)	(5)	(6)
	SLgrowth		STR income growth		LTR income growth	
Bnb_ban	0.599***	0.473**	0.597***	0.449**	0.004	0.002
	(0.216)	(0.218)	(0.200)	(0.201)	(0.018)	(0.017)
Supply(ln)		−0.546**		−0.645**		−0.009*
		(0.232)		(0.272)		(0.005)
District Controls						
New Permits(ln)	−0.171	−0.244	−0.280	−0.367	−0.001	−0.002
	(0.225)	(0.236)	(0.326)	(0.339)	(0.027)	(0.026)
Overnight(ln)	−0.046	0.022	−0.057	0.023	0.006	0.007
	(0.124)	(0.142)	(0.124)	(0.142)	(0.013)	(0.012)
New Construction(ln)	−0.003	−0.173	−0.051	−0.252	−0.003	−0.006
	(0.212)	(0.260)	(0.205)	(0.265)	(0.017)	(0.017)
Constant	1.285	3.472	2.340	4.921	−0.032	0.005
	(1.572)	(2.130)	(2.373)	(3.118)	(0.196)	(0.198)
Observations	2251	2251	2251	2251	2251	2251
R-Squared	0.044	0.064	0.039	0.058	0.015	0.015
Adjusted R-Squared	0.017	0.036	0.010	0.030	−0.014	−0.014
Year F.E.	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Quarter F.E.	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Regional F.E.	*District*	*District*	*District*	*District*	*District*	*District*
Cluster S.E.	*District*	*District*	*District*	*District*	*District*	*District*

This Table shows the baseline results of the effects of the STR regulation on STR and LTR income growth. The main variable of interest –Bnb_ban– is a dummy indicator for the period after the ban on short-term listings was activated. Variable –Supply– is a logarithmic transformation of the total supply of STR housing per postal code and month. The results derive from an unbalanced dataset of 186 postal codes by 16 monthly observations. We include yearly and quarterly fixed effects to account for time trends and seasonality and we cluster standard errors at the district level, in order to allow cross-sectional autocorrelation between residuals among postal codes in the same district. Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3: The effects of the regulation on short and long-term income growth, conditional on home-ownership

	(1)	(2)	(3)	(4)	(5)	(6)
	SLgrowth		STR income growth		LTR income growth	
Bnb_ban	0.606**	0.481*	0.620**	0.472*	0.014	0.012
	(0.265)	(0.266)	(0.240)	(0.238)	(0.019)	(0.019)
Bnb_ban=0 × Ownership_rate	−0.155	−0.105	−0.158	−0.099	0.013	0.014*
	(0.173)	(0.145)	(0.151)	(0.122)	(0.008)	(0.008)
Bnb_ban=1 × Ownership_rate	−0.161*	−0.109*	−0.177**	−0.116	0.004	0.005
	(0.084)	(0.062)	(0.084)	(0.073)	(0.004)	(0.004)
Supply(ln)		−0.533**		−0.631**		−0.010*
		(0.230)		(0.272)		(0.005)
District Controls						
New Permits(ln)	−0.171	−0.242	−0.279	−0.364	−0.000	−0.001
	(0.222)	(0.236)	(0.324)	(0.340)	(0.027)	(0.026)
Overnight(ln)	−0.058	0.012	−0.069	0.014	0.007	0.008
	(0.118)	(0.137)	(0.119)	(0.139)	(0.013)	(0.012)
New Construction(ln)	−0.012	−0.175	−0.062	−0.255	−0.004	−0.007
	(0.211)	(0.258)	(0.205)	(0.263)	(0.017)	(0.017)
Constant	1.688	3.695*	2.763	5.138*	−0.058	−0.020
	(1.553)	(2.078)	(2.359)	(3.049)	(0.195)	(0.197)
Observations	2251	2251	2251	2251	2251	2251
R-Squared	0.046	0.064	0.040	0.059	0.015	0.016
Adjusted R-Squared	0.018	0.036	0.011	0.030	−0.015	−0.015
Year F.E.	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Quarter F.E.	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Regional F.E.	*District*	*District*	*District*	*District*	*District*	*District*
Cluster S.E.	*District*	*District*	*District*	*District*	*District*	*District*

This Table shows the effects of STR regulation on STR and LTR income growth. The dependent variable is long-term rental prices growth. The main variable of interest –Bnb_ban– is a dummy indicator for the period after the ban on short-term listings was activated. Ownership_rate is the ratio of long-term listings for sale over the total housing stock in postal code level. Variable –Supply– is a logarithmic transformation of the total supply of STR housing per postal code and month. Columns 2,4 and 6 illustrate heterogeneous pattern with regards to different levels of homeownership rates. The results derive from an unbalanced dataset of 186 postal codes by 16 monthly observations. We include yearly and quarterly fixed effects to account for time trends and seasonality and we cluster standard errors at the district level, in order to allow cross-sectional autocorrelation between residuals among postal codes in the same district. Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4: The effects of the regulation on long-term rental price growth

	(1)	(2)	(3)	(4)
	LTRgrowth			
Bnb_ban	0.009	0.010		
	(0.008)	(0.008)		
$STRgrowth_{t-3}$			0.002*	0.002*
			(0.001)	(0.001)
District Controls				
New Permits(ln)	−0.002	−0.002	−0.001	−0.001
	(0.004)	(0.004)	(0.004)	(0.005)
Overnight(ln)	0.001	0.002	0.003	0.004
	(0.004)	(0.004)	(0.004)	(0.004)
New Construction(ln)	0.003	0.003	−0.003	−0.003
	(0.006)	(0.006)	(0.008)	(0.008)
Ownership_rate		0.020*		0.014
		(0.011)		(0.010)
Constant	−0.033	−0.050	−0.007	−0.019
	(0.037)	(0.037)	(0.034)	(0.035)
Observations	2422	2417	1729	1725
R-Squared	0.011	0.012	0.021	0.022
Adjusted R-Squared	−0.016	−0.015	−0.015	−0.015
Year F.E.	*Yes*	*Yes*	*Yes*	*Yes*
Quarter F.E.	*Yes*	*Yes*	*Yes*	*Yes*
Regional F.E.	*District*	*District*	*District*	*District*
Cluster S.E.	*District*	*District*	*District*	*District*

This Table shows the effects of STR regulation on LTR prices, as well as the effects of STR income growth on LTR prices. The dependent variable is long-term rental prices growth. The main variable of interest –Bnb_ban– is a dummy indicator for the period after the ban on short-term listings was activated. Variable STRgrowth_{t-3} indicates the growth in short-term rental listings supply in the last quarter. The difference in the observation count between Column 1, 2 and 3, 4 is due to the limited time span if the STR data. The results derive from an unbalanced dataset of 186 postal codes by 16 monthly observations. We include yearly and quarterly fixed effects to account for time trends and seasonality and we cluster standard errors at the district level, in order to allow cross-sectional autocorrelation between residuals among postal codes in the same district. Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5: The effects of the regulation on short-term rental income growth for rooms

	(1)	(2)	(3)
		STR growth	
Bnb_ban	−0.117	−0.119	0.058
	(0.124)	(0.117)	(0.192)
Ownership_rate			0.021
			(0.253)
Bnb_ban × Ownership_rate			−0.432
			(0.347)
Supply(ln)		−0.100***	
		(0.033)	
District Controls			
New Permits(ln)	−0.326	−0.028	−0.055
	(0.291)	(0.108)	(0.109)
Overnight(ln)	−0.250	−0.027	−0.092
	(0.231)	(0.078)	(0.072)
New Construction(ln)	0.413	0.087	0.081
	(0.310)	(0.106)	(0.101)
Constant	2.457	0.445	1.303
	(2.659)	(1.178)	(1.178)
Observations	2362	2362	2362
R-Squared	0.049	0.009	0.007
Adjusted R-Squared	0.022	0.006	0.003
Year F.E.	*Yes*	*Yes*	*Yes*
Quarter F.E.	*Yes*	*Yes*	*Yes*
District F.E.	*District*	*District*	*District*
Cluster S.E.	*District*	*District*	*District*

This Table shows the effects of STR regulation on STR income growth for listed rooms. The dependent variable is short-term rental income growth for rooms. The main variable of interest –Bnb_ban– is a dummy indicator for the period after the ban on short-term listings was activated. Ownership_rate is the ratio of long-term listings for sale over the total housing stock in postal code level. Variable –Supply– is a logarithmic transformation of the total supply of STR housing per postal code and month. The results derive from an unbalanced dataset of 186 postal codes by 16 monthly observations. Supply is the logarithmic transformation of the number of short-term rental listings in each postal code and month. We include yearly and quarterly fixed effects to account for time trends and seasonality and we cluster standard errors at the district level, in order to allow cross-sectional autocorrelation between residuals among postal codes in the same district. Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6: The effects of the regulation on long-term purchase price growth

	(1)	(2)	(3)	(4)	(5)	(6)
	Long-term Sales Price Growth					
Bnb_ban	0.002	−0.009				
	(0.007)	(0.013)				
$STRgrowth_{t-3}$			0.000	0.001		
			(0.003)	(0.004)		
$STRsupplygrowth_{t-1}$					0.009	0.024
					(0.015)	(0.023)
District Controls						
New Permits(ln)	−0.005	−0.007	−0.001	−0.011	0.003	−0.007
	(0.004)	(0.008)	(0.010)	(0.012)	(0.004)	(0.010)
Overnight(ln)	−0.007*	−0.012*	−0.004	−0.006	−0.011***	−0.017**
	(0.004)	(0.006)	(0.009)	(0.010)	(0.004)	(0.007)
New Construction(ln)n	0.008**	0.016	0.001	0.001	0.006	0.020*
	(0.003)	(0.011)	(0.015)	(0.017)	(0.006)	(0.012)
Ownership_rate		0.020*		0.014		
		0.048**		0.041**		0.055**
		(0.023)		(0.019)		(0.027)
Constant	0.085	0.103	0.079	0.144	0.123**	0.124
	(0.063)	(0.078)	(0.116)	(0.148)	(0.052)	(0.091)
Observations	7060	2358	2307	1732	3821	2029
R-Squared	0.005	0.015	0.013	0.020	0.007	0.018
Adjusted R-Squared	−0.005	−0.013	−0.015	−0.017	−0.010	−0.015
Year F.E.	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Quarter F.E.	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Regional F.E.	*District*	*District*	*District*	*District*	*District*	*District*
Cluster S.E.	*District*	*District*	*District*	*District*	*District*	*District*

This Table shows the effects of the STR regulation on long-term purchase prices for apartments. The dependent variable is long-term rental price growth. The main variable of interest –Bnb_ban– is a dummy indicator for the period after the ban on short-term listings was activated. Variables $STRgrowth_{t-1}$ and STRgrowth_{t-3} indicates the growth in short-term rental listings supply in the last month and quarter respectively. The results derive from an unbalanced dataset of 186 postal codes by 16 monthly observations. We include yearly and quarterly fixed effects to account for time trends and seasonality and we cluster standard errors at the district level, in order to allow cross-sectional autocorrelation between residuals among postal codes in the same district. Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7: The effects of short-term rental supply on long-term rental prices - IV estimator

	(1)	(2)	(3)	(4)
	LTR prices		LTR price growth	
Supply (ln)	6.165***	5.617***	0.013***	0.013***
	(0.462)	(0.395)	(0.003)	(0.004)
New Permits		1.357***		0.001
		(0.353)		(0.003)
Overnight Stays		0.360		−0.001
		(0.639)		(0.003)
New Construction		0.456**		0.003*
		(0.203)		(0.002)
Observations	4884	4588	4883	4587
Kleibergen - Paap F-test	57.734	48.170	59.966	51.498
Year F.E.	*Yes*	*Yes*	*Yes*	*Yes*
Quarter F.E.	*Yes*	*Yes*	*Yes*	*Yes*
Regional F.E.	*None*	*District*	*District*	*District*
Cluster S.E.	*District*	*District*	*District*	*District*

This table shows an IV regression of the effects of STR supply on long-term rental prices. The main variable of interest –Supply– is a logarithmic transformation of the total supply of STR housing per postal code and month. The dependent variable is the level of long-term rental prices per postal code (Columns (1) and (2)) and the long-term rental price growth (Columns (3) and (4)). The results derive from an unbalanced dataset of 186 postal codes by 16 monthly observations. We include yearly and quarterly fixed effects to account for time trends and seasonality and we cluster standard errors at the district level, in order to allow cross-sectional autocorrelation between residuals among postal codes in the same district. Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

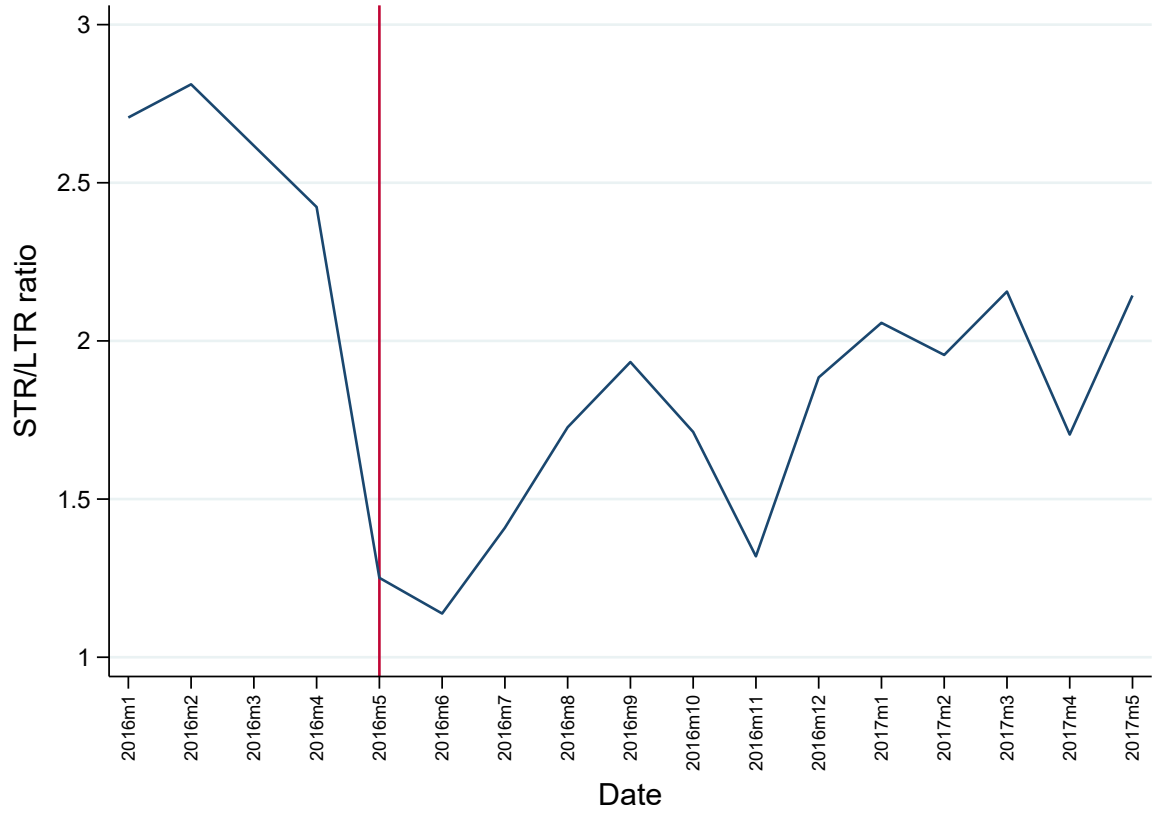
Table 8: The effects of the regulation on long-term rental price growth - GMM estimator

	(1)	(2)	(3)	(4)
	LTR prices		LTR price growth	
$LTRprices_{t-1}$	0.254***	0.251***	−0.488***	−0.487***
	(0.002)	(0.005)	(0.003)	(0.003)
$LTRprices_{t-2}$	0.134***	0.123***	−0.203***	−0.201***
	(0.002)	(0.005)	(0.003)	(0.003)
Supply (ln)	0.124***	0.049***	0.017***	0.015***
	(0.010)	(0.016)	(0.001)	(0.002)
New Permits		−0.262***		−0.021***
		(0.023)		(0.004)
Overnight Stays		4.282***		0.111
		(0.469)		(0.126)
New Construction		0.210***		0.025***
		(0.017)		(0.004)
Constant	6.015***	−55.443***	−0.028***	−1.692
	(0.040)	(6.764)	(0.002)	(1.815)
Observations	4247	3984	4247	3984
Year F.E.	*Yes*	*Yes*	*Yes*	*Yes*
Quarter F.E.	*Yes*	*Yes*	*Yes*	*Yes*
Regional F.E.	*District*	*District*	*District*	*District*
Estimator	*GMM*	*GMM*	*GMM*	*GMM*

This Table shows the effects of STR regulation on STR income growth for listed rooms using a two-step GMM Arellano-Bond estimator. The dependent variable is long-term rental price growth, autoregressed by two lags. The main variable of interest –Supply– is the logarithmic transformation of the total number of short-term rental housing in each postal code and month. The results derive from an unbalanced dataset of 186 postal codes by 16 monthly observations. We include yearly and quarterly fixed effects to account for time trends and seasonality and we cluster standard errors at the district level, in order to allow cross-sectional autocorrelation between residuals among postal codes in the same district. Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

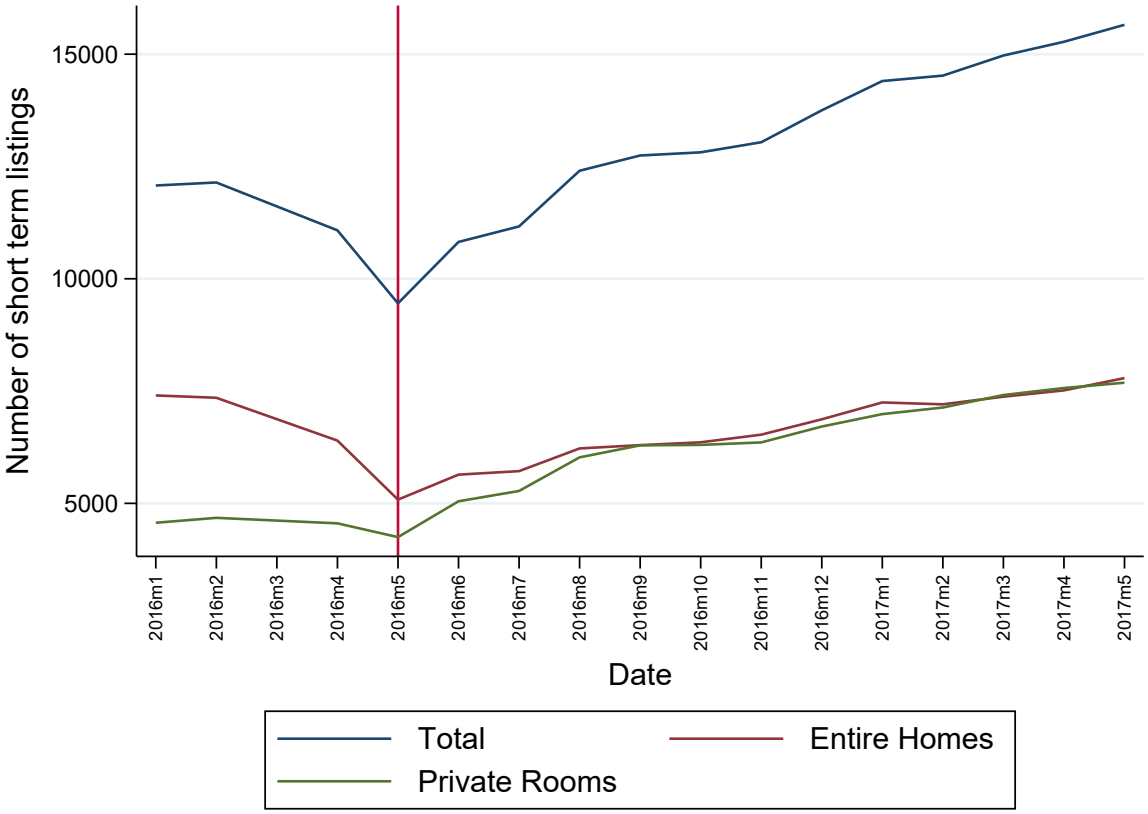
Figures

Figure 1: Median short-term rental income and counterfactual median long-term rental income ratio



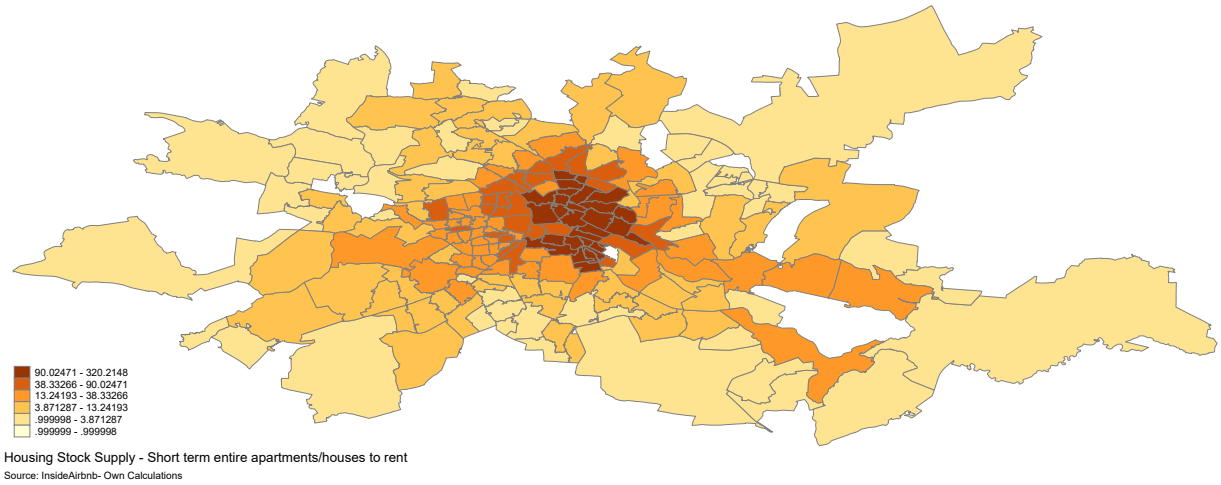
This figure illustrates the median short to long-term rental income from January 2016 to May 2017. The red vertical line indicates the activation of the ban on short-term apartment listings.

Figure 2: Total number of short-term listings per category



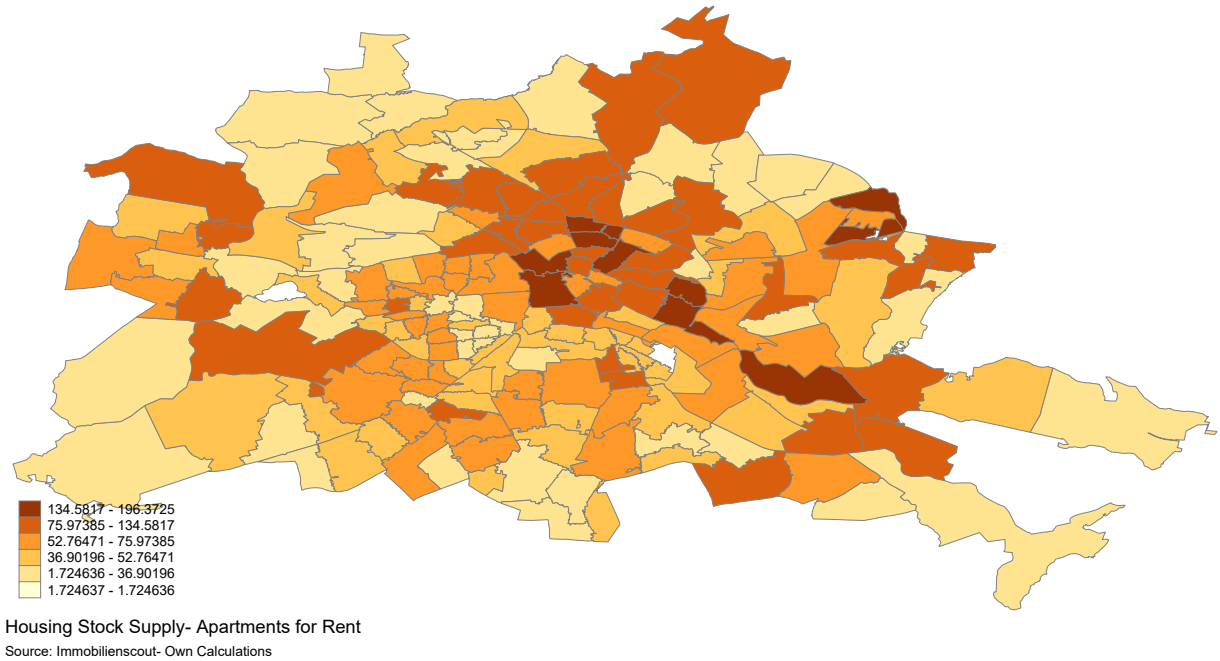
This figure illustrates the total number of short-term rental listings from January 2016 to May 2017. The red vertical line indicates the activation of the ban on short-term apartment listings.

Figure 3: Housing Stock Supply - Short-term entire apartments for rent



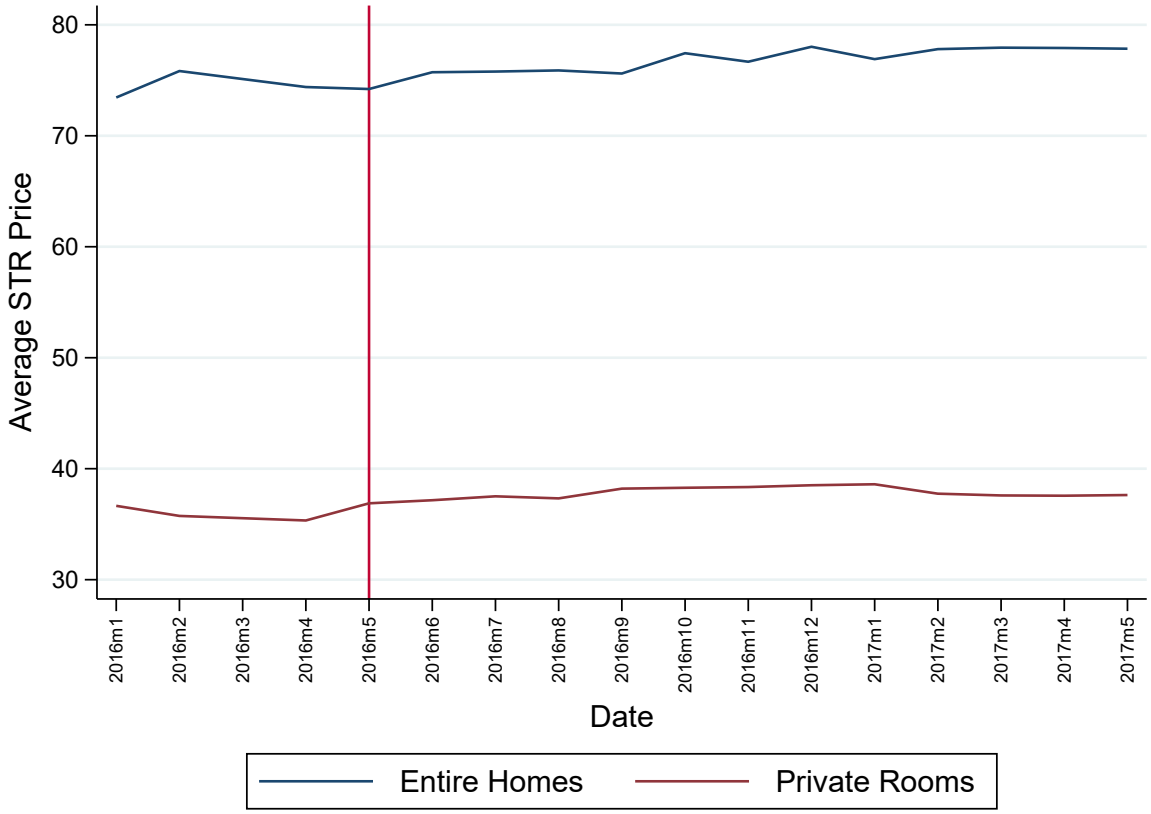
This map illustrates the average number of short-tert rental listings by postal code throughout the sample period of January 2016 to May 2017. Boxplot values are displayed in legend.

Figure 4: Housing Stock Supply - Long-term apartments for rent



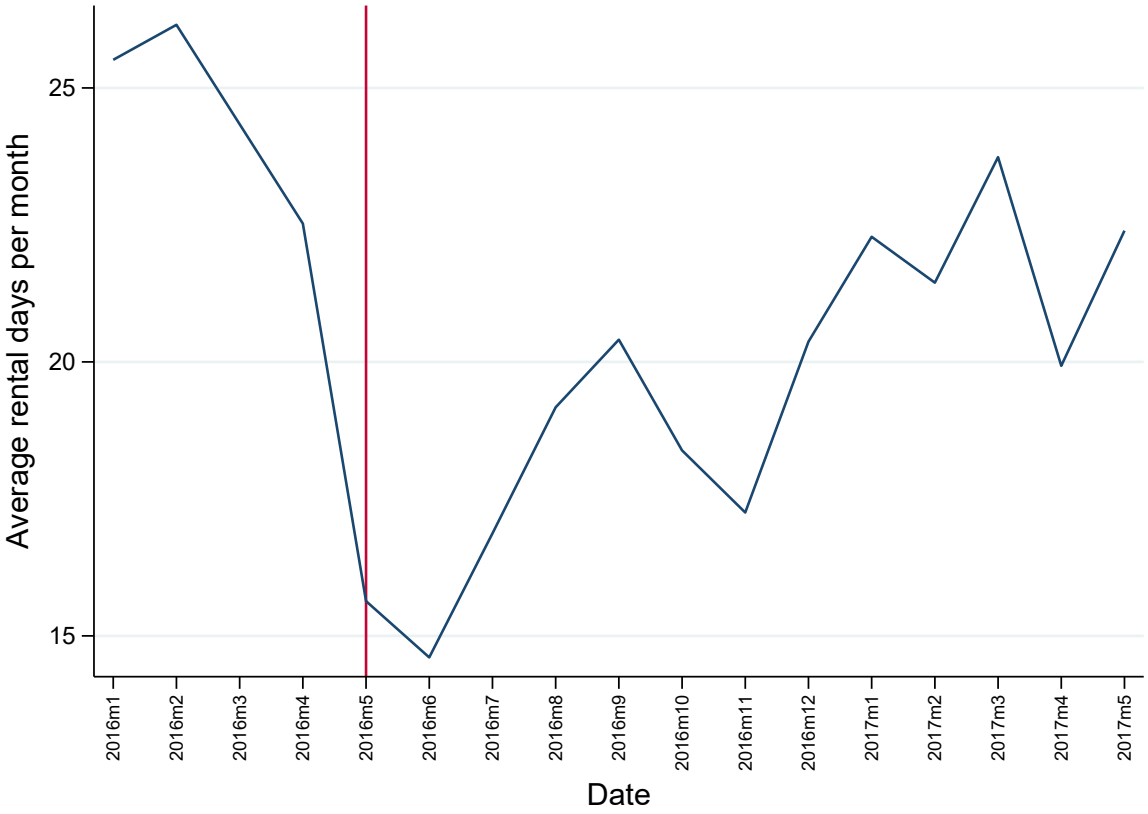
This map illustrates the average number of long-term rental apartments by postal code throughout the sample period of January 2016 to May 2017. Boxplot values are displayed in legend.

Figure 5: Average asking short-term rental prices



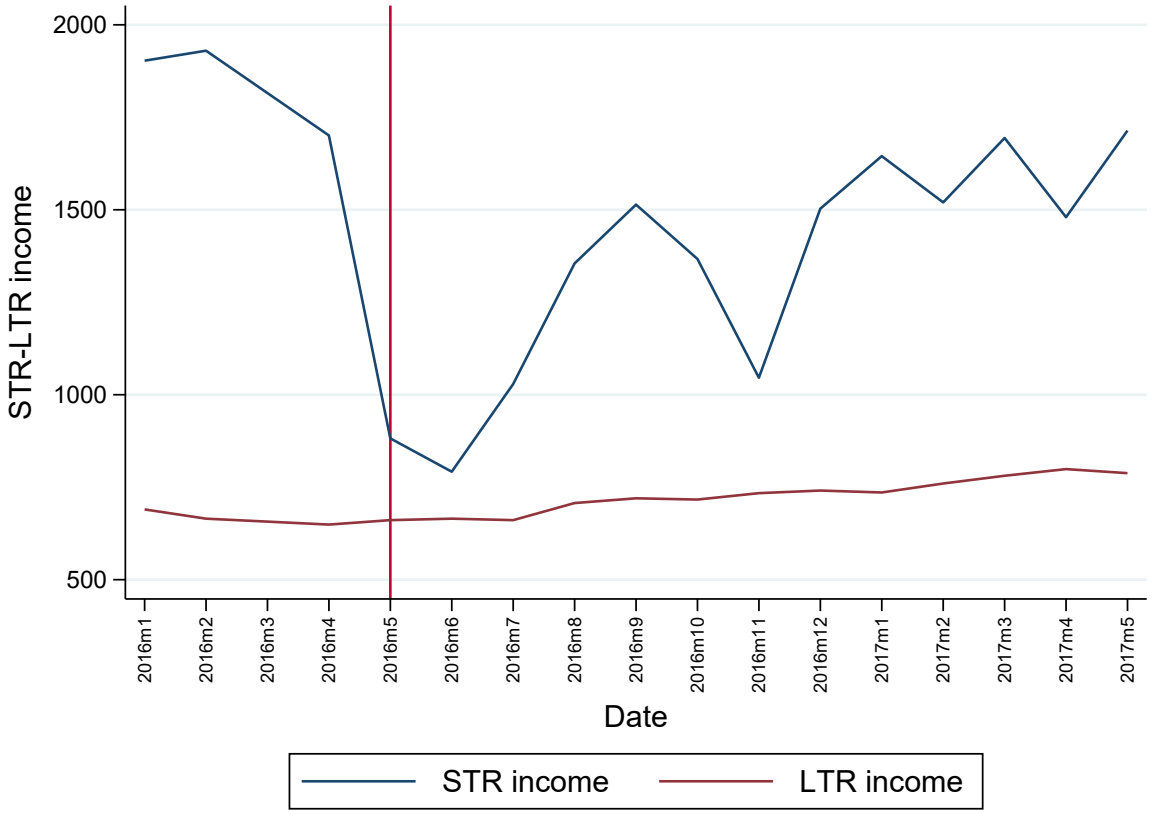
This figure illustrates the average asking short-term rental price from January 2016 to May 2017. The red vertical line indicates the activation of the ban on short-term apartment listings.

Figure 6: Average days rented by apartment as a housing demand indicator



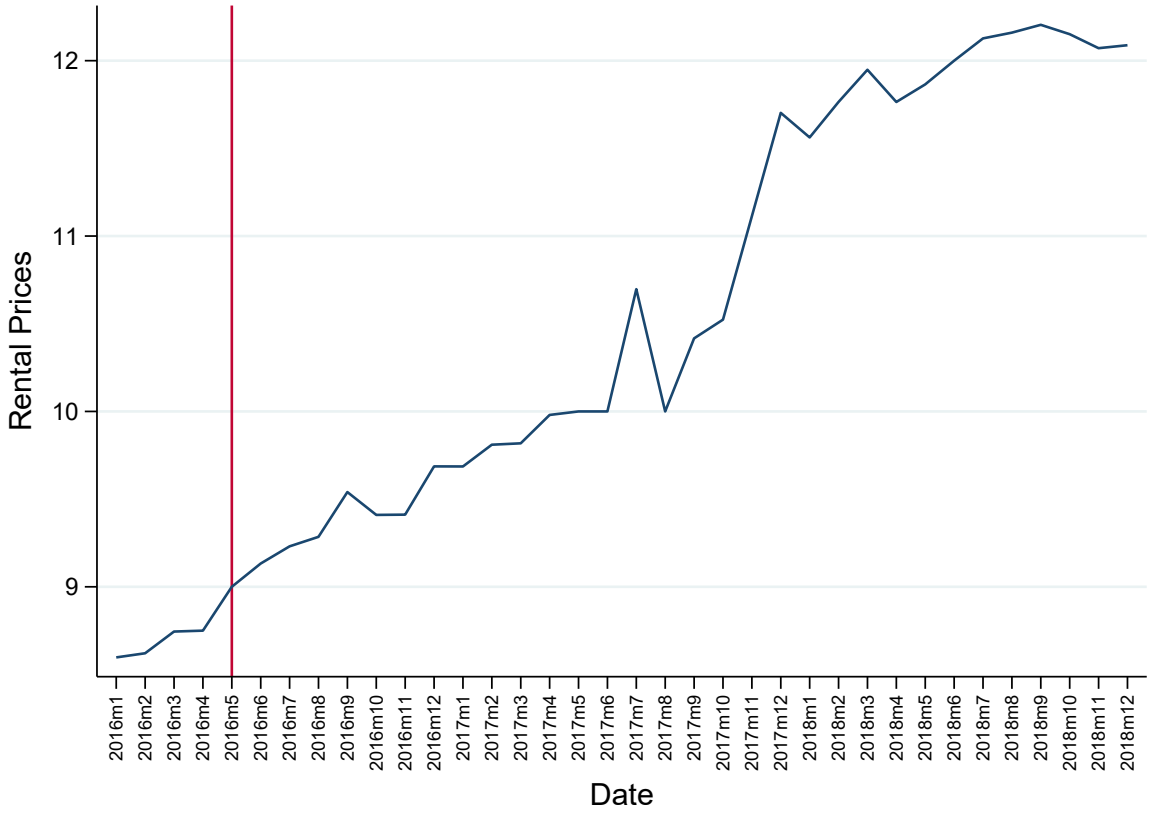
This figure illustrates the average short-term rented days from January 2016 to May 2017. The red vertical line indicates the activation of the ban on short-term apartment listings.

Figure 7: Average short and long-term rental income



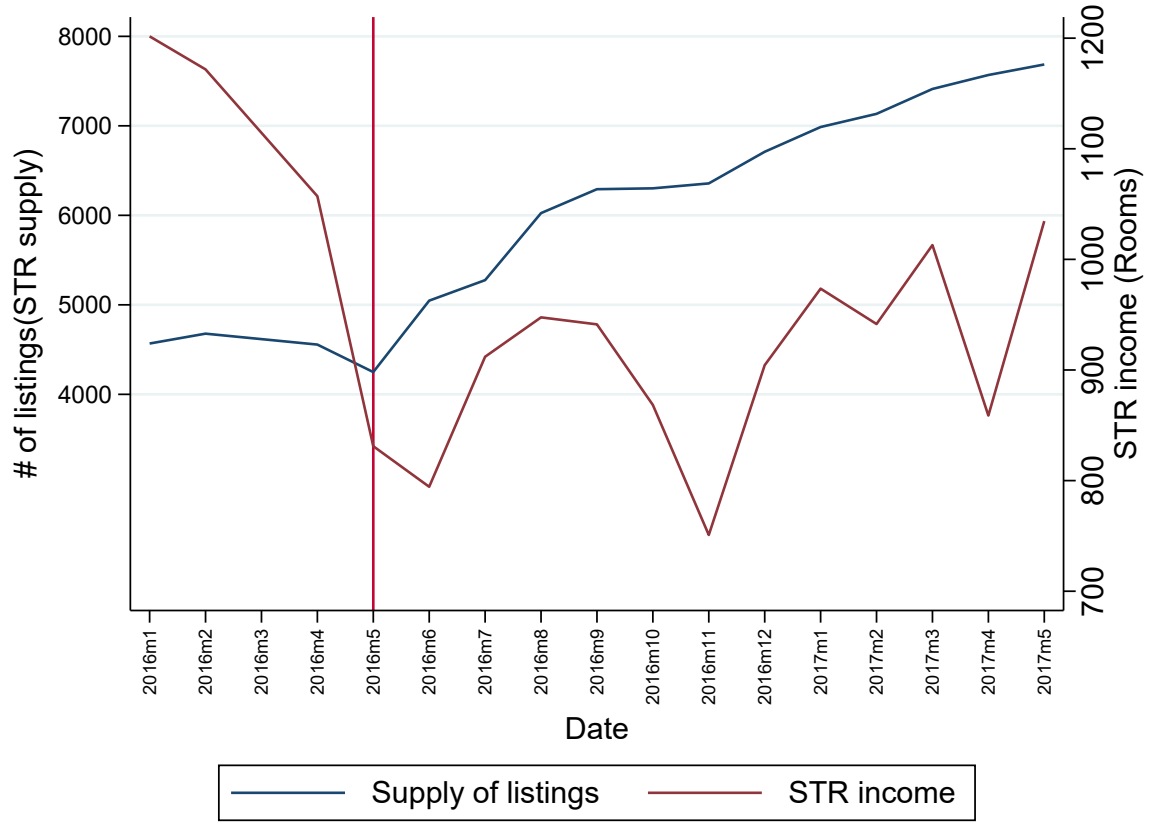
This figure illustrates the average short-term rental and average long-term rental income from January 2016 to May 2017. The red vertical line indicates the activation of the ban on short-term apartment listings.

Figure 8: Average long-term rental price levels



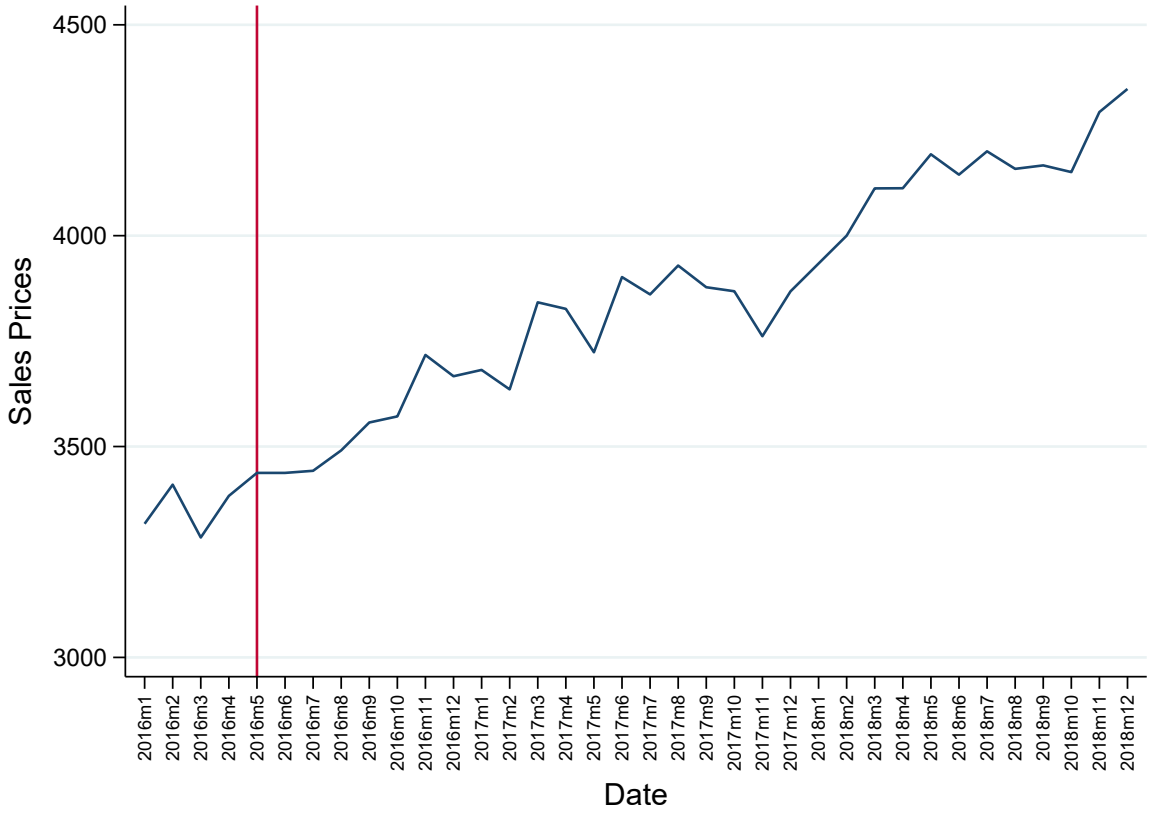
This figure illustrates the average long-term rental prices from January 2016 to May 2017. The red vertical line indicates the activation of the ban on short-term apartment listings.

Figure 9: Total supply of short-term rental rooms and average generated short-term rental income



This figure illustrates the average number of short-term rentals and average STR income for rooms from January 2016 to May 2017. The red vertical line indicates the activation of the ban on short-term apartment listings.

Figure 10: Average long-term sales price levels



This figure illustrates the average long-term purchase prices from January 2016 to May 2017. The red vertical line indicates the activation of the ban on short-term apartment listings.

Appendix

Robustness Checks

Table A.1: Short-term rental income growth on long-term rental income growth - Event analysis

	(1)	(2)	(3)	(4)
		Inc_growth		
STR growth$_{t-1}$	0.002*			
	(0.001)			
STR growth$_{t-2}$	0.000			
	(0.001)			
STR growth$_{t-3}$	0.001			
	(0.001)			
STR growth$_{t-4}$		−0.001		
		(0.001)		
STR growth$_{t-5}$		−0.000		
		(0.001)		
STR growth$_{t-6}$		−0.000		
		(0.001)		
STR growth$_{t-7}$			0.000	
			(0.001)	
STR growth$_{t-8}$			0.001	
			(0.001)	
STR growth$_{t-9}$			−0.001	
			(0.001)	
STR growth$_{t-10}$				−0.001
				(0.001)
STR growth$_{t-11}$				0.002
				(0.002)
STR growth$_{t-12}$				0.004
				(0.004)
District Controls				
New Permits(ln)	−0.000	−0.006	0.015	0.024
	(0.003)	(0.005)	(0.009)	(0.022)
Overnight(ln)	0.000	0.001	0.008	0.016
	(0.002)	(0.003)	(0.006)	(0.013)
New Construction(ln)	0.000	0.006	−0.016	−0.026
	(0.003)	(0.006)	(0.011)	(0.021)
Constant	0.009	−0.020	−0.064	−0.145
	(0.028)	(0.037)	(0.056)	(0.154)
Observations	1179	851	542	215
R-Squared	0.015	0.028	0.103	0.191
Adjusted R-Squared	−0.040	−0.047	−0.005	−0.069
Year F.E.	*Yes*	*Yes*	*Yes*	*Yes*
Quarter F.E.	*Yes*	*Yes*	*Yes*	*Yes*
Regional F.E.	*District*	*District*	*District*	*District*
Cluster S.E.	*District*	*District*	*District*	*District*

This Table is a robustness check with regard to the choice of lag in Table 4. The dependent variable is long-term rental income(price) growth. The main variable of interest –STR growth– is the short-term rental income growth. We include yearly and quarterly fixed effects to account for time trends and seasonality and we cluster standard errors at the district level, in order to allow cross-sectional autocorrelation between residuals among postal codes in the same district. Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A.2: The effects of the regulation on short and long-term income growth, conditional on the supply of short-term housing over population

	(1) SL growth	(2) STR income growth	(3) LTR income growth
Bnb_ban	0.658**	0.668***	−0.001
	(0.250)	(0.232)	(0.019)
Bnb_ban=0 × STRcapita	−0.019	−0.027	−0.004
	(0.030)	(0.029)	(0.003)
Bnb_ban=1 × STRcapita	−0.072**	−0.091**	−0.003***
	(0.029)	(0.037)	(0.001)
District Controls			
New Permits(ln)	−0.179	−0.185	0.020
	(0.128)	(0.132)	(0.013)
Overnight(ln)	−0.216**	−0.189**	0.010
	(0.094)	(0.089)	(0.007)
New Construction(ln)	0.160	0.117	−0.014
	(0.132)	(0.149)	(0.011)
Constant	2.624**	2.616**	−0.102
	(1.250)	(1.269)	(0.093)
Observations	2251	2251	2251
R-Squared	0.014	0.011	0.001
Adjusted R-Squared	0.010	0.006	−0.003
Year F.E.	*Yes*	*Yes*	*Yes*
Quarter F.E.	*Yes*	*Yes*	*Yes*
Regional F.E.	*District*	*District*	*District*
Cluster S.E.	*District*	*District*	*District*

This Table shows population weighted regressions of the effects of the STR regulation on the SL ratio ,STR and LTR income growth. The main variable of interest –Bnb_ban– is a dummy indicator for the period after the ban on short-term listings was activated. Variable STRcapita is a postal code specific measure of short-term listings per capita. The results derive from an unbalanced dataset of 186 postal codes by 16 monthly observations. We include yearly and quarterly fixed effects to account for time trends and seasonality and we cluster standard errors at the district level, in order to allow cross-sectional autocorrelation between residuals among postal codes in the same district. Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A.3: Variable definition

Variable name	Source	Unit	Frequency	Level	Description
Primary dependent variables: House Prices					
STR income	insideairbnb.com	Euros	Monthly(01:2016-06:2017)	Postal code	Derived from Calendar dataset; See 3
LTR income	immobilienscout24.de;	Euros	Monthly(01:2007-12:2019)	Postal code	Asking rental prices for online adverts
Matching variables					
Postal code	InsideAirbnb, Immo	Integer	Monthly(01:2016-06:2017) Monthly(01:2007-12:2019)	-	5 digit Berlin postal codes
Date	InsideAirbnb, Immo	Date	Monthly	-	Dates need to be standardized across datasets
Bathrooms	InsideAirbnb, Immo	Integer	Monthly(01:2016-06:2017) Monthly(01:2007-12:2019)	Housing Unit	# of bathrooms
Bedrooms	InsideAirbnb, Immo	Integer	Monthly(01:2016-06:2017) Monthly(01:2007-12:2019)	Housing Unit	# of bedrooms
Bank Controls lagged by one quarter					
STR supply	insideairbnb.com	Integer	Monthly(01:2016-06:2017)	Postal code	# of STR listings per postal code
Sales/Total	immobilienscout24.de;	Ratio	Monthly(01:2007-12:2019)	Postal code	# of sales over total
Rentals/Total	immobilienscout24.de;	Ratio	Monthly(01:2007-12:2019)	Postal code	# of rentals over total housing

This Table shows definitions and sources of the variables.

Table A.4: Areas and districts in Berlin

Area	Code	District Code	Area	Code	District Code
Mitte	101	1011	**Berlin-Köpenick**	124	1243
	101	1017		124	1245
Friedrichshain	102	1024		124	1248
Friedrichsfelde	103	1031	**Berlin-Köpenick**	125	1252
	103	1036		125	1255
Prenzlauer Berg	104	1040		125	1258
	104	1043	**Berlin-Marzahn**	126	1261
Charlottenburg	105	1055		126	1262
	105	1058		126	1267
Berlin-Charlottenburg	106	1062		126	1268
Kreuzberg	107	1070	**Berlin-Gesundbrunnen**	130	1305
	107	1071		130	1308
	107	1077	**Berlin-Pankow**	131	1312
	107	1078		131	1315
Schöneberg	108	1082		131	1318
Neukölln	109	1096	**Berlin-Gesundbrunnen**	133	1334
	109	1099		133	1335
Berlin-Neukölln	120	1204	**Berlin-Gesundbrunnen**	134	1340
	120	1205		134	1343
	120	1209		134	1346
Berlin-Schöneberg	121	1210	**Berlin-Reinickendorf**	135	1350
	121	1215		135	1358
	121	1216		135	1359
Berlin-Lichterfelde	122	1220	**Berlin-Tegel**	136	1362
	122	1224	**Potsdam**	140	1405
	122	1227		140	1408
Berlin-Lichtenrade	123	1230	**Berlin-Wilmersdorf**	141	1410
	123	1234		141	1412
	123	1235		141	1416
				141	1419

This Table illustrates the areas and districts of Berlin included in the sample. A visualization of the above can be seen in Figure 3. There are in total 24 areas and 59 districts within our sample. Some areas share the same administrative name, but they are classified as different areas according to https://www.suche-postleitzahl.org/plz-gebiet/10.

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