Short-term rentals and housing market: Evidence from portuguese metropolitan areas*

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Abstract

In this paper, we make use of the rapid expansion of short-term rentals in Portugal, based on a policy change in 2014, to estimate the effects on house prices. Using a novel dataset consisting of property transaction data, from 2010 to 2017, for the metropolitan areas of Lisbon and Porto, we causally identify the impact of these reforms through a two-way fixed effects model, at the quarterly level, where we control for property-specific characteristics and location and time fixed effects. The evidence suggests that a one-unit increment in the number of local lodging establishments results in a 0.17% increase in the value of transaction, which is ensured by a set of robustness exercises. Stronger effects are found for properties with four or more bedrooms, owned by citizens outside of the European Union, in the municipality of Porto and at the upper quantiles. We also document a decrease in the number of transactions of new buildings and a positive effect on the value of commercial properties.

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1 Introduction

Over the last few decades, the emergence of temporary accommodation services and short-term rental platforms, such as Airbnb, has sparked an intense debate in the media, academia, and among political agents due their perceived role in driving up house prices and displacing residents, especially in highly touristic areas (Lee, 2016; Sheppard and Udell, 2016; Barron et al., 2021). However, little is yet known regarding the precise economic mechanisms through which these effects operate.

The effects on house prices can potentially act through different mechanisms. Firstly, the development and revamping of buildings to turn into short-term accommodation services increase the overall attractiveness of the neighbourhood and area where they are located, affecting the value of the surrounding properties. In addition, as discussed by Garcia-López et al. (2020), this trend may prompt homeowners to switch from long-term to short-term rentals, resulting in a decrease in the supply of residential properties available for traditional long-term leasing and affecting short and long-term real estate markets worldwide (Duso et al., 2021).

Recent literature on this topic can be divided into two branches. On one hand, some studies have examined the effect of placing restrictions on short-term rentals. For example, Duso et al. (2021), Koster et al. (2021), Peralta et al. (2022), Seiler et al. (2023) have analyzed the impact of these restrictions in Berlin, Los Angeles and Lisbon respectively, finding a reduction in house prices as well as in the supply of Airbnb's due to the implementation of the new legislation. Valentin (2021), Seiler et al. (2023) reach similar conclusions.

In contrast, Garcia-López et al. (2020) studied the impact of the growth of the Airbnb platform on the real estate market in Barcelona. According to the authors, it led to a 1.9% increase in rental prices and a 4.6% increase in transaction prices. Similarly, Horn and Merante (2017) and Franco and Santos (2021) examine the impact of increased Airbnb listings in Boston and Lisbon, identifying a positive effect on house prices and asking rents.

Our paper contributes to the growing literature regarding the impact of short-term rental on housing markets, through different channels. Firstly, we rely on the exogenous variation derived from a policy change in 2014, which created a legal framework for the development of short-term rentals, commonly known, in our context of study, as local lodging establishments. This led to an exponential increase in the number of short-term accommodation services, as seen in Figure 1. We make use of this exogenous variation, to obtain causal estimates of the impact of short-term rentals on house prices.

We employ a novel dataset consisting of comprehensive transaction data from the Portuguese tax authority, concerning the two metropolitan areas, Lisbon and Porto, and for the period of 2010-2017. Rather than estimating the effect on average house prices, we are able to calculate what are the marginal effects of the presence of these short-term rentals on each transaction. Furthermore, this dataset allows us to identify, through their geographical coordinates, transactions of properties which have been turned into temporary accommodation services and to analyze the number of transactions of new buildings in a given period, which could indicate how housing supply reacts to the presence of local lodgings. Moreover, we complement it with an analysis of the effects on the price of commercial properties, with data from one of the largest online advertisement platforms called *Imovirtual*. In the literature, the role that short-term rentals play in shaping the business environment has been looked at through the impact on consumption amenities (Hidalgo et al., 2022; Zervas et al., 2017). Here, we proxy business activity with a higher frequency variable such as property prices.

In addition, while most of previous literature relies on AirBnb listings, we employ the number of short-term establishments registered at the National Short-Term Rental Registry (RNAL), similiarly to Peralta et al. (2022), which include venues that are advertised in other platforms than Airbnb, representing a more complete measure of the presence of short-term accommodation services. Moreover, while AirBnb data might come from web scrapping which provides information on a particular point in time, or for Inside Airbnb, which requires hosts to be registered in the platform, this dataset gives us the exact moment each short-term

rental started to operate.

Finally, we contribute to the literature by exploiting the granular nature of our data, allowing us to perform a series of heterogeneous exercises. These exercises will aid the understanding of which geographical areas and type of properties were more affected by the development of temporary accommodation services. Showing that not all properties are affected in the same way could have important implications in terms of public policies, since it might indicate that general restrictions to the development of short-term rentals may not have the desired effect in all geographical areas.

The identification strategy relies on the exogenous and exponential variation from the presence of short-term rentals, based on a policy change. Our baseline model employs a two-way fixed effects strategy, where we aggregate transactions and new short-term establishments at quarterly and civil parish level, while controlling for property-specific attributes and time and location fixed effects. In this model, we view the number of short-term rentals in the nearby area as a contributing attribute to the value of a property.

Our results suggest that an increment in the number of local lodging establishments increases transaction values by approximately 0.172%, robust to the inclusion of several fixed effects. Given that we have on average around 3 new establishments per quarter and civil parish, this represents an average quarterly increase of 0.516%. Using the high-frequency nature of our data, we replicate our baseline model at the monthly and weekly level, yielding results of stronger magnitude.

Our estimates are also robust to dropping the years before the policy reform of 2014 and considering only single-transaction properties. In addition, they are robust to dropping observations above the 99 percentile in terms of the number of new local lodging establishments, per quarter and parish. In addition, we find that it resulted in a decrease in the transactions of new buildings, especially in the metropolitan area of Porto.

Using the lags of our variable of interest, our results suggest the presence of persistent effects, with the number of local lodging places opening up to 4 quarters prior affecting

the value of the transactions in the current period. Our strategy is validated through a falsification exercise, where we find that the number of venues opening 4 quarters after does not impact transactions' value in the current period.

Our heterogeneous exercises show that the impact on house prices is stronger in the municipality of Porto, in non-coastal civil parishes, below the median in terms of school dropout rates, population density and unemployment rate. The effects also seem to be larger for properties with 4 or more bedrooms, in a co-ownership status and owned by citizens outside the European Union.

We also study the effects across the distribution through quantile regressions, following Machado and Santos Silva (2019). Although significant across the distribution, the effects are stronger in the upper quantiles. These findings also support the results conveyed in the baseline model, with larger coefficients for the municipality of Porto. For the municipality of Lisbon, these are only positive and significant at the 0.75 and 0.90 quantile. Lastly, we find a positive and significant effect on the value of stores and offices for rent.

The remainder of the paper is organised as follows. Section 2 presents the institutional context behind the policy change, section 3 describes the data sources, followed by section 4 where we outline the identification strategy. Then, we discuss the results in section 5, followed by an analysis of the presence of spillovers to commercial properties on section 6. We conclude with final remarks in section 7.

2 Institutional Context

Since the 1990s, a large emphasis has been placed on the urban revitalization of Portuguese cities with the aim of increasing tourism and real estate investment. The tourism surge experienced in Portugal over the past decade is, in part, the result of various reforms implemented across time, providing an interesting case to study. In 2012, an urban lease reform[1] was implemented in an attempt to boost the lease market and ensure the supply of lease

[1]Law 31/2012: https://dre.pt/dre/detalhe/lei/31-2012-175305

agreements at affordable prices, whilst promoting the rehabilitation of urban real estate in a streamlined manner.[2]

This reform, demanded by the European Union (EU) and the IMF as a condition for Portugal's bailout, liberalized old rent contracts, introduced measures to broaden the renegotiation of rent-contracts and was aimed at removing market distortions caused by various rent laws dating back to 1990, which controlled rents at levels below market rates and protected by open-ended leases that could not be easily terminated by landlords. The 2012 reform deregulated the private rental market, making it easier for landlords to end tenancy agreements and removing the minimum length requirement of five years for rental contracts (Cocola-Gant and Gago, 2021; Mendes, 2022). The introduction of more flexible tenancy agreements made real estate investment in Portugal particularly attractive, causing a significant growth in demand for short and long-term rental properties.

Further increase in demand for Portuguese real estate occurred in 2012 with the introduction of the "golden visa" programme by the Portuguese government, which offered freedom of movement within the Schengen and Portuguese citizenship to non-EU applicants who buy properties valued at least € 500,000 or invest € 350,000 into real estate rehabilitation in Portugal, thereby encouraging investors from outside the EU to purchase Portuguese properties (Barata Salgueiro et al., 2017; SEF, 2022). The latter caused a €4bn real-estate spree during a six-year period. Additional policies such as fiscal incentives for real estate investment funds and lower bureaucracy for real estate licensing proceedings further increased the attractiveness of the Portuguese real estate for foreign investors (Barata Salgueiro et al., 2017).

Moreover, Portugal introduced further changes to local housing laws in 2014, through the Decree-Law no. 128/2014[3], creating the legal concept of temporary accommodation establishments, named in portuguese *alojamento local* and which we shall refer to in this

[2]The implementation of a model for urban rehabilitation commenced in 2004 with government incentives focused on policies to stimulate private housing rehabilitation in historic municipalities across the country (Franco and Santos, 2021).

[3]http://business.turismodeportugal.pt/SiteCollectionDocuments/alojamento-local/Dec-Lei-128-2014-ENG-nov-2017.pdf

paper as "Local lodging establishments". This term refers to properties that were renovated and revamped and then turned into temporary accommodation services.

Although the concept of local lodging ("Alojamento Local (AL)") was first introduced in 2008 (Carvalho and Policarpo, 2018), the 2014 reform created the legal framework for their development, providing a fully online and streamlined procedure for landlords to register their local accommodations for free. In turn, this resulted in an exponential increase in the number of local lodging establishments. Establishments engaging in temporary accommodation activities prior to 2014, had to register their establishments in compliance with this new procedure within a 30 day period following the approval of the law.

The rise in local lodging options has played a significant role in the surge of tourism in Portugal during this time. However, this also created challenges for municipal councils, leading to a decreased supply of housing for local residents.[4]. As a result, some municipalities imposed restrictions to contain the growth of lodging establishments and reduce the displacement of local residents, especially in touristic areas. Most notably, the municipality of Lisbon introduced a ban on short-term rentals in 2018 as mentioned in Peralta et al. (2022).

Overall, in the last decade, there has been an increase in the market value of properties. Figure A1 displays the evolution of the average value of buildings sold for each metropolitan area and Portugal. The value of buildings has experienced an upward trend since 2012, with the average value being considerably higher in the metropolitan area of Lisbon than in Portugal as a whole (Franco and Santos, 2021; Peralta et al., 2022). Therefore, understanding well the causes of this evolution in the real estate market, in particular the effect of the increase in the number of local lodging establishments on house prices, presents important public policy implications. For our main analysis, the focus is placed upon the period in which the 2014 reform.

[4]In certain parishes, the number of tourists has surpassed the number of local residents. This is noticeable in parishes belonging to major touristic hubs in the country, such as Lisbon and Porto. According to data from Statistics Portugal (INE), in 2021 Lisbon received an estimated 1.94 million tourists, 5.30% more than the number of residents in the same year.

3 Data Sources

To correctly identify the effects of the legislative changes that increased the number of Local lodging establishments on the price of properties sold, we would ideally require data that matches the values of transactions and rentals of the properties with information on its characteristics, which could then be linked with the new registries of Local lodging venues. To accomplish this, we construct a novel dataset that combines Portuguese data from four different sources for the period 2010-2017, building upon the current literature.

The information regarding the new registries of Local lodging establishments comes from the National Short-Term Rental Registry (RNAL), which is made publicly available by Turismo de Portugal (*Tourism of Portugal*)[5]. In addition, to obtain the transaction data, we combine two different tax registries that provide the value of transaction and the characteristics of the individual properties, following Evangelista et al. (2020). These two datasets were provided by the national statistical office, or Statistics Portugal. Lastly, the data on housing rentals and commercial properties for sale and rental comes from *Imovirtual*, one of the largest online real estate platforms in Portugal.

Portugal's territory is administratively divided in districts, municipalities and civil parishes, with districts being the largest and civil parishes the smallest. The territory was also defined using the Nomenclature of Territorial Units for Statistics from the Eurostat (NUTS). Using the Portuguese NUTS III territorial divisions, we focus on the metropolitan areas of Lisbon and Porto, the two largest cities in the country, which contain 35 municipalities in total, as we want to study our research question in the context of urban centres. Within these metropolitan regions, our geographical unit of analysis are the civil parishes, locally referred to as *freguesia*.

Figure 2 plots each local lodging establishment in our sample and shows where the two metropolitan areas are located within the country. The lines in the figure define the bound-

[5] https://dadosabertos.turismodeportugal.pt/

aries of the Portuguese NUTS III territorial divisions. The set of points to the north represents the metropolitan area of Porto, comprising areas located within the districts of Porto and Aveiro. Similarly, the set of points to the south represents the metropolitan area of Lisbon, containing areas within the districts of Lisbon and Setúbal.

Table A1 provides descriptive statistics for the two metropolitan areas and their evolution from the beginning to the end of our sample. Together the two regions comprised approximately 44% of the population with a population density between 7.5 and 8.4 times higher than the country's average. These regions also contained around 10% of the total number of civil parishes[6]. In addition, in 2017, they accounted for 56% of the total number of companies created. As our descriptive statistics show, these two areas alone are representative of the Portuguese economy and population.

For our analysis, we focus on the period from 2010 to 2017[7]. As pointed out by Peralta et al. (2022), the municipality of Lisbon introduced a ban on short-term rentals in 2018. As we want to estimate the effect of the policy change in 2014, considering the period beyond 2017 would incorporate the effects of the ban and confound our estimates. Thus, restricting the sample to 2017 can provide estimates that are closer to the true policy effect.

3.1 Local lodging

The data for the Local lodging establishments, or *Alojamento Local*, comes from the publicly available National Short-Term Rental Registry (RNAL). This dataset provides details on the owner of the establishment, address, geographical coordinates, date of registry, date of opening to the public, postcode, administrative territorial division to which the establishment belongs and whether the civil parish is coastal or non-coastal.

For the time period considered, we have a sample of 16,936 establishments, 12,621 in the metropolitan area of Lisbon and 4,315 in the metropolitan area of Porto. As mentioned

[6]It should be noted that there was a reorganization process happened in 2013 that led to extinction of some civil parishes or incorporation into others, as also noted in Franco and Santos (2021).

[7]Table A1 only starts from 2011 and we only had population data from the Census 2011.

before, figure 1 shows the number of establishments in each year of our sample, conveying a dramatic increase in the number of establishments from 2014 onwards. Figure A2 presents the geographical location of the local lodging establishments, within each metropolitan area. It shows that the establishments in the metropolitan area of Porto are more concentrated around the municipality of Porto, while being slightly more disperse in the metropolitan area of Lisbon.

In our sample, the vast majority are classified as apartments, comprising 13,764, while having 1,648 villas and 1,286 guest houses. Table A2 presents summary statistics on the number of new Local lodging establishments. On average, we have 3 new establishments opening by quarter and parish and 56 opening per parish. For the two metropolitan areas, there are on average 490 new establishments opening each quarter and 1963 each year. The table also displays information on standard deviations, minimum and maximum of each of these indicators.

3.2 Transaction data

In our study, house prices are measured by transaction data. Transaction values are obtained through the real estate transfer tax (IMT) records, while the property characteristics were obtained from local property tax (IMI). The IMT tax records provide information regarding the date of the transaction, civil parish of the property and the value of the transaction., which are obtained through a form filled to the authorities at the moment of transaction.

The IMI tax records contain data on property attributes such as number of floors, number of bedrooms, total area, age of the building and a set of coefficients that measure the attractiveness of the location and overall quality and comfort of the house, reported in evaluations made by the tax authority of the properties, which happen when it is a new building or when there is a change in one or more of its attributes. Hence, the reason behind the evaluation is also part of the dataset. Lastly, we link each transaction to its latest evaluation through a unique property identifier (Evangelista et al., 2020).

Our sample consists of properties with either a single transaction, more than one transaction in the same day or with multiple transactions in different days. In total, over the time period considered, we have a sample of 150,714 properties, corresponding to 210,445 transactions. Moreover, we have 46,618 properties in the metropolitan area of Porto and 104,096 in Lisbon. Table 1 presents descriptive statistics of the properties and number of transactions. On average we have approximately 1.4 transactions per property, with the maximum being 12. We have around 45 transactions per quarter and civil parish, with a sample mean value of €205,210.3. On average, the properties contain, 3 bedrooms, 1 floor, 100 square meters of area and are located on 25-year old buildings.

3.3 *Imovirtual*

We employ a novel dataset from *Imovirtual*, one of the largest online real estate platforms in Portugal, which started to operate in 2011. The data provided by the website referrers to listings of commercial properties, containing information on the type of property (store, office and storage unit), asking price, geographical location, approximated coordinates, square footage, operation (rental or sale) and exact date the advertisement of the property became online. Even though, we possess data from 2011, we choose as period of analysis, the years 2015-2017, as we have a more balanced number of online advertisements during this period, as seen in figure A3.

In total, we possess 45,571 observations, with stores for sale comprising around 51% of our sample. Around 60% of our listed properties are located in the Metropolitan area of Lisbon. Table A3 reports the summary statistics for price (asking) and number of advertisements (per quarter and civil parish) for the the different types of properties in our sample, with offices for sale having higher average value and being the most advertised.

4 Identification Strategy

When estimating the causal effects of the development of local lodging establishments on house prices two main issues may arise: i) endogeneity concerns, where the development of these establishments is caused or accelerated by a rise in prices; ii) omitted variables bias, where the properties' price might be driven by a variable unaccounted in our model, such as a surge in real estate market.

To mitigate the first set of concerns, we make use of the rapid variation in the number of new local lodging establishments based on an exogenous policy change. Figures 1 and A1 make it clear that although there is an increase on the average price of buildings sold from 2012, the number of local lodging venues opening each year dramatically increased from 2014 onwards, when the reform that created the legal framework for their establishment occurred. We also control for municipality time trends to account for trends that have turned some municipalities into a "hotspot" of short-term rentals. Secondly, to minimize the bias from omitted variables we include a set of property-characteristic controls as well as a wide set of location and time fixed effects.

In addition, another issue could be that the number of local lodging establishments is driven by the number of transactions. In this regard, the literature has not yet identified with precision what was the previous use of the properties that are now being utilised as short-term rental. We attempt to shed some light into this issue, by geolocating the properties in transaction dataset to the closest local lodging, through ArcGIS.[8] As a result of this exercise, we have identified 8 transactions of properties that have been later transformed into a local lodging. Cautiously interpreting this as suggestive evidence, it seems that the properties of local lodging establishments are not coming from the long-term housing, but possibly from the longer rental market. Properties owners that were renting their places have

[8]This is merely an approximation exercise. As previously stated, the transaction data can only be accessed in a secure facility known as a safe centre and the geographical system encompassing the coordinates of the transacted properties deviates from the one employed for local lodging establishments. Hence, a transformation of the coordinates of the local lodging dataset is performed and uploaded directly onto the safe centre.

possibly decided to switch to the short-term market as it became perhaps more profitable. Nevertheless, we exclude the possibility of our variation in the number of local lodgings being driven by transactions of properties that were later transformed into short-term rentals.

Therefore, the identification strategy relies on the variation caused by the policy reform, which amplified the number of local lodging establishments, and the wide range of fixed effects employed. We believe that this a stronger empirical strategy than following a shift-share instrument, often used in recent literature, as it only identifies heterogeneous treatment effects when the shocks are as-good-as-random, which is hard to obtain in our setting (de Chaisemartin and Lei, 2023; Borusyak et al., 2022). Thus, at the baseline model, we focus on transactions at the quarter and civil parish level:

$$\ln(P_{i,t,f}) = \alpha_0 + \alpha_1 LL_{t,f} + \alpha_2 X_{i,t,f} + \gamma^f + \delta^t + \epsilon_{i,f} \tag{1}$$

where $P_{i,t,g}$ is the value of transaction of property i, transacted on quarter t, located at the civil parish f. As was previously stated, for certain properties we have more than one transaction, some of which happened in the same date. In those cases, our outcome variable is a sum of the value of the same-day transactions. $LL_{t,f}$ is the number of Local lodging establishments opening to the public on quarter t and civil parish f, while $X_{i,t,f}$ is a set of attributes for property i. γ^f is a civil parish fixed effects while δ^t controls for quarter fixed effects. Standard errors are clustered at the civil parish level. To the baseline specification we add several fixed effects, such as postcode sector (the first 4 digits of the 7-digit portuguese postocde) and municipality, to show the robustness of our results. In our analysis, we drop outliers in terms of value of transaction in the 1st and 99th percentiles. We replicate this analysis for commercial properties, using only the square footage as property characteristics, as it was the only information provided in the corresponding dataset.

Then, we make use of the high frequency of the data to replicate the baseline model, aggregating the transactions and the number of new local lodging venues by month and week, instead of quarter. Again, a high variety of fixed effects are included to capture

unobserved time and location-specific heterogeneity.

Moreover, we use as outcome measure the number of transactions happening in a civil parish, by month and quarter, to see whether the presence of these short-term rentals also affected the number of properties being transacted in the market. We also estimate the effect on the number of transactions of new buildings, using the information provided in the evaluations made for the IMI tax registry. In this regressions, we only control for time and civil parish fixed effects.

To ensure the validity of our results, we perform a set of robustness checks, using our baseline specification at the quarterly level. Namely, we only consider properties with one recorded transaction and we drop the transactions happening before the policy reform of 2014. In addition, since there was a reform of the civil parish classification in 2013, by dropping the observations before 2014, we circumvent any potential difference in civil parish coding between our local lodging and transaction database. As a placebo test, we look at sample before 2014, in order to show that it was the policy reform that led to short-term rentals to have an impact on house prices. Moreover, we also drop observations in the 99th percentile in terms of local lodgings per quarter and civil parish. Lastly, we use as an outcome variable the price of the transactions per square meter.

To strengthen our identification strategy, we present a falsification exercise, where we hypothesise that the number of local lodging venues opening in the periods ahead should not have an impact on the value of transactions in the current period. Moreover, to assess whether there is a certain level of persistence on the effects, we employ the number of local lodging establishments that opened in the periods before as an independent variable.

One important contribution of our paper is to study which properties are most affected by having local lodging establishments in the vicinity. To achieve that, we perform a comprehensive set of heterogeneous exercises. Our data presents the ideal characteristics to engage in such exercises as it contains detailed information on the attributes, location and valuation of the properties.

We start by replicating the model but dividing the sample by metropolitan area, in order to estimate the effect in each region separately. Within these areas, we also look specifically an the municipalities of Porto and Lisbon and their historical centres. Furthermore, we divide the sample by the number of bedrooms in the properties, estimating the effect in properties with 0, 1, 2, 3, 4 and more than 4 bedrooms and by the nationality of the owner of the properties.

We then obtain information, at the civil parish, from the 2011 census[9], regarding school dropout rates, unemployment rates and population density and we divide the sample below and above the median, replicating the baseline model for each sub-sample respectively. We chose these variables as we believe they could be a good indication of the average level of income.Moreover, we also divide between coastal and non-coastal civil parishes.

Lastly, we examine the variations in the effects across the complete spectrum of transaction values by employing quantile regressions. Specifically, we employ the methodology proposed by Machado and Santos Silva (2019) to conduct a quantile analysis within the framework of panel data with fixed effects. This approach enables us to assess the differential impacts at different quantiles of the distribution, thereby capturing potential heterogeneity across the range of transaction values.

5 Results

5.1 Main Results

This analysis begins by considering the marginal effects of an increase in the number of local lodging establishments on house prices, at the quarterly level, which are presented in table 2. The dependent variable refers to the log of transaction prices and include various location fixed-effects and time-trends. As in Duso et al. (2021), our approach allows us to control for

[9]Given that there was a restructuring of the civil parishes in 2013, some of them do not appear in the 2011 census, therefore not taking part of this exercise.

property-specific characteristics including number of floors, area (in square-meter), the age of the building, coefficients of location and quality[10].

Columns (1) - (5) of table 2 show that an increase in the number of local lodging establishments leads to an increase in transaction values, for all specifications. In column (1), without any property-controls and including only quarter and civil parish fixed effects, our results suggest that an additional establishment opening in the quarter leads to a significant increase of 0.176% in the value of transactions. When including our set of controls, the effects are slightly lower, at 0.173%, but still highly significant, remaining relatively stable to the inclusion of postcode and municipality fixed-effects.

Making use of the high-frequency nature of the data, we estimate these effects, but aggregate the properties and the new establishments by month, as displayed in table A4. The results indicate that when aggregating by month the effects are around 2.3 times larger than the baseline model at the quarterly level, with a new local lodging venue leading to a 0.39% increase in the value of transactions. In addition, the difference in effects between the specification without property-controls, in column (1), and the one with controls and including postcode and municipality fixed effects, in column (4), are smaller.

Table A5 presents the results at the weekly level. The estimates are now 4.7 times higher than the baseline model at the quarterly level, strengthening the hypothesis that these shorter aggregation periods provide stronger effects. One additional establishment increases the value of transactions happening on the same week by around 0.82%. The effects remain broadly similar when including postcode and municipality fixed effects.

Lastly, we present in table A6 the results when using the number of transactions in a civil parish as the outcome variable, aggregating at both quarterly and monthly level. We find a positive and significant effect for the entire sample and both metropolitan areas, with the coefficient being of larger magnitude for the metropolitan area of Porto. The estimated effects on the number of transactions of new buildings is reported in table 8,

[10]Coefficients of location and quality considered in our regressions refer to the four coefficients reflecting the quality, comfort and attractiveness of the location of the buildings, provided by the Portuguese tax authorities.

with a marginally significant positive effect for the entire sample, at the quarterly level, and negative and significant for the metropolitan area of Porto. When using a monthly aggregation and therefore increasing the power of our estimations, only the negative effect for the metropolitan area of Porto remains significant. Hence, our results seem to suggest that the presence of local lodging establishments seems to lead to a reduction in the transaction of new buildings in the metropolitan area of Porto but not in Lisbon. Although we only have access to the recorded transactions, this could suggest that there is also a reduction in supply.

Overall, our main results suggest that an increase in the number of local lodging establishments leads to a marginal increase in the transaction prices. Since on average 3 new venues open in each quarter and civil parish, it means that over our time period considered there was a 0.516% increase in the value of transactions per quarter, which is not negligible. When aggregating by shorter periods, there is a more pronounced effect on the house prices, with the development of short-term rental resulting in a further positive effect on the number of properties transacted.

5.2 Robustness analysis

A series of robustness checks are performed to confirm the validity of our results, presented in 4. Since our baseline results are consistent to the inclusion of different fixed effects, the baseline specification at the quarterly level is used to perform these exercises, including only quarter and civil parish fixed effects, and using the log of value of transactions as outcome variable.

We start in column (1), by dropping transactions before the policy change of 2014, yielding estimates slightly lower to the baseline model, while remaining highly significant. In column (2), we look at properties with only one transaction. The effects are again slightly lower than the baseline model while remaining statistical significant. In column (3), we drop observations in the 99th percentile in terms of number of local lodging establishments by

civil parish and quarter, with estimates around 1.75 higher than the baseline model. In column (4), we use the years before the policy change as a placebo test, to show that it was the exponential increase in short-term rentals after 2014 that led to an increase in house prices. In column (5), we use a measure of price per square meter as outcome variable, which provides slightly stronger results than our baseline model.

Lastly, we analyse the timing and persistence of our effects and perform a falsification exercise, displayed in table 5. As the different specifications produce similar estimates, we include only civil parish and quarter fixed effects for this exercise. In columns (1) and (2), we use as variable of interest the number of local lodging establishments opening four quarters and one quarter before, respectively. The effects exhibit a considerable level of persistence, with the number of new venues opening 4 quarters and 1 quarter before still having a positive and significant impact on the value of transactions in the current period. In fact, the coefficients are slightly higher than the baseline model at the quarterly level.

The persistence in these effects could be ascribed to the renovation and revamping necessary to turn the establishments into temporary accommodation services, or local lodging. This might increase the attractiveness of a particular area, potentially leading to a higher level of tourism, raising the value of the properties located there, with persistent effects lasting for a considerable period of time.

In columns (4) and (5) we present a falsification exercise. As previously stated, if our specification is correct the number of establishments opening periods ahead should not affect house prices at the current period. In column (4) we use as a variable of interest the number of establishments opening one period ahead, finding a positive and significant effect. Although this finding might be surprising, it should be noted that if an establishment is opening in the period ahead, it is probably being built or renovated already in the current period, signalling the attractiveness of that area which can be incorporated into the house prices.

Nevertheless, the number of short-term accommodation venues opening far into the future should not affect the value of property transactions in the current period. Indeed, this is

consistent what we find in column (5), where using the number of establishments opening 4 quarters ahead has a negative and insignificant effect on the prices of houses in the current period.

5.3 Heterogeneous effects

We then make use of the high level of information in our dataset to perform a series of heterogeneous exercise, using our specification at the quarterly level and including civil parish and quarter fixed effects. Our aim is to understand how the effects differ by geographical locations and by types of property, which addresses a gap in the literature.

We start by dividing our sample by metropolitan areas. In columns (1) and (4) of table 6, we replicate our baseline model for the metropolitan areas of Lisbon and Porto, respectively. The effects are positive and highly significant in both cases, while being slightly larger, in terms of magnitude, for the metropolitan area of Lisbon, even when compared to the baseline model at the quarterly level.

Within each metropolitan area, we analyze the effects only for the municipality of Lisbon and Porto, which is displayed in columns (2) and (5), respectively. The effects are 5.3 times higher for the municipality of Porto, with the coefficient being in line with our baseline model at the quarterly level. Moreover, only for the municipality of Porto are these statistically significant.

Furthermore, when considering just the historical centres of Lisbon and Porto, the results show a similar pattern, with a considerable stronger effect for the historical centre of Porto, and once again in line with our baseline model. In addition, the coefficient for the historical centre of Lisbon is negative, although insignificant. These results are at odds with the findings of Franco and Santos (2021) who obtain stronger results for the historical centres between the period of 2010-2016. These findings can be related to the results reported in table 8, where we document how the presence of short-term rentals led to a decrease in transactions of new buildings in the metropolitan area of Porto but not in Lisbon.

We proceed by analyzing the heterogeneous effects by number of bedrooms, as presented in columns (1)-(6) of table A7. We only control for the number of bedrooms in column (6), considering properties with more than 4 bedrooms, as this is the only sub-sample where the number of bedrooms differs across properties. Our estimates indicate that the effects are larger for properties with 4 bedrooms, with an increase in the number of local lodging venues leading to a significant increase of 0.24% in the value of transactions. The effects for properties with 2 and above 4 bedrooms, presented in columns (3) and (6) respectively, are also higher than our baseline model at the quarterly level. In contrast, the estimates for properties with 1 and 3 bedrooms are slightly lower than our baseline model, while remaining highly significant. We found no significant effect for properties with no bedrooms.

The difference in effects by the nationality of the owner of the property transacted and ownership status is reported in table 7. In column (1), we estimate the model on the sub-sample of properties owned by a Portuguese national, finding an increase of 0.172%, in line with our baseline model. In column (2), we consider only properties owned by citizens of other countries of the European Union, finding a negative although insignificant coefficient. In column (3), we look at owners from outside the European Union, finding a considerably large positive and significant effect, despite the much lower number of observations. An increment in the number of local lodging establishments leads to an increase of 2.6% in the value of transactions of properties owned by overseas citizens. This effect is around 15 times higher than the one found in column (1) and in the baseline model. Foreign owners seem to demonstrate a heightened perception of the potential benefits associated with the development of accommodation venues, as they recognise how such developments can result in an increase in the overall attractiveness of the areas where their properties are located.

In columns (4) and (5) we estimate the effects for properties owned by a single person and co-owned properties, respectively. The effect on properties singularly owned are in line with our baseline model, while being slightly larger for co-owned properties. An increment in local lodging establishments leads to a 0.22% increase in the value of co-owned properties.

Lastly, in table A8, we divide the sample between civil parishes that are below and above the median, in terms of unemployment rate, population density and school dropout rates and replicate the baseline model for each sub-sample separately. The results show that the effects are stronger for civil parishes below the median. The coefficient is even larger than the baseline model, suggesting that the impact of local lodging is not homogeneous across all areas. Nevertheless, we also find positive effects on civil parishes above the median in terms of unemployment rate. This result could suggest that short-term rentals might lead to welfare losses in some areas. If we consider that an unemployed person may facing financial constraints when buying an house, if there is an increase in property prices due to the presence of temporary accommodation services, it could further exacerbate their difficulties in purchasing an house and lower their level of welfare. Finally, we also compare the effects in coastal versus non-coastal civil parishes, with the effects being larger for non-coastal areas.

5.4 Quantile analysis

Up to this point, our results seem to suggest that the impact of local lodging establishments is not homogeneous across properties. The effects appear to be larger in civil parishes with a higher average value of transaction. We further explore this heterogeneity in our effects through quantile regressions, which allows us to estimate how different are the effects across our distribution.

We follow the estimator proposed in Machado and Santos Silva (2019), which makes it possible to perform quantile regressions with panel data and fixed effects. As in our baseline model, we control for property characteristics, quarter and civil parish fixed effects. We focus on the 0.10,0.20,0.5,0.75 and 0.90 quantiles. Our results are displayed graphically in figures 3, 4 and 5.

As conveyed by figure 3, for our entire sample the effects get stronger as we move along the distribution, while being significant for all the quantiles considered. The coefficient at the median is in line with our baseline model, while being larger for the 0.75 and 0.90 quantile.

In terms of currency, at these percentiles the transactions are valued in the €155,000 and €352,500 range.

We proceed by examining separately the municipalities of Lisbon and Porto and their historical centres, presented in figures 4 and 5 respectively. For the municipality of Lisbon, the effects get larger as we move across the distribution, with the increase not being as steep as when considering our entire sample. Here, the effects only become positive and significant at the 0.75 and 0.90 quantile. Our data makes it possible to discern that these effects are located in the upper quantiles. In the municipality of Lisbon, at these percentiles the transactions are valued in €287,000 and €565,500 range.

For the historical centres, the coefficients are always negative and significant at the 0.10, 0.25 and 0.50 quantile. This might suggest an increased preference for the rental market. In these areas, properties in the long-term housing market and in the lower part of the distribution might get substituted by rental properties. The larger availability of temporary accommodation services in the historical centre of Lisbon, which has become a tourist hotspot, can be ascribed to a growing consumer preference for rental properties, causing a decrease in the value of transactions.

The effects for the municipality and historical centre of Porto are stronger and more in line with the overall effect, which was also the case when using our two-way fixed effects model. The coefficients are significant across all quantiles, apart from 0.10, and larger than our main estimations above the 0.50 quantile.

Unlike previous research, our dataset allows us to estimate which properties are most affected by the presence of short-term rentals. The quantile analysis performed, while supportive of our baseline results, demonstrates that the effects are considerably stronger for properties with higher values, located in the upper quantiles. The results also suggest that the effects are stronger in the municipality of Porto. There are some positive effects in the municipality of Lisbon at the upper quantiles, but lower in magnitude than our main estimations.

6 Spillovers: Commercial properties

In this section, we study the presence of spillover effects, by analyzing the effects on the price of commercial properties. Existing research has primarily concentrated on the repercussions of short-term rentals on consumption amenities (Hidalgo et al., 2022; Zervas et al., 2017). Here, we use the level of business activity as a proxy for the value of commercial price, a high-frequency variable derived from the asking price of advertisements on the online platform.

Table 8 reports the results of regressing the number of local lodgings opening in a specific civil parish and quarter on the asking prices for commercial properties, both stores and offices, available for rent or sale. Our specification includes quarter, civil parish and municipality fixed effects as well as municipality time trends. In Panel A, we investigate the impact across the entire sample. Our analysis reveals a noteworthy positive effect, which is statistically significant, specifically concerning stores available for rent. These findings underscore the role played by short-term rentals in enhancing the appeal of a locality, as stores situated in areas with recently revamped local lodging establishments hold greater value.

Panel B and C estimate the effect on the municipalities of Lisbon and Porto, separately. The estimates are more significant for Porto, with a statistically positive impact observed for both offices and stores for rent, while in the municipality of Lisbon the effects are solely present on stores for rent, with the coefficient being, approximately, 4 times higher. Finally, considering that the observed effects attain significance exclusively for rental properties, one plausible explanation could be attributed to the tendency of short-term rental to attract individuals that are more inclined to stay in metropolitan areas for a shorter period of time.

7 Final Remarks

The impact of local lodging establishments on the housing market has been a topic of interest to recent research. The Portuguese housing market exhibits the ideal characteristics to examine this research question due to a set of exogenous policy reforms, which deregulated the private rental market and augmented the availability of local lodging establishments. The development of these establishments enhances the overall appeal of the area where they are located, potentially leading to an increment in house prices.

Using a novel dataset of high-frequency transaction data, obtained by combining two different tax registries, and exploiting the rapid variation in local lodging establishments based on an exogenous reform in 2014 reform, we present causal evidence regarding the positive effect on transaction prices, for the metropolitan regions of Porto and Lisbon. The estimates from our baseline model show that an increment in the number of these venues leads to a significant increase of around 0.17% in the value of transactions, which still holds when including different location fixed effects.

The robustness checks performed demonstrate that our results remain positive, significant and exhibit similar magnitudes. Using a lagged variable of interest in our model, we conclude that there is some persistence on the effects found, as the number of establishments opening 4 periods before still have an impact of the present value of transactions. To strengthen the credibility of our identification strategy, we perform a falsification exercise, in which we use our variable of interest some periods ahead. The results suggest that the number of establishments opening 4 periods ahead do not have an impact on the present value of transactions.

Our heterogeneity analysis conveys a positive and highly significant effect of one additional local lodging establishment in the metropolitan areas of Lisbon and Porto. The effects are larger, in magnitude, for the metropolitan area of Lisbon, but both estimates remain quantitatively larger than the baseline model at the quarterly level. Contrasting results are

found when considering solely the municipalities and their historical centres, with positive and significant effects found solely for Porto. Moreover, we find stronger effects on properties with 4 or more bedrooms, particularly those situated in non-coastal regions. The impact is particularly notable among properties owned by overseas citizens and those held under co-ownership status.

Our quantile regressions, confirm our main estimates. In general, there is a positive and significant impact across our distribution, with the effects being larger at the upper quantiles. The effects are also stronger for the municipality of Porto, with positive and significant results for Lisbon only at the upper quantiles. Lastly, we identified spillovers to commercial properties, impacting positively the value of stores and offices for rent.

Overall, our results contribute to the existing literature by showing that the development of local lodging establishments does not have a homogeneous effect. This nuanced effect, which could not be established when using average house prices per parish as an outcome measure, conveys valuable insights into the socio-economic ramifications of short-term rental market services. Importantly, our results hold potential policy implications, casting doubt on general restrictions to local lodging establishments.

References

Barron, Kyle, Edward Kung, and Davide Proserpio, "The effect of home-sharing on house prices and rents: Evidence from airbnb," *Marketing Science*, 2021, *40* (1), 23–47.

Borusyak, Kirill, Peter Hull, and Xavier Jaravel, "Quasi-Experimental Shift-Share Research Designs," *The Review of Economic Studies*, 01 2022, *89* (1), 181–213.

Carvalho, Jorge Morais and Pedro Policarpo, "Regulating Airbnb in Portugal," *Journal of European Consumer and Market Law*, 2018, pp. 256–258.

Cocola-Gant, Agustin and Ana Gago, "Airbnb, buy-to-let investment and tourism-driven displacement: A case study in Lisbon," *Environment and Planning A: Economy and Space*, 2021, *53* (7), 1671–1688.

de Chaisemartin, Clément and Ziteng Lei, "More Robust Estimators for Instrumental-Variable Panel Designs, With An Application to the Effect of Imports from China on US Employment," 2023.

Duso, Tomaso, Claus Michelsen, Maximilian Schäfer, and Kevin Ducbao Tran, "Airbnb and Rental Markets: Evidence from Berlin," 2021.

Evangelista, Rui, Esmeralda A. Ramalho, and João Andrade e Silva, "On the use of hedonic regression models to measure the effect of energy efficiency on residential property transaction prices: Evidence for Portugal and selected data issues," *Energy Economics*, 2020, *86*, Article 104699.

Franco, Sofia F. and Carlos Daniel Santos, "The impact of Airbnb on residential property values and rents: Evidence from Portugal," *Regional Science and Urban Economics*, 2021, *88*, 103667.

Hidalgo, Alberto, Massimo Riccaboni, and Francisco J. Velázquez, "The Effect of Short-Term Rentals on Local Consumption Amenities: Evidence from Madrid," January 2022, (01/2022).

Horn, Keren and Mark Merante, "Is home sharing driving up rents? Evidence from Airbnb in Boston," *Journal of Housing Economics*, 2017, *38* (C), 14–24.

Koster, Hans R.A., Jos van Ommeren, and Nicolas Volkhausen, "Short-term rentals and the housing market: Quasi-experimental evidence from Airbnb in Los Angeles," *Journal of Urban Economics*, 2021, *124*, 103356.

Lee, Dayne, "How Airbnb short-term rentals exacerbate Los Angeles's affordable housing crisis: Analysis and policy recommendations," *Harv. L. & Pol'y Rev.*, 2016, *10*, 229.

Machado, José A.F. and J.M.C. Santos Silva, "Quantiles via moments," *Journal of Econometrics*, 2019, *213* (1), 145–173. Annals: In Honor of Roger Koenker.

Mendes, Luis, "Mendes, L. (2022) – "The dysfunctional rental market in Portugal: a policy review", Land, vol.11, n.º1, 566. 17pgs.," *Land*, 04 2022, *11*, 17 pgs.

Peralta, Susana, João Pereira dos Santos, and Duarte Gonçalves, "Short-Term Rental Bans and Housing Prices: Quasi-Experimental Evidence from Lisbon," IZA Discussion Paper No. 15706 2022.

Salgueiro, Teresa Barata, Luis Mendes, and Pedro Guimarães, *Tourism and urban changes. Lessons from Lisbon* 06

SEF, "Article 90-A – Residence Permit for Investment Purposes – The Official Website of Portuguese Immigration," https://imigrante.sef.pt/en/solicitar/residir/art90-a/ 2022.

Seiler, Michael J., Ralph B. Siebert, and Liuming Yang, "Airbnb or not Airbnb? That is the question: How Airbnb bans disrupt rental markets," *Real Estate Economics*, 2023, *00* (n/a), 1–32.

Sheppard, Stephen and Andrew Udell, "Do Airbnb Properties Affect House Prices?," Department of Economics Working Papers 2016-03, Department of Economics, Williams College 2016.

Valentin, Maxence, "Regulating short-term rental housing: Evidence from New Orleans," *Real Estate Economics*, 2021, *49* (1), 152–186.

Zervas, Georgios, Davide Proserpio, and John W. Byers, "The Rise of the Sharing Economy: Estimating the Impact of Airbnb on the Hotel Industry," *Journal of Marketing Research*, 2017, *54* (5), 687–705.

Àngel Garcia-López, Miquel, Jordi Jofre-Monseny, Rodrigo Martínez-Mazza, and Mariona Segú, "Do short-term rental platforms affect housing markets? Evidence from Airbnb in Barcelona," *Journal of Urban Economics*, 2020, *119*, 103278.

Figures and Tables

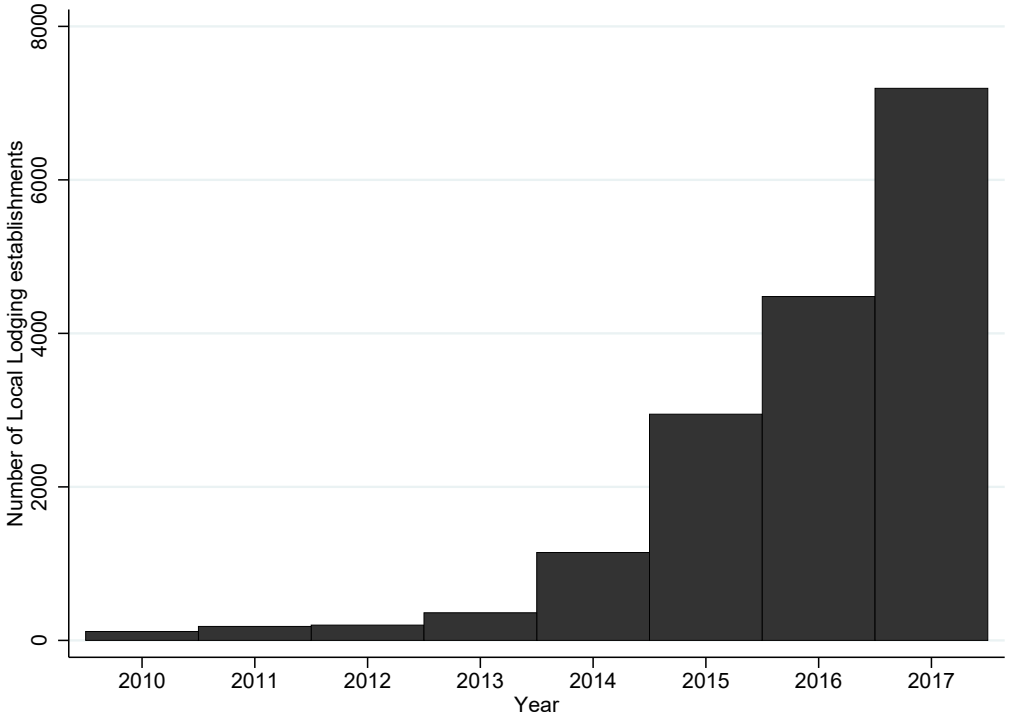


Figure 1: Number of local lodging establishments opening by year

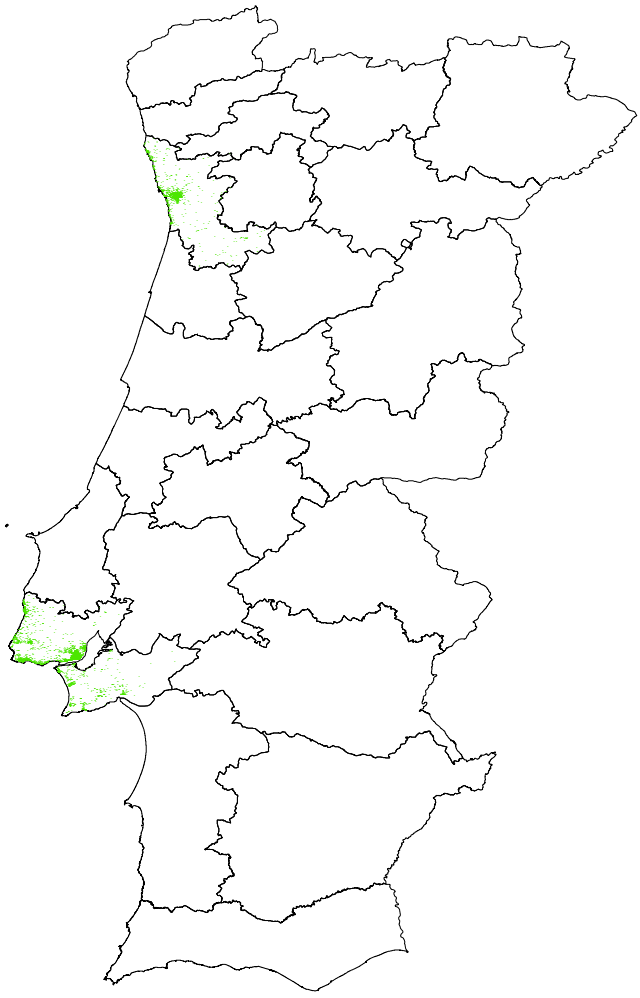


Figure 2: Geographical location of Local lodging establishments, within Portugal
Notes: The black lines delimit each NUTS III administrative division. The green dots represent each local lodging in our sample.

Figure 3: Quantile analysis - entire sample

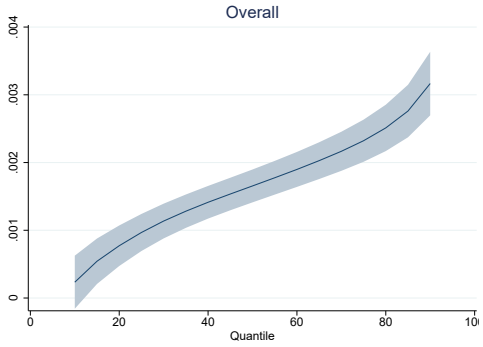
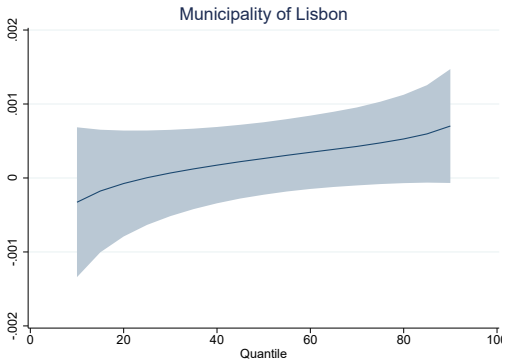
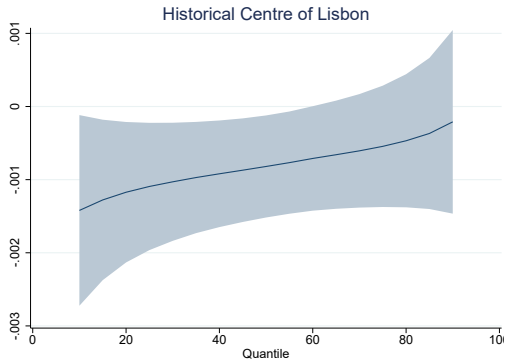


Figure 4: Quantile analysis - Lisbon

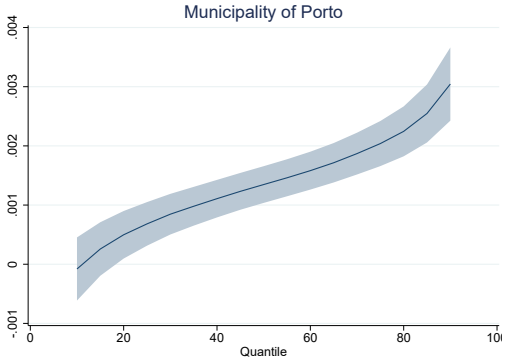


(a) Municipality

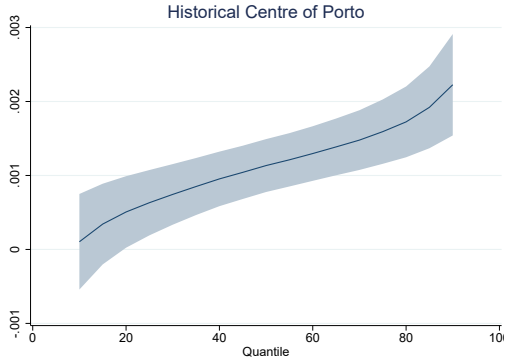


(b) Historical Centre

Figure 5: Quantile analysis - Porto



(a) Municipality



(b) Historical Centre

Table 1: Summary statistics of properties transacted

	Mean	Std. Dev.	Min	Max	Total transactions
Number of transactions (per property)	1.40	0.72	1	12	210,462
Number of transactions (per week and civil parish)	5.33	5.42	1	126	210,462
Number of transactions (per month and civil parish)	17.58	10.03	1	176	210,462
Number of transactions (per quarter and civil parish)	44.59	53.41	1	442	210,462
Number of transactions (per year and civil parish)	142.98	198.01	1	1423	210,462
Number of transactions (per civil parish)	757.06	1081.044	1	5186	210,462
Number of transactions (per week)	757.06	319.61	114	1412	210,462
Number of transactions (per month)	2192.313	1327.304	651	5221	210,462
Number of transactions (per quarter)	6576.938	3969.73	2229	14123	210,462
Number of transactions (per year)	26307.75	16230.46	9707	52108	210,462
Value of transactions	205210.3	533439.6	2002.49	7,883,690	210,462
Number of bedrooms	2.86	1.23	0	34	210,462
Number of floors	1.09	0.38	1	13	210,462
Area (square meters)	100.23	43.79	3.6	1657.9	210,462
Age of the building (years)	24.88	23.07	0	298	210,462

Notes: This table reports the number of observations, mean, standard deviation, as well as minimum and maximum values for our transaction data. The number of transactions is presented based upon several time and geographical dimensions. This includes the number of transactions per property, per week, month, quarter, year and civil parish. It also reports the value of the transactions and several property-specific characteristics such as the number of bedrooms, floors, area (in square meters) and the age of the building.

Table 2: Baseline model

Variables	Log(prices)	Log(prices)	Log(prices)	Log(prices)	Log(prices)
Number of Local Lodging	0.00176***	0.00172***	0.00173***	0.00173***	0.00148***
	(0.00038)	(0.00036)	(0.00038)	(0.00033)	(0.000203)
Number of bedrooms	No	✓	✓	✓	✓
Number of floors	No	✓	✓	✓	✓
Area (square meters)	No	✓	✓	✓	✓
Age of building	No	✓	✓	✓	✓
Coefficients of location and quality	No	✓	✓	✓	✓
Civil parish FE	✓	✓	✓	✓	✓
Quarter FE	✓	✓	✓	✓	✓
Postcode FE	No	No	✓	✓	✓
Municipality FE	No	No	No	✓	✓
Municipality time trends	No	No	No	No	✓
Number of clusters	261	261	261	261	261
Observations	210,445	210,445	210,438	210,438	210,438
R^2	0.146	0.325	0.329	0.329	0.334

Note: Results for the baseline model at the quarterly level, where we regress the number of local lodging establishments opening in a quarter and civil parish on the logarithm of transactions prices. Column (1) presents the results including civil parish and quarter fixed effects and without any property-specific controls. Column (2) includes property-specific controls and civil parish and quarter fixed effects. In column (3),(4) and (5) we add postcode, municipality fixed effects and municipality time trends, respectively, while keeping all control variables. All regressions include a constant. Standard errors are clustered by civil parish. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Outcome variable: number of transactions of new buildings

	Entire sample	Metropolitan area of Lisbon	Metropolitan area of Porto
Variables	Number of Transactions	Number of Transactions	Number of Transactions
	Panel A: Quarterly aggregation		
Number of Local Lodging	0.00171*	0.00113	-0.00385***
	(0.000924)	(0.00101)	(0.000686)
Civil parish FE	✓	✓	✓
Quarter FE	✓	✓	✓
Number of clusters	278	135	112
Observations	8,896	2,528	2,037
R-squared	0.124	0.201	0.144
	Panel B: Monthly aggregation		
Number of Local Lodging	0.00351	-0.000457	-0.00391***
	(0.00231)	(0.00123)	(0.00128)
Civil Parish FE	✓	✓	✓
Month FE	✓	✓	✓
Number of clusters	278	137	113
Observations	26,688	6,769	4,743
R-squared	0.121	0.241	0.101

Note: Effects on the number of transactions of new buildings, at the quarterly (Panel A) and monthly (Panel B) level. Column (1) presents the results for the entire sample, column (2) for the metropolitan area of Lisbon and column (3) for the metropolitan area of Porto. In all specifications, the outcome variable is the number of transactions of new buildings in the present period and include a constant, quarter (in Panel A), month (in Panel B) and civil parish fixed effects. Standard errors are clustered by civil parish. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Robustness checks

Variables	Dropping below 2014 Log(prices)	One transaction per property Log(prices)	Dropping 99pct LL Log(prices)	Placebo Log(prices)	Log(prices/m$\hat{2}$)
Number of Local Lodging	0.00156***	0.00145***	0.0034***	0.00122	0.0018***
	(0.00032)	(0.00033)	(0.00062)	(0.0163)	(0.00037)
Number of rooms	✓	✓	✓	✓	✓
Number of floors	✓	✓	✓	✓	✓
Area (square meters)	✓	✓	✓	✓	No
Age of building	✓	✓	✓	✓	✓
Coefficients of location and quality	✓	✓	✓	✓	✓
Civil parish FE	✓	✓	✓	✓	✓
Quarter FE	✓	✓	✓	✓	✓
Number of clusters	225	249	261	240	261
Observations	160,062	97,698	208,317	50,373	210,445
R^2	0.3571	0.3806	0.3250	0.278	0.2270

Note: This table reports the estimates for a set of robustness checks. In column (1) we consider only transactions from 2014 onwards, in column (2) only properties with one transaction, in column (3) we drop areas in the 99th percentile in terms of number of local lodging establishments per quarter and civil parish, in column (4) we only consider the period before 2014, as a placebo test. In columns (1) - (4), the outcome variable is the log value of transactions in the present period. In column (5), the outcome variable is a measure of price per square meter. All regressions include a constant, property-specific controls, quarter and civil parish fixed effects. Standard errors are clustered by civil parish. *** p<0.01, ** p<0.05, * p<0.1

Table 5: Falsification exercise and timing of the effects

Variables	Log(prices)	Log(prices)	Log(prices)	Log(prices)	Log(prices)
Number of Local Lodging$_{t-4}$	0.0028***				
	(0.00055)				
Number of Local Lodging$_{t-1}$		0.00198***			
		(0.00055)			
Number of Local Lodging$_{t}$			0.0017***		
			(0.00036)		
Number of Local Lodging$_{t+1}$				0.00081***	
				(0.00025)	
Number of Local Lodging$_{t+4}$					-0.000065
					(0.00017)
Number of bedrooms	✓	✓	✓	✓	✓
Number of floors	✓	✓	✓	✓	✓
Area (square meters)	✓	✓	✓	✓	✓
Age of building	✓	✓	✓	✓	✓
Coefficients of location and quality	✓	✓	✓	✓	✓
Civil parish FE	✓	✓	✓	✓	✓
Quarter FE	✓	✓	✓	✓	✓
Number of clusters	261	261	261	261	261
Observations	210,445	210,445	210,445	210,445	210,445
R^2	0.3252	0.3255	0.3252	0.3244	0.3242

Note: Results for the falsification and timing of the effects exercises, at the quarterly level. Column (1) presents the results when using the number of local lodging establishments opening 4 quarters before. In column (2) we use the number of establishments opening one quarter before. Column (3) is the baseline model. Column (4) displays the estimates when using the number of establishments opening the quarter after, and column (5) when using the establishments opening 4 quarters after. In all specifications, the outcome variable is the log value of transactions in the present period and include a constant, property-specific controls, quarter and civil parish fixed effects. Standard errors are clustered by civil parish. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Heterogenous effects: by metropolitan area

	Lisbon			Porto		
Variables	Metropolitan area Log(prices)	Municipality Log(prices)	Historical centre Log(prices)	Metropolitan area Log(prices)	Municipality Log(prices)	Historical centre Log(prices)
Number of Local Lodging	0.0024**	0.00026	-0.00079	0.0016***	0.00138***	0.0011***
	(0.00082)	(0.00063)	(0.00066)	(0.00011)	(0.00016)	(0.00012)
Number of bedrooms	✓	✓	✓	✓	✓	✓
Number of floors	✓	✓	✓	✓	✓	✓
Area (square meters)	✓	✓	✓	✓	✓	✓
Age of building	✓	✓	✓	✓	✓	✓
Coefficients of location and quality	✓	✓	✓	✓	✓	✓
Civil parish FE	✓	✓	✓	✓	✓	✓
Quarter FE	✓	✓	✓	✓	✓	✓
Number of clusters	144	37	6	117	10	3
Observations	144,461	42,676	10,838	65,984	18,017	8,038
R^2	0.3482	0.3336	0.3641	0.2723	0.3165	0.3286

Note: Results for heterogeneous exercises, by metropolitan area, at the quarterly level. Columns (1) and (3) present the results when considering separately the metropolitan areas of Lisbon and Porto, respectively. Columns (2) and (4) display the results when considering separately the municipalities of Lisbon and Porto, respectively. Columns (3) and (6) show the estimates when considering separately the historical centres of Lisbon and Porto, respectively. In all specifications, the outcome variable is the log value of transactions in the present period and include a constant, property-specific controls, quarter and civil parish fixed effects. Standard errors are clustered by civil parish. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Heterogeneous effects: by nationality of properties' owners and ownership status

	Owner's nationality			Ownership status	
Variables	Portuguese Log(prices)	European Union Log(prices)	Overseas Log(prices)	Singular Log(prices)	Co-ownership Log(prices)
Number of Local Housing	0.00172***	-0.0028	0.026**	0.00161***	0.0022***
	(0.00035)	(0.0056)	(0.0104)	(0.00048)	(0.0006)
Number of bedrooms	✓	✓	✓	✓	✓
Number of floors	✓	✓	✓	✓	✓
Area (square meters)	✓	✓	✓	✓	✓
Age of building	✓	✓	✓	✓	✓
Coefficients of location and quality	✓	✓	✓	✓	✓
Civil parish FE	✓	✓	✓	✓	✓
Quarter FE	✓	✓	✓	✓	✓
Number of clusters	261	66	15	260	196
Observations	209,938	343	108	184,434	24,077
R^2	0.3249	0.6839	0.8684	0.3354	0.3278

Note: Results for heterogeneous exercises, by nationality of the properties' owners and their ownership status. In column (1), we consider properties belonging to Portuguese owners. In column (2) we consider properties belonging to owners from the European Union and in column (3) properties owned by overseas owners. In column (4), we turn our attention to ownership status, considering the properties with singular ownership. We conclude in column (5) by considering properties that are co-owned. In all specifications, the outcome variable refers to the log value of transactions in the present period and includes a constant, property-specific controls and quarter and civil-parish effects. Standard errors are clustered by civil parish. *** p<0.01, ** p<0.05, * p<0.1

Table 8: Spillover effects: price of commercial properties

Panel A: Overall sample				
Variables	Offices for rent	Offices for sale	Stores for rent	Stores for sale
Number of Local Lodging	0.0000773	-0.000190	0.000522***	-0.00033
	(0.000326)	(0.000341)	(0.000179)	(0.000258)
Civil parish FE	✓	✓	✓	✓
Quarter FE	✓	✓	✓	✓
Municipality FE	✓	✓	✓	✓
Municipality time trends	✓	✓	✓	✓
Number of clusters	133	144	208	221
Observations	5,609	6,172	9,674	23,164
R^2	0.366	0.403	0.434	0.255
Panel B: Municipality of Lisbon				
Variables	Offices for rent	Offices for sale	Stores for rent	Stores for sale
Number of Local Lodging	-0.000312	-0.000119	0.00256**	0.000439
	(0.00212)	(0.00121)	(0.00115)	(0.00142)
Civil parish FE	✓	✓	✓	✓
Quarter FE	✓	✓	✓	✓
Municipality FE	✓	✓	✓	✓
Municipality time trends	✓	✓	✓	✓
Number of clusters	23	23	23	23
Observations	2,194	1,417	1,658	4,012
R^2	0.191	0.239	0.499	0.295
Panel C: Municipality of Porto				
Variables	Offices for rent	Offices for sale	Stores for rent	Stores for sale
Number of Local Lodging	0.00135***	0.0000544	0.000574**	-0.0000439
	(0.000246)	(0.000241)	(0.000171)	(0.000457)
Civil parish FE	✓	✓	✓	✓
Quarter FE	✓	✓	✓	✓
Municipality FE	✓	✓	✓	✓
Municipality time trends	✓	✓	✓	✓
Number of clusters	7	7	7	7
Observations	1,063	1,158	1,027	2,844
R^2	0.434	0.250	0.204	0.105

Note: Results for spillover effects, at the quarterly level. In columns (1) and (2), we look at offices for rent and sale, respectively, while in columns (3) and (4) we analyze stores for rent and sale. Panel A uses the composite sample, containing both metropolitan areas. Panel B and C analyze separately the effects on the municipality of Lisbon and Porto, respectively. In all specifications, the outcome variable is the log value of asking price in the present period and include a constant, property-specific controls and quarter, civil parish, municipality FE and municipality time trends. Standard errors are clustered at the civil parish. *** p<0.01, ** p<0.05, * p<0.1

Appendix

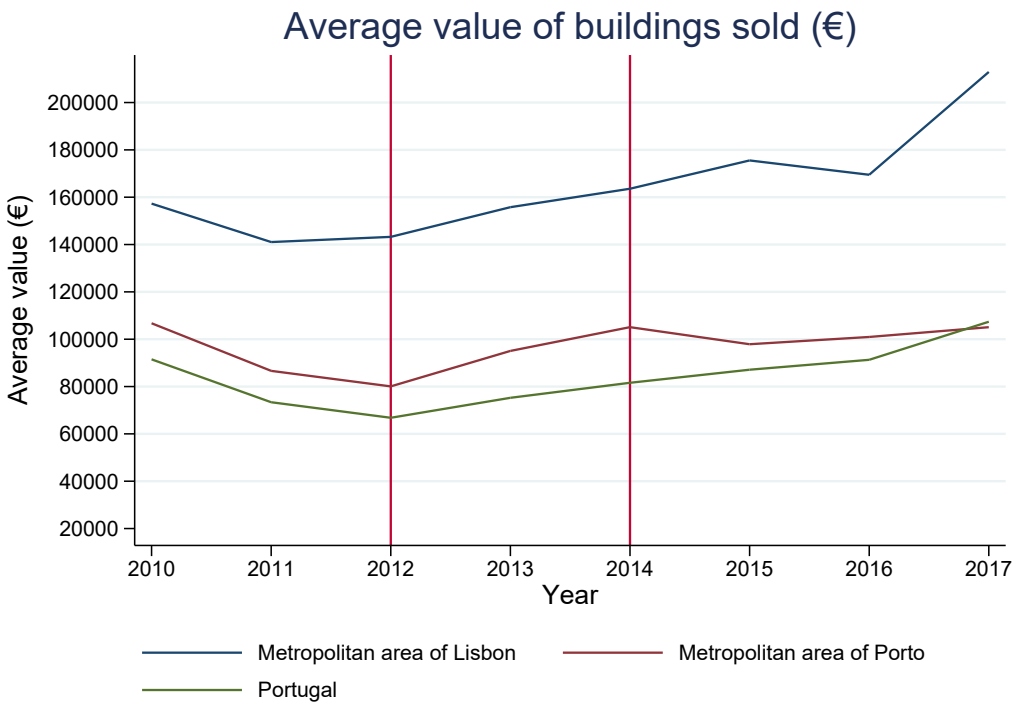
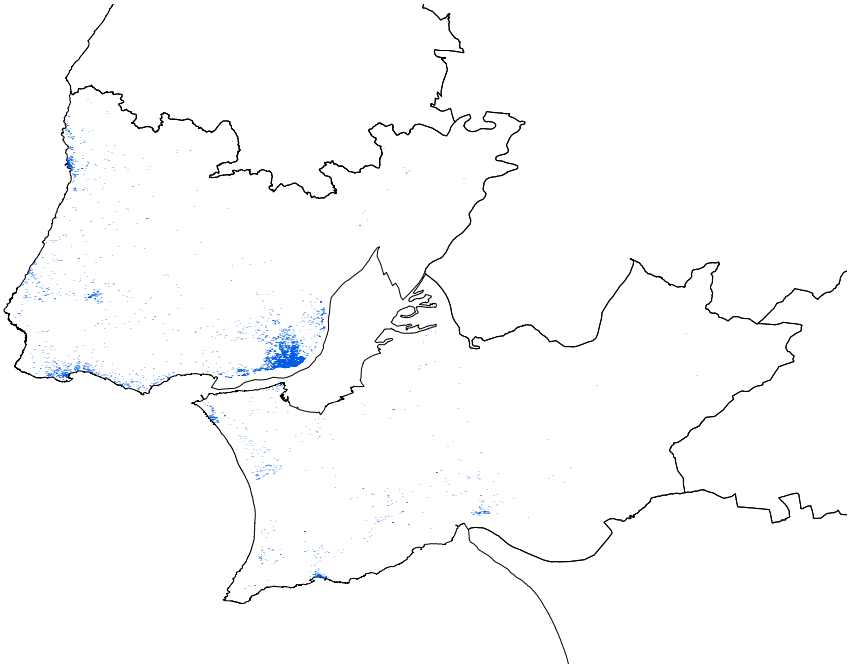
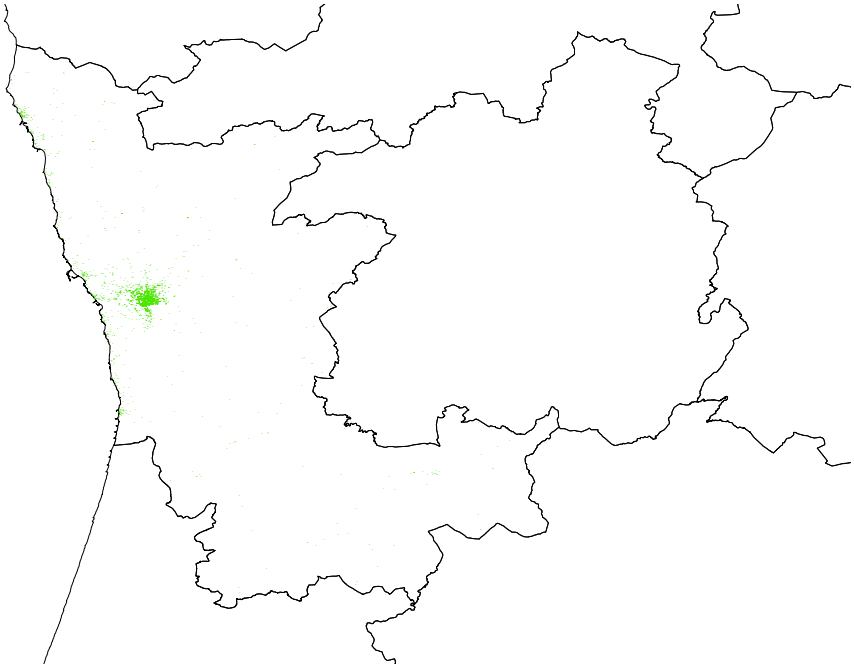


Figure A1: Average value of buildings sold. Source: Pordata

Figure A2: Geographical location of Local lodging establishments



(a) Metropolitan area of Lisbon



(b) Metropolitan area of Porto

Figure A3: Number of online advertisements per month

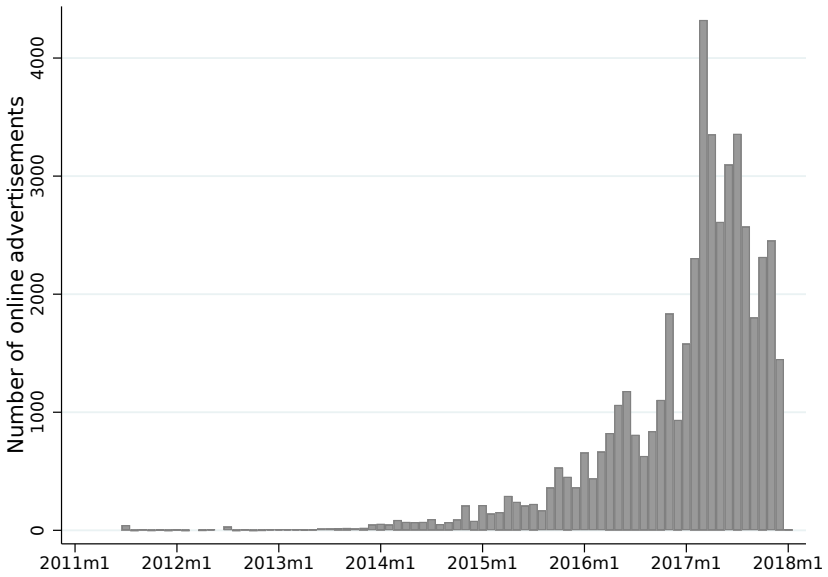


Table A1: Descriptive statistics per metropolitan area

Year	Area	Number of cities	Number of civil parishes	Population	Population density/km^2	Number of doctors	Number of companies
2017	Portugal	159	3092	10,291,027	111.6	51,937	38,497
	Metropolitan area of Porto	27	173	1,719,702	842.4	11,864	6,634
	Metropolitan area of Lisbon	17	118	2,833,679	939.8	18,197	14,986
2011	Portugal	158	4260	10,542,398	114.3	42,796	33,028
	Metropolitan area of Porto	27	266	1,758,991	861.7	9,945	6,132
	Metropolitan area of Lisbon	17	211	2,827,050	941.7	15,856	11,069

Notes: This table reports various descriptive statistics per Portuguese metropolitan area during the beginning and end of our sample. It includes the population density, number of cities, parishes, doctors, companies and population for Lisbon and Porto, conveying their evolution from the beginning to the end of our sample. Source: Statistics Portugal

Table A2: Summary statistics: Number of new local lodging establishments

	Mean	Std. Dev.	Min	Max	Total
Per week and civil parish	0.384	2.13	0	67	16,622
Per month and civil parish	1.30	6.90	0	179	16,622
Per quarter and civil parish	3.33	18.23	0	461	16,622
Per civil parish	56.48	253.84	0	2389	16,622
Per week	36.48	56.22	0	420	16,622
Per month	161.95	225.78	0	1092	16,622
Per quarter	490.69	663.39	1	2575	16,622
Per year	1962.75	2609.931	14	7032	16,622

Note: This table reports the number of observations, mean, standard deviation, as well as minimum and maximum values for new local lodging establishments in our sample. We present statistics based on various time dimensions, including week, month quarter and year and geographical determinants such as the civil parish.

Table A3: Summary statistics of commercial properties advertised

	Mean	Std. Dev.	Min	Max
(a) *Asking Price*				
Offices for rent	1,466.352	2,237.083	70	21,400
Offices for sale	227,526.5	324,282.2	750	2,580,000
Stores for rent	1,240.801	2,538.952	150	3,5000
Stores for sale	170,904.6	204,164.5	3,800	1,500,000
(b) *Advertisements (per quarter and civil parish)*				
Offices for rent	11.406	22.226	1	167
Offices for sale	5.808	10.265	1	114
Stores for rent	7.015	12.802	1	106
Stores for sale	10.656	16.446	1	238

Notes: This table reports the , mean, standard deviation, as well as minimum and maximum values for price (asking) of the commercial properties advertised in the platform and number of advertisements per civil parish and quarter. *Imovirtual*.

Table A4: Baseline model: Monthly aggregation

Variables	Log(prices)	Log(prices)	Log(prices)	Log(prices)	Log(prices)
Number of Local Lodging	0.0041***	0.0039***	0.0039***	0.0039***	0.00326***
	(0.00075)	(0.00069)	(0.00073)	(0.00073)	(0.00067)
Number of bedrooms	No	✓	✓	✓	✓
Number of floors	No	✓	✓	✓	✓
Area (square meters)	No	✓	✓	✓	✓
Age of building	No	✓	✓	✓	✓
Coefficients of location and quality	No	✓	✓	✓	✓
Civil parish FE	✓	✓	✓	✓	✓
Month FE	✓	✓	✓	✓	✓
Postcode FE	No	No	✓	✓	✓
Municipality FE	No	No	No	✓	✓
Municipality time trends	No	No	No	No	✓
Number of clusters	261	261	261	261	261
Observations	210,445	210,445	210,438	210,438	210,438
R^2	0.156	0.334	0.337	0.337	0.343

Note: Results for the baseline model at the monthly level, where we regress the number of local lodging establishments opening in a month and civil parish on the logarithm of transactions prices. Column (1) presents the results including civil parish and month fixed effects and without any property-specific controls. Column (2) includes property-specific controls and civil parish and month fixed effects. In column (3),(4) and (5) we add postcode, municipality fixed effects and municipality time trends, respectively, while keeping all control variables. All regressions include a constant. Standard errors are clustered by civil parish. *** p<0.01, ** p<0.05, * p<0.1

Table A5: Baseline model: Weekly aggregation

Variables	Log(prices)	Log(prices)	Log(prices)	Log(prices)	Log(prices)
Number of Local Lodging	0.0083***	0.0083***	0.0082***	0.0082***	0.00653**
	(0.0031)	(0.0024)	(0.0024)	(0.0024)	(0.00301)
Number of bedrooms	No	✓	✓	✓	✓
Number of floors	No	✓	✓	✓	✓
Area (square meters)	No	✓	✓	✓	✓
Age of building	No	✓	✓	✓	✓
Coefficients of location and quality	No	✓	✓	✓	✓
Civil parish FE	✓	✓	✓	✓	✓
Week FE	✓	✓	✓	✓	✓
Postcode FE	No	No	✓	✓	✓
Municipality FE	No	No	No	✓	✓
Municipality time trends	No	No	No	No	✓
Number of clusters	261	261	261	261	261
Observations	210,445	210,445	210,438	210,438	210,438
R^2	0.174	0.350	0.353	0.353	0.358

Note: Results for the baseline model at the weekly level, where we regress the number of local lodging establishments opening in a week and civil parish on the logarithm of transactions prices. Column (1) presents the results including civil parish and week fixed effects and without any property-specific controls. Column (2) includes property-specific controls and civil parish and week fixed effects. In column (3),(4) and (5) we add postcode, municipality fixed effects and municipality time trends, respectively, while keeping all control variables. All regressions include a constant. Standard errors are clustered by civil parish. *** p<0.01, ** p<0.05, * p<0.1

Table A6: Outcome variable: number of transactions

	Entire sample	Metropolitan area of Lisbon	Metropolitan area of Porto
Variables	Number of Transactions	Number of Transactions	Number of Transactions
	Panel A: Quarterly aggregation		
Number of Local Lodging	0.978***	0.197**	0.727***
	(0.171)	(0.0832)	(0.0459)
Civil parish FE	✓	✓	✓
Quarter FE	✓	✓	✓
Number of clusters	278	135	112
Observations	8,896	2,565	2,124
R-squared	0.717	0.884	0.915
	Panel B: Monthly aggregation		
Number of Local Lodging	0.866***	0.137**	0.613***
	(0.150)	(0.0579)	(0.0319)
Month FE	✓	✓	✓
Quarter FE	✓	✓	✓
Number of clusters	278	138	113
Observations	26,688	6,919	5,029
R-squared	0.667	0.796	0.821

Note: Effects on the number of transactions, at the quarterly (Panel A) and monthly (Panel B) level. Column (1) presents the results for the entire sample, column (2) for the metropolitan area of Lisbon and column (3) for the metropolitan area of Porto. In all specifications, the outcome variable is the number of transactions in the present period and include a constant, quarter (in Panel A), month (in Panel B) and civil parish fixed effects. Standard errors are clustered by civil parish. *** p<0.01, ** p<0.05, * p<0.1

Table A7: Heterogenous effects: by number of bedrooms in the properties

Variables	0 Log(prices)	1 Log(prices)	2 Log(prices)	3 Log(prices)	4 Log(prices)	>4 Log(prices)
Number of Local Lodging	0.00058	0.0014***	0.0020**	0.0011**	0.0024***	0.0023***
	(0.00064)	(0.00031)	(0.00068)	(0.00048)	(0.0005)	(0.00057)
Number of bedrooms	No	No	No	No	No	✓
Number of floors	✓	✓	✓	✓	✓	✓
Area (square meters)	✓	✓	✓	✓	✓	✓
Age of building	✓	✓	✓	✓	✓	✓
Coefficients of location and quality	✓	✓	✓	✓	✓	✓
Civil parish FE	✓	✓	✓	✓	✓	✓
Quarter FE	✓	✓	✓	✓	✓	✓
Number of clusters	89	173	225	232	202	153
Observations	2,753	20,012	59,64	76,078	37,553	14,331
R^2	0.4277	0.3570	0.2848	0.3241	0.23866	0.3307

Note: Results for heterogeneous exercises, by number of bedrooms, at the quarterly level. In column (1) we consider properties with no bedrooms, in column (2) with 1 bedroom, in column (3) with 2 bedrooms, in column (4) with 3 bedrooms, in column (5) with 4 bedrooms and in column (6) with more than 4 bedrooms. In all specifications, the outcome variable is the log value of transactions in the present period and include a constant, property-specific controls, quarter and civil parish fixed effects. Only in column (6) do we include the number of bedrooms as a control. Standard errors are clustered by civil parish. *** p<0.01, ** p<0.05, * p<0.1

Table A8: Heterogeneous effects: by characteristics of the civil parish

	Unemployment rate		Density		School dropout		Coastal vs non-coastal	
Variables	Below median Log(prices)	Above median Log(prices)	Below median Log(prices)	Above median Log(prices)	Below median Log(prices)	Above median Log(prices)	Non-coastal Log(prices)	Coastal Log(prices)
Number of Local Lodging	0.00570*	0.00255*	0.00869***	0.000222	0.00874**	0.00117	0.0027**	0.00105**
	(0.00329)	(0.00131)	(0.00261)	(0.00204)	(0.00386)	(0.00170)	(0.000899)	(0.00026)
Number of bedrooms	✓	✓	✓	✓	✓	✓	✓	✓
Number of floors	✓	✓	✓	✓	✓	✓	✓	✓
Area (square meters)	✓	✓	✓	✓	✓	✓	✓	✓
Age of the building	✓	✓	✓	✓	✓	✓	✓	✓
Coefficients of location and quality	✓	✓	✓	✓	✓	✓	✓	✓
Civil parish FE	✓	✓	✓	✓	✓	✓	✓	✓
Quarter FE	✓	✓	✓	✓	✓	✓	✓	✓
Number of clusters	84	78	107	55	59	77	117	41
Observations	51,717	52,716	53,845	54,313	54,419	53,713	140,794	54,221
R^2	0.309	0.252	0.269	0.312	0.294	0.260	0.330	0.353

Note: Results for heterogeneous exercises, by characteristics of the civil parish, at the quarterly level. In column (1)-(2) we consider civil parishes that are below and above the median in terms of unemployment rate, respectively, while in column (3)-(4) we look at civil parishes that are below and above the median in terms of population density. In columns (5)-(6) we analyze parishes below and above the median in terms of school dropout rates. In column (7) we look at non-coastal civil parishes, while analyzing coastal civil parishes in column (8). In all specifications, the outcome variable is the log value of transactions in the present period and include a constant, property-specific controls, quarter and civil parish fixed effects. Standard errors are clustered by civil parish. *** p<0.01, ** p<0.05, * p<0.1