THE EFFECT OF AIRBNB IN THE REAL ESTATE MARKET: THE EVIDENCE IN THE OWNER-OCCUPIED SUBMARKET IN AMSTERDAM

Abstract

Airbnb is a new phenomenon and many people claim to be triggering an unstoppable growth of real estate prices. This project analyzes which part of it is true and which is the effects on prices of the owner-occupied housing market in the city of Amsterdam due to the implementation of the platform Airbnb. The analysis has consisted in geo-localizing both the houses sold since 1986 until 2018 and the Airbnb units. Taking the number of Airbnb, in two different radius, hedonic price models have been used to find the impact of it, considering the location, physical, environment and time effects of each observation. Two techniques have been used, a cross-sectional for the whole dataset and a panel data for those houses repeatedly sold during the period. Both approaches give a positive and significant effect on the housing market, which amounts from 3% to 33%, on average, depending on the method and the case chosen.

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Finally, I want to emphasize and encourage the concept of “ideas” and their flow, usually not recognized. Two minds will always be better than just one. The borders of knowledge will boost with their exchange, and it is possible to achieve it in good environments that ease it. And the best places are the university campuses and the research centres.

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1. Introduction

1.1 New phenomena in Internet

The expansion of the use of Internet has caused an important change in society: how it works, how it relates or how it behaves, and also it has come along with an increased number of entrepreneur opportunities. Examples of these deep changes are the unstoppable growth of online shopping, whose volume is higher year after year the volume is higher, and it seems to be one of the causes of the end of shopping mall era, or new communication channels, whose victims are traditional newspapers. Some sectors are facing the birth of new business concepts through online platforms, such as Uber or the same Airbnb, that are distorting behaviour of the consumers.

What makes these new platforms born due to the internet innovative is the ease to match supply and demand, which leads to a better utilization of the assets and it allows a reduction of the cost of the services. Owners of assets can participate in markets, which would have been closed otherwise, and have some income flows from them. This is the so-called Sharing Economy, defined as "*the peer-to-peer-based activity of obtaining, giving, or sharing the access to goods and services, coordinated through community-based online services*" by Sjöklint and Ukkonen (2016). Based on that, this new economic system is based on the utility that a product provides rather than the property of itself, leading to a better utilization of the asset, reducing the marginal cost and allowing fares to go down. However, the introduction of these competitors does not seem to be fair for the incumbents. While the traditional markets are highly regulated and taxed, the new actors avoid the legislation and offer the same product, or closely similar, at a lower price, thus creating disloyal competence. For instance, Guttentag (2015) described Airbnb as a disruptive innovation, which is understood as the appearance of a new product that matches with a latent demand that either was kicked out of the market due to the prices or it creates a new one. Hence, previous companies become more specialized and focus on the higher part of the market.

1.2 Changes in the society

With such change, intended as a *de facto* liberalization, companies of the same market or related submarkets may struggle to keep working. For example, Airbnb may have an impact not only in the balance sheet of the hotels, like the case of Austin, where it has been concluded that the revenues of the them in the city have dropped between 8 and 10% (Zervas G. et al. 2017), but also for employees who might have been hired in the informal market. Their rights as workers will be despised compared to those employees whose job is in a formal hotel and who are protected by collective agreements or labour unions. This means a precariousness of the labour market in the tourism industry, which has been considered to bring social prosperity from several sides (economic, physical, social, psychological, cultural and political) for years (Crouch G. et al. 1999). Yet, the quality labour market is just one that can be lowered by a misunderstanding of the Sharing Economy. However, in the case of Airbnb, the housing market, both property and rental ones, faces important changes in its conditions.

1.3 Airbnb and real estate market

But when an analysis on real estate market has to be done, hypothesizing that Airbnb has a real impact on it, the specific characteristics of the housing market must be taken into consideration. First, two products -houses- are not equal, due to the fact that they occupy space, a piece of land, which is fixed, and cannot be transported nor divided, and once this space is occupied, it is going to stay there for a long period of time and it won't be able to replace it before it is not dropped down. This means that supply is inelastic for a specific house. Second, and related to the previous attribute, houses are non-tradable goods (they are not mobile). Thus, a house in a certain city will provide a residential surface to that city, but not somewhere else. Third, the environment where the house is located has an impact on the price, which means that the supply is affected by some public goods. Fourth, the depreciation of the houses is very slow, in some cases, it is longer than four decades. Due to this length, long-term mortgages are needed and, the longer it is, the riskier it becomes. Fifth, the market adjustment period is long enough to differentiate the long and short run. The consequence of such differentiation is that, while in the long-term market leads to a match between the supply and the demand, short-term shortages that may face the housing market, such as it would be an exogenous demand shock, the market would be tensioned in the short

term. The question that arises is whether Airbnb causes an exogenous shock, either by increasing the aggregated demand, in terms of more demand for space, or by reducing residential supply, or not.

1.4 City as a consumption good

New phenomena are emerging in the society, and some of them are related to the shift of the economy from a manufactured basis to a service basis, which is affecting not only the traditional markets but also the way we live physically. Thus, cities also have become a centre of consumption, letting behind the importance of the agglomerations effects for the manufacturing sector that used to have. This means that cities are more valuable and attractive because of the amenities that have, and hence they will attract more dwellers and push up house prices (Glaeser et al. 2001). Tourists, consider as a float number of inhabitants, will prefer to go to these cities, since the touristic industry is basically to provide an experience. However, tourism is a highly space consuming industry. This leads us to think about the consequences of tourism and how it can stress some markets that are exclusive to a specific input (space). And this is the case, where land is a rival good, and either it can be used for tourists or dwellers, which enters in the core business of Airbnb.

Since the liberalization of the airline market in the last 70s in America, and after that in the 90s in Europe, fares have decreased (Kahn A. 1988), and this seems to have triggered a growth in the number of tourists. Rey, Myro and Galera (2011) found that an increase of 10% of low-cost carriers passengers would increase 0.2% the number of per capita tourists in Spain. Many cities are facing problems due to the number of tourists and their negative externalities. Examples of them are Amsterdam, Barcelona or Berlin. The huge affluence of tourists detracts daily life of citizens in some historic neighbourhoods, which become noisy and dirty, and residents may lose shops and local facilities to make space for stores and businesses focused on tourists. These cities try to avoid beginning the vicious circle that led Venice to be the paradigm of a touristic city that Russo (2002) explained.

1.5 Tourists against dwellers

Besides factors such as noisy neighbourhoods or crowded spaces, it may appear also a process of substitution of the inhabitants by richer people called gentrification. While cities become centres of consumption and keep expanding, and so does the commuting time spent to reach the city centre, costs of construction seem not to decrease, upper and middle-upper classes will prefer to relocate themselves in the older zones. This would cause a renewal them at the expense of affordable housing and pushing up the standard of living, while expelling the lower classes from them (Smith N. 1979). It is a process that can be accelerated with tourism, because neighbourhoods become unaffordable for common people and consumer-oriented places, attracting retailers and entertainment industries, as it happened in Vieux Carre and Abasto (Gotham K. (2005) and Skoll G. et al. (2014)). And that is the problem that the location of Airbnb may trigger: demoted neighbourhoods close to the city centre, which tend to be those with strong multicultural character and bohemian life, are seen as a new touristic attraction that pushes up prices of amenities and thus expels lower income classes.

1.6 The purpose of this project

Thus, this research project tries to shed some light in this complex world of new platforms, substitution of incumbents for an informal economy that is hard for the administrations to have control on, the insatiable attractiveness of cities and the continuous growth of tourism. The introduction of new technologies is such a big change of paradigm in all fields of the current society that it is an act of responsibility to contribute to understand either the positive and negative effects of it and to identify the winners and the losers of it, and to give a bunch of possible solutions.

Amsterdam is one of the best cities to analyse. Its reputation, which causes an attraction of more people and capitals, is motivating a continuous growth, while its historical centre keeps attracting more and more tourists that have had the opportunity to fly with cheaper flights. The birth of new platforms might help to change the uses for what a building was built to other ones, cutting down the surface for living spaces and pushing up prices.

Therefore, the research question is to determine whether the introduction of Airbnb in the city of Amsterdam has caused an increment of prices in the owner-occupied housing market. In case to be so, how big has the impact been? Is there any different effect on pricing houses

if the Airbnb listed around is an entire house or only a room? Or is the effect different if the Airbnb listed is able at the market for less than 60 days? In section 2, it will be presented a literature review, mostly focused on possible causes that affect prices in real estate its supply. Section 3 consists of data and the methodology, which consisted in geolocalizing the transactions performed by a NVM broker in the city of Amsterdam since 1986 and considering the growing number of Airbnb in the surrounding area. In section 4, the results of several models, applying either cross-sectional and panel data techniques, will be presented. Section 5 will consist of the synthesis and the discussion, while the 6 will consist of the conclusions, recommendations and conclusions.

2. Literature review

2.1 Hedonic price model in real estate

The real estate market is different from the others due to product differentiation. Thus, houses' value is affected by many variables: from the composition of the house to the environmental attributes. Hedonic price models are useful to quantify the value of a specific characteristic of a composed good. Yet, in 1939, Andrew Court realized the price differentiation of cars, which consist of a set of diverse components and brands, in America and developed a hedonic price index for them. Some years later, in 1966, Lancaster took a new approach of microeconomics in which argued that utility is generated due to the properties of the good, not the good in the strict sense. Based on this idea, Rosen, in 1974, mathematically theorized the hedonic price model system in which the characteristics of the composed goods could be valued in an implicit market. With such methodology, it is possible to know the marginal effect on the house price of each structural characteristic, such as the number of rooms, or surrounding aspects, such as views to the ocean or the percentage of ethnic minorities. However, Malpezzi gathered in four different big groups the characteristics that can affect housing prices: structural characteristics, neighbourhood characteristics, location within the market and contract conditions. Additionally, he also included a time variable.

2.2 Factors affecting prices

In terms of the structural attribute, Sirmans et al. (2005) analysed the most common internal, external and structural attributes used in several academic research and they found that these aspects are the lot size, square meters, number of full bathrooms, the presence of fireplace, pool, air conditioning and garage; which mostly have a positive effect on price; and the age; which most times has a negative effect on house price. But age can have a non-linear relation with the price (Goodman and Thibodeau, 1995), which means that age can cause an increase in price. This holds true when houses are very old and unique. However, not all characteristics have the same marginal value everywhere. For instance, pools have a bigger effect on house prices in the American Southwest, and square footage has greater marginal effect in Southwest and East and in the Midwest, while fireplace does not provide a significant different marginal effect along territory (Sirmans et al. 2006). Thus, houses are valued

differently due to their set of characteristics, but people as well have different valuations over the components depending on where they live. The type of houses, this is whether it is semi-detached, corner house, etc, may have a positive or negative effect on price (Fletcher, Gallimore & Mangan, 2000).

But neighbourhoods' characteristics or the environment around the house have an impact on prices as well. For instance, localized negative externalities, such as air-polluting industries, will have a negative effect on prices of houses close to them, but it does not apply with other kinds of industries (Brunell, 1985). Another negative externality is the foreclosure processes that may arise when a neighbour goes into bankruptcy (Campell et al. 2011). If the house is forced sold, it can be sending a signal to surrounding houses of their price that may reduce their value. Furthermore, a high percentage of rental houses in a neighbourhood reduces the price of real estate too (Wang, Grissom, Webb and Spellman, 1991). While the presence of ethnic minorities produces price spread in some American cities, although the gap is being reduced (Kiel and Zabel, 1996).

On the contrary, green areas, which provide leisure and regulates noise and temperature with their ecosystem, have a positive effect on prices (Morancho, 2003). Furthermore, it has been proved that people are willing to pay almost 30% more for historical buildings, which creates positive spillovers close by, and there is a premium on sales for the houses that are located in protected (Lazrak, Nijkamp, Rietveld and Rouwendal, 2014). Yet, it is important to take in consideration that tourists would prefer to be close to the touristic attraction like historical heritage and neighbourhoods are. Hence, the gentrification process stated in the previous section can be more accentuated in these kinds of zones.

People prefer to pay up to 6% more for houses located in a well-equilibrated diversity of land use, which means with different kind of functions (residential, business, leisure, retail, etc), but not densely populated neighbourhoods (Koster and Rouwendal, 2012). Also, it has been found that the diversity and fragmentation of the ecology is more valued in the urban and rural areas, where the scarcity of one of the elements makes them more desired, while not in between, where it has attracted people that do not value these elements (Georghenan et al. 1997).

Mobility is another element that has an influence on real estate prices. For instance, homes' valuation in Hong Kong was highly influenced by the accessibility to public transport (So et al. 1997). In the Netherlands, houses close to stations with better destinations are more expensive, being the effect larger in urbanized areas (Debrezion et al. 2011). Nevertheless, the design of the neighbourhoods is important to determine the price of the house. It has been found that a close connection to light rail stations, better connectivity between blocks and streets, the reduced use of cul-de-sac and the upgraded accessibility to commercial uses are preferred by people (Sond and Knaap, 2003).

2.3 Airbnb as a factor

Airbnb can be recognized as an environmental characteristic of a neighbourhood, like the number of bars or restaurants. But Airbnb is a new phenomenon and, as a consequence, there are many topics to be analysed. Lee D. (2016) presented a research in which exemplifies the problems and consequences that arose in Los Angeles due to Airbnb. Despite the zoning code that cities have under their control in order to determine the use of each parcel in the city, the transformation of spaces destined to accommodate citizens (people who live and work in the city) into short-term rent units (STR) and therefore the creation of irregular hotels is a clear violation of the norms. Besides the fact that these rooms do not pay taxes as the regular hotels do, it undermines public health regulations and public safety. Also, coding zones are designed in a way to manage the necessities that each city's activity. In this case, residential and touristic activities are different and, usually, rival.

As long as STR furnishes higher rents to households and letting apart personal characters (risk-averse people may prefer to lend the property to dwellers), it reduces the aggregated supply of space. In basic economic theory, the reduction of the supply while keeping the demand leads to an increased price of such product. In that case, less profitable houses, this means houses that have lower rents in terms of a normal real estate market, will be more attractive to transform them into Airbnb units since owners can receive higher rents. And it seems realistic that in most touristic zones and neighbourhoods this premium increases. Thus, a reduction of affordable housing in the city centres (where tend to be the most touristic part) would lead to the process of gentrification, substituting lower-income residents for higher

income and tourists. Having a look at the page insideairbnb, which provides the data of current Airbnb units in the most touristic cities in Europe, North America, Oceania and Hong Kong, it can be slightly appreciated that city centres are widely more populated than the peripheries. Moreover, Gutierrez, Garcia-Palomares, Romanillos and Salas-Olmedo confirmed in 2017 the patter centre-periphery for the locations of the Airbnb in the city of Barcelona. The generation of ghettos according to the personal income, which can be caused by the gentrified zones due to Airbnb, impede social cohesion and they trigger socioeconomic inequality. On the other hand, while it has been said that Airbnb generates income flows for the tenants, it does not look like that tourists would easily accept to go to poor and degraded zones. This means that, at the end, only the already wealthier neighbourhoods will take advantage of the income streams.

2.4 DiPascuale model

These are consequences of the market conditions of the housing market. DiPasquale and Wheaton formulated in 1992 a model for the real estate market. This model defines two markets in the real estate, which are the market for ownership (asset or capital market), and the market for space (property market). The demand for the last one comes from the firms and families, which occupy space. Both economic agents' demand will make their choice based on the opportunity cost of the rent of space, this is output for firms and consumption of other goods for families. So, the opportunity cost will vary depending on the level of the rent of the space they want to consume, with a negative relationship with the demand, and the economic conditions, with a positive relationship. Hence, the equilibrium is reached when demand and supply, which in the short term it is fixed, match.

When the rent is determined, the price in the capital markets can be calculated as well. In that case, the investors are willing to buy a stream of present and future payments if they give back a yield, which is called the capitalization rate. This rate depends basically on the long-term interest rate of the economy, the expected growth rate and the risk associated with the fact of holding real estate. Given the price in the capital market and the construction costs of new building, which it is a function of the costs, it determines the surface to be built. The last step to consider is the net quantity of new space, which is the difference between the

new space built minus the depreciation of previous constructions. Thus, the quantity of space is also the supply of the space market, where the rent is determined.

2.5 Application of the model

In the property market, rents are determined by supply, the stock of space, and demand, which depends on the economic level and long-term interest rate. If the economic growth is positive, the demand from companies and families will be greater due to a better economic performance. Tourism is a growing industry in several cities and, as it has been stated before, it is highly space consuming. Hence, the implementation of an Airbnb, which provides space for the tourists, means both a reduction of supply of residential space for a greater aggregated demand. In order to bring the market in equilibrium again, rents must go up. Based on the model presented previously, the prices in the asset market should increase. This goes in line with what Sheppard and Udell (2016) found for the city of New York, where prices of houses, during the period between 2008 and 2015, had been affected by the introduction of Airbnb. It was reported that doubling the number of Airbnb's in that city would be associated with an increase of prices between 6% and 31%.

However, the capitalization rate is an important factor in the asset market and it depends on long-term interest rate and expected growth in rents, among others. In a context of low-interest rates and low economic growth, activities that do have greater yields would receive an increasing amount of resources by the investors. If the real estate market provides higher profits than other economic assets, such as bonds or the stock exchange, the shift of the conditions in that market will lead to a higher value of the houses and thus more construction. The incorporation of more stock of square meters would cause a reduction of rents in the first market. Theoretically, there are two forces acting in opposite direction in the property market. From one side, houses will face an increment of their value. On the other side, the effect in the rental market is ambiguous. This means that if the force of the demand is higher than the yields force, rents will boost, otherwise, they will fall.

Moreover, tourism has a localized economic impact that can attract different companies for which their aim market are tourists. As this process can go along with the gentrification of a certain neighbourhood, these new amenities tend to be more expensive than the others. It is

not unusual and actually generates mistrust among local dwellers and local administrations, to witness the reoccupation of a historical bar, in which the neighbourhood environment was kept for years, by a new fancy-vintage branch coffee shop. However, it is a problem when this shift is at a large scale. Hence, neighbourhoods such as this described will finally attract a specific group of wealthy dwellers and tourists.

The framework is clear and articulated. From one side, there has been a reduction of fares in the airline industry that has boosted the tourist industry around Europe. From another side, peer-to-peer platforms have enabled the match between informal supply and latent demand and, since tourism is more profitable for property holders, there has been a relocation of the surface from residential uses to touristic uses. These effects will be stronger in iconic and central locations, because tourists prefer to go there, and where capitals will pour their investments, increasing prices and expelling dwellers. With lower inhabitants and the crowdedness of tourists, amenities will also change due to the demand's change, and for instance, local shops will make space for big international fast food chains. This would be a perfect example of the gentrification process triggered by tourism. However, it can also be interpreted as a revival of the neighbourhoods, although the result does not change, which is the exclusion of lower income people from their houses.

3. Methodology and data description

3.1 Model and assumptions

According to DiPascuale's theory, either a growth of demand or a decrease of supply, keeping constant the counterpart, will cause an increase of prices in the real estate market (if capitalization rate keeps constant). However, it is also important to consider the capitalization rate, which is a financial variable that represents the possible yields of the investment, considering the expectations of the market in terms of both economic growth and interest rate. Having said that, the exogenous part of this capitalization rate affects all houses at the same time and in the same strength and it only varies according to the characteristics of each house. This means that all houses face the same interest rate and the same income growth, but it varies across different houses due to its location, etc.

Each house will then have a number of Airbnb around, and they will act as a signal of income streams that can be obtained by listing the house on the platform. A huge number of Airbnb units can be interpreted in two ways. The first one is that is a very attractive location for a touristic activity and hence the value of the place is higher, because the monthly rent is de facto reduced (since part of the expenses of the monthly "mortgage" is paid by the tourism, either if list the whole apartment or just a room on Airbnb), and as a consequence demand will go up. The second interpretation is that the supply of housing space dedicated to inhabitants has decreased. This holds in an owner-occupied real estate market.

Thus, the best way to catch the effect of having Airbnb units, considering them as environmental factors, surrounding a house is by using a hedonic price model. Moreover, thanks to the big amount of data that the research has had (and which will be explained followingly), two technics will be used. First, a cross-sectional data model that will use all observations occurred in Amsterdam. Then, a panel data model, which will take only those houses that have been solved several times.

3.1.1 The models

The models will consist of the logarithm of the price of each house that has been sold in Amsterdam as a dependent variable. The independent variables will consist of structural

characteristics of the house (log of square meters, number of bedrooms, lift, type of apartment and house, whether it is a monument, whether it has a garage and year of construction), location characteristics (distance to the closest park, distance to the closest business park, which is understood as a source of employability, distance to the city centre, which has been decided to be Dam Square, distance to the closest mass public transport (metro or tram), distance to a historical building and whether it is on a busy road), neighbourhood control (a dummy for the neighbourhood where the house is located, and which captures all fixed effects of the neighbourhood), and year control (dummy for the year that the house has been transacted, which captures the fixed effects of the year). Finally, the last variable that will be included, and which is the most important one, is the number of Airbnb units that there are around the house and the characteristics of these Airbnb units (percentage of Airbnb with high availability, percentage of Airbnb that are entire houses, and percentage of Airbnb considered to be expensive and cheap), which will be used as robustness checks. The model has been formalized as:

$$lnPrice_i = \beta_1 numAirbnb_i + \beta_2 pA_i + \beta_3 C_i + \beta_4 X_i + \beta_5 Y_i + \beta_6 A_i + u_i$$

Where pA_i are the percentage of entire houses, high availability, expensive or cheap Airbnb units, C_i is a matrix of the structural characteristics, X_i is a matrix of the distance characteristics of the house (which have already been said previously), the Y_i is the dummy for the year that the house has been transacted (from 1986 to 2018) a and A_i is the dummy for one of each 480 neighbourhood in which the city is divided.

The dummies for the year of transaction and neighbourhood will let us construct a quasi-fix effect model. Although panel data only exists for the fact that the same individual is analysed in several periods, with this method the unobservable fix effects of neighbourhoods and years that affect at the same time all the houses that have been transacted in a certain year and period will be controlled.

Thus, adding the variables such as the location within the city and the dummies for every neighbourhood, we control for the centrality of the house. For instance, it will be explained the reason why a house near Dam Square will be more expensive or attractive for the tourism

industry than a house with the same physical characteristics in Diemen. Also, adding the time dummy allows controlling for the financial market conditions that are equal for all transactions and affect all houses

3.2 Data explanation

The dataset consists of all transactions of houses occurred in the city of Amsterdam from 1986 until 2018 and that have performed by NVM, the Dutch Association of Real Estate and whose members represent the 75% of the real estate agents in the Netherlands. It is composed by over 160.000 observations, each of it with the physical characteristics that the house has: squared meters, number of bedrooms, classification of the house according to NVM's criteria and period of construction.

However, transactions with a lower value of 35.000 euros and over 1.500.000 have been eliminated due to the low representativeness of these observations. On the other hand, houses smaller than 26 square meters and over 515 have also been eliminated. This reduces the data set to 150.385 observations. Finally, those observations that had more than 20 rooms have been eliminated, remaining 150.382.

Each house and each Airbnb unit listed at the end of 2017 and provided by insideairbnb have been geolocalized using QGIS. Followingly, all transactions have counted the number of Airbnb units had within a radius of 250 meters and 500 according to the year occurred. Other researchers, such as Sheppard and Udell (2016), use up to 1000 meters for the city of New York, but Amsterdam is a much smaller city both in terms of population and extension. For instance, a house sold in 2015 has counted the number of Airbnb that had until 2015. Since the webpage insideairbnb do not provide an entering or an exiting date, it has been taken the date of the first entering of the host (who is the person that lists the house at the platform) and the houses are cumulative. This means that a unit listed for the first time in October 2011, it will be listed for the rest of the years but not before.

The research has also considered the heterogeneity of the Airbnbs listed. For instance, there are some that do not rent the house for more than 60 days, or just rent a room, instead of the entire house. Thus, the same procedure has been used in these cases. Each transaction

has counted the number of Airbnb around according to the availability (listed either more or less than 60 days, which is the legal limit that the City Council of Amsterdam allows), the type of the unit (either entire house or just the room) and the price. In the last case, it has been considered as expensive those units with a price higher than 224€ per night, which is the 95th higher quintile, and cheap those units with prices lower than 75€, which is the 5th lower quintile. Finally, to get a deeper insight in the analysis, it has been taken the ratio between the number of Airbnbs according to each characteristic (prices, entire homes or private rooms and availability) and the total number of Airbnb units around.

Moreover, the squared number of Airbnb units in both radiuses have been included. Since Airbnb can bring income to the owners but massive tourism is associated to negative and localized externalities for the neighbourhood, there might be a certain point in which costs are higher than benefits, for which houses will be less attractive and prices will decrease.

Finally, In the case of panel data, the same ID has been given to all observations that had the same address, plus the same number, plus the same door, plus the same square meters. The timely series used for the panel data has been in a monthly base because there have been some observations that had been sold more than one time in less than a year.

In this table, there are the descriptive statistics for the most important variables used.

Variable	Obs	Mean	Std. Dev	Min	Max
Price	150.382	265.757	184.243,40	35.000	1.500.000
m2	150.382	88,5809	40,49416	26	515
Total250	150.382	11,35023	33,2258	0	349
Total500	150.382	42,71551	112,691	0	958
_pEntire250	46.364	0,7516606	0,2554844	0	1
_pEntire500	53.363	0,6515953	0,3072469	0	1
_pHigh250	46.364	0,4328843	0,2578616	0	1
_pHigh500	53.363	0,3988265	0,2435345	0	1
_pCheap250	46.364	0,1429076	0,2250855	0	1
_pCheap500	53.363	0,1400577	0,2073155	0	1
_pExpensive250	46.364	0,0945957	0,1406959	0	1
_pExpensive500	53.363	0,0796223	0,0999809	0	1
Num bedrooms	150.382	3,2746	1,3575	0	20
Distance to Dam	150.382	3.497,14	2.132,88	102,4942	11.904,37
Distance to Park	150.382	317,4505	230,2038	0,6013857	6.586,07

Distance to Historical Building	150.382	1.743,86	1.775,70	2,795514	8.725,74
Distance to Business Park	150.382	1.296,13	697,4349	2,647914	7.078,99
Distance to Public Transport	150.382	439,7182	671,6536	10,45768	7.622,48

4. Results

First, the cross-sectional models will be analysed. Four models have been run, two for each radius and two more considering the whole dataset, this means since 1986, or only taking the period that Airbnb began in Amsterdam (2010). This distinction has been made to ease the interpretation with the robustness checks. Due to the structure of the data, the percentages regarding the characteristics of the Airbnb units around, those houses with 0 observations disappear, and this holds for any house sold before 2010 because Airbnb didn't exist in Amsterdam before this date.

4.1 Cross-sectional data

The results are presented in table 1. Model 1 and 2 present the results for the number of Airbnb units in 250 meters, while 3 and 4 the results for 500 meters. Model 1 and 3 take all observations since 1986, while model 2 and 4 only take since 2010. In 4 cases, the effect of the number of Airbnb in both radiuses is positive and significant. On the other hand, the square number of Airbnb units is also significant, but negative. This leads us to think there is a marginal negative relationship: an Airbnb listed close by a house can be seen as a way to reach more income. However, every new unit will produce a lower increase in price, reaching a moment in which the costs of a new Airbnb will exceed the benefits. Taking the average results for 2017 (the last completed year), a house in Amsterdam had on average almost 88 units in 250 meters, while circa 300 in 500 meters. According to these results, it represents an increase in the house between 31% and 9.7%, ceteris paribus. All models have been controlled for each and for each neighbourhood to avoid endogeneity problems, as well as for year.

Table 1

VARIABLES	Model 1	Model 2	Model 3	Model 4
num of Airbnb in 250 meters	0.00360***	0.00153***		
	(5.17e-05)	(5.22e-05)		
sq. num of Airbnb units in 250 meters	-1.10e-05***	-4.77e-06***		
	(2.55e-07)	(2.18e-07)		
num of Airbnb in 500 meters			0.00120***	0.000498***
			(1.49e-05)	(1.72e-05)
sq. num of Airbnb units in 500 meters			-1.19e-06***	-5.00e-07***
			(2.18e-08)	(2.20e-08)

lnm2	0.780***	0.776***	0.780***	0.775***
	(0.00242)	(0.00345)	(0.00242)	(0.00345)
Lift	0.0518***	0.0446***	0.0510***	0.0444***
	(0.00162)	(0.00239)	(0.00161)	(0.00239)
Num of Bedrooms	0.0148***	0.0208***	0.0148***	0.0209***
	(0.000743)	(0.00124)	(0.000742)	(0.00125)
Historical Dummy	0.0184***	0.00635	0.0176***	0.00568
	(0.00421)	(0.00592)	(0.00421)	(0.00593)
Distance to Dam	-9.45e-05***	-9.43e-05***	-8.87e-05***	-8.84e-05***
	(7.84e-06)	(1.11e-05)	(7.80e-06)	(1.11e-05)
Square Distance to Dam	6.22e-09***	6.01e-09***	5.80e-09***	5.59e-09***
	(7.34e-10)	(8.64e-10)	(7.24e-10)	(8.58e-10)
Parking	0.0174***	0.00535***	0.0172***	0.00532***
	(0.00125)	(0.00205)	(0.00125)	(0.00205)
Distance to Park	-8.08e-05***	-8.19e-05***	-8.11e-05***	-8.16e-05***
	(4.98e-06)	(6.81e-06)	(4.97e-06)	(6.82e-06)
Distance to Employment	-1.38e-06	2.83e-06	-1.36e-06	2.11e-06
	(3.40e-06)	(4.76e-06)	(3.38e-06)	(4.75e-06)
Distance to Historical Building	6.35e-06	-9.23e-06	8.61e-06	-7.28e-06
	(6.31e-06)	(9.09e-06)	(6.28e-06)	(9.06e-06)
Distance to Public transport	3.40e-05***	3.10e-05***	3.39e-05***	3.04e-05***
	(4.65e-06)	(6.61e-06)	(4.63e-06)	(6.61e-06)
BusyRoad	-0.0378***	-0.0443***	-0.0371***	-0.0438***
	(0.00217)	(0.00308)	(0.00218)	(0.00309)
Constant	7.434***	9.794***	7.433***	9.792***
	(0.0420)	(0.0664)	(0.0419)	(0.0670)
Observations	150,382	61,991	150,382	61,991
R-squared	0.928	0.920	0.928	0.919

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Some robustness checks have been run, where the percentages of surrounding Airbnb have been included for both radiuses. The models are in table 2 and 3 in the following pages. All models (1-14) suggest that there is a positive and significant relationship between the number of Airbnb units that are located around the house. However, the most complex models (the 7th and the 14th), the impact decreases compared to the previous models. For instance, the number of Airbnb units in 250 meters changes from the previous 0,00153 to 0,000457. Now, the same average house in Amsterdam in 2017, which has almost 88 units around, is 3,4% more expensive due to Airbnbs, ceteris paribus. The same happens with the estimator of the 500 meters radius, which goes from 0,000498 to 0,000307. In this case, the average house (2017) is 9% more expensive, c.p.

It is interesting as well to analyse the explanatory parameters of the Airbnbs. In the case of 250 meters radius, the only significant estimator is the one that gives the percentage of the

Table 2

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6	(7) Model 7
num of Airbnb units in 250 meters	0.00482***	0.00525***	0.000408***	0.000450***	0.000453***	0.000451***	0.000457***
	(5.27e-05)	(4.88e-05)	(7.15e-05)	(6.83e-05)	(6.84e-05)	(6.84e-05)	(6.84e-05)
sq. num of Airbnb units in 250 meters	-1.23e-05***	-1.32e-05***	-1.27e-06***	-1.61e-06***	-1.61e-06***	-1.61e-06***	-1.62e-06***
	(2.58e-07)	(2.42e-07)	(2.57e-07)	(2.40e-07)	(2.40e-07)	(2.40e-07)	(2.40e-07)
% of Entire Airbnb in 250 meters	-0.0290***	-0.0520***	0.0271***	0.0106***		0.0101***	0.00200
	(0.00555)	(0.00521)	(0.00493)	(0.00372)		(0.00389)	(0.00453)
% of High availability Airbnb in 250 meters	-0.0871***	-0.0957***	-0.00104		-0.00406	-0.00148	-0.00276
	(0.00460)	(0.00429)	(0.00416)		(0.00347)	(0.00363)	(0.00367)
% of Expensive Airbnb in 250 meters	0.164***	0.0201**	0.119***				0.00862
	(0.0100)	(0.00866)	(0.00835)				(0.00728)
% of Cheap Airbnb in 250 meters	-0.144***	-0.0434***	-0.113***				-0.0176***
	(0.00675)	(0.00633)	(0.00607)				(0.00529)
lnm2	0.908***	0.790***	0.864***	0.774***	0.774***	0.774***	0.774***
	(0.00481)	(0.00418)	(0.00446)	(0.00392)	(0.00392)	(0.00392)	(0.00392)
Lift	0.0709***	0.0524***	0.0481***	0.0493***	0.0492***	0.0493***	0.0493***
	(0.00384)	(0.00329)	(0.00345)	(0.00283)	(0.00283)	(0.00283)	(0.00283)
Num of Bedrooms	0.0201***	0.0232***	0.0252***	0.0258***	0.0258***	0.0258***	0.0258***
	(0.00178)	(0.00156)	(0.00168)	(0.00149)	(0.00149)	(0.00149)	(0.00149)
Historical Dummy	0.132***	0.0251***	0.0864***	0.00224	0.00261	0.00230	0.00240
	(0.00294)	(0.00797)	(0.00275)	(0.00688)	(0.00687)	(0.00688)	(0.00688)
Distance to Dam Square	6.84e-06**	-8.59e-05***	-4.23e-05***	-0.000108***	-0.000107***	-0.000108***	-0.000108***
	(2.68e-06)	(1.49e-05)	(2.48e-06)	(1.32e-05)	(1.32e-05)	(1.32e-05)	(1.32e-05)
sq. Distance to Dam Square	-8.67e-11	7.34e-09***	3.57e-09***	8.02e-09***	7.93e-09***	8.03e-09***	7.98e-09***
	(2.77e-10)	(1.21e-09)	(2.56e-10)	(1.08e-09)	(1.08e-09)	(1.08e-09)	(1.07e-09)
Distance t Park	-4.13e-05***	-0.000104***	-1.51e-05**	-8.05e-05***	-7.97e-05***	-8.06e-05***	-7.88e-05***

	(6.17e-06)	(9.46e-06)	(6.22e-06)	(8.21e-06)	(8.21e-06)	(8.21e-06)	(8.24e-06)
Distance to Empoyment	-2.92e-07	4.69e-06	-1.45e-05***	1.77e-06	2.55e-06	1.85e-06	1.56e-06
	(2.12e-06)	(7.25e-06)	(1.85e-06)	(6.17e-06)	(6.18e-06)	(6.18e-06)	(6.18e-06)
Distance to Historical Building	-6.15e-05***	-7.18e-06	-9.56e-05***	-2.73e-05**	-2.74e-05**	-2.74e-05**	-2.59e-05**
	(2.39e-06)	(1.28e-05)	(2.17e-06)	(1.11e-05)	(1.12e-05)	(1.11e-05)	(1.12e-05)
Distance to Public Transport	-3.61e-05***	5.00e-05***	-6.22e-05***	3.08e-05***	3.01e-05***	3.07e-05***	3.07e-05***
	(2.48e-06)	(9.50e-06)	(2.34e-06)	(8.13e-06)	(8.13e-06)	(8.13e-06)	(8.13e-06)
Busy Road	-0.0596***	-0.0446***	-0.0590***	-0.0460***	-0.0459***	-0.0460***	-0.0459***
	(0.00443)	(0.00388)	(0.00401)	(0.00347)	(0.00346)	(0.00347)	(0.00346)
Constant	8.790***	9.430***	9.464***	9.922***	9.927***	9.923***	9.924***
	(0.139)	(0.0980)	(0.106)	(0.0825)	(0.0824)	(0.0825)	(0.0826)
Control for year	No	No	Yes	Yes	Yes	Yes	Yes
Control for Neighbourhood	No	Yes	No	Yes	Yes	Yes	Yes
Observations	46,364	46,364	46,364	46,364	46,364	46,364	46,364
R-squared	0.836	0.893	0.866	0.916	0.916	0.916	0.916

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3

VARIABLES	(8) Model 8	(9) Model 9	(10) Model 10	(11) Model 11	(12) Model 12	(13) Model 13	(14) Model 14
num of Airbnb units in 500 meters	0.00132***	0.00146***	0.000295***	0.000317***	0.000314***	0.000318***	0.000307***
	(1.64e-05)	(1.51e-05)	(2.26e-05)	(2.14e-05)	(2.14e-05)	(2.14e-05)	(2.15e-05)
sq. num of Airbnb units in 500 meters	-1.00e-06***	-1.08e-06***	-3.27e-07***	-3.22e-07***	-3.19e-07***	-3.22e-07***	-3.13e-07***
	(2.28e-08)	(2.11e-08)	(2.69e-08)	(2.48e-08)	(2.48e-08)	(2.48e-08)	(2.49e-08)
% of Entire Airbnb in 500 meters	0.193***	0.208***	0.0381***	0.0354***		0.0300***	0.00504
	(0.00364)	(0.00323)	(0.00637)	(0.00414)		(0.00437)	(0.00564)
% of High availability Airbnb in 500 meters	-0.0311***	-0.0412***	-0.000694		-0.0278***	-0.0184***	-0.0196***
	(0.00498)	(0.00482)	(0.00534)		(0.00423)	(0.00448)	(0.00451)
% of Expensive Airbnb in 500 meters	0.211***	-0.0630***	0.180***				0.0185*
	(0.0152)	(0.0119)	(0.0132)				(0.0103)
% of Cheap Airbnb in 500 meters	0.0545***	0.177***	-0.124***				-0.0395***
	(0.00590)	(0.00566)	(0.00651)				(0.00561)
lnm2	0.906***	0.792***	0.868***	0.776***	0.777***	0.777***	0.777***
	(0.00451)	(0.00394)	(0.00420)	(0.00369)	(0.00369)	(0.00369)	(0.00369)
Lift	0.0687***	0.0489***	0.0509***	0.0479***	0.0476***	0.0479***	0.0478***
	(0.00350)	(0.00306)	(0.00314)	(0.00260)	(0.00260)	(0.00260)	(0.00260)
Num of Bedrooms	0.0176***	0.0202***	0.0228***	0.0229***	0.0229***	0.0229***	0.0230***
	(0.00163)	(0.00142)	(0.00155)	(0.00137)	(0.00137)	(0.00137)	(0.00137)
Historical Dummy	0.122***	0.0218***	0.0802***	0.00581	0.00706	0.00659	0.00643
	(0.00291)	(0.00767)	(0.00264)	(0.00642)	(0.00643)	(0.00643)	(0.00643)
Distance to Dam Square	-1.70e-06	-9.13e-05***	-4.05e-05***	-9.94e-05***	-9.67e-05***	-9.94e-05***	-9.57e-05***
	(2.50e-06)	(1.35e-05)	(2.33e-06)	(1.20e-05)	(1.20e-05)	(1.20e-05)	(1.20e-05)
sq. Distance to Dam Square	8.13e-10***	8.77e-09***	3.24e-09***	6.94e-09***	6.90e-09***	7.05e-09***	6.91e-09***
	(2.50e-10)	(1.05e-09)	(2.30e-10)	(9.31e-10)	(9.37e-10)	(9.32e-10)	(9.29e-10)
Distance t Park	-4.71e-05***	-0.000108***	-1.99e-05***	-7.89e-05***	-7.69e-05***	-7.86e-05***	-7.67e-05***
	(5.66e-06)	(8.74e-06)	(5.45e-06)	(7.49e-06)	(7.49e-06)	(7.49e-06)	(7.49e-06)
Distance to Empoyment	1.91e-06	1.07e-05*	-1.10e-05***	1.81e-06	1.78e-06	2.10e-06	2.32e-06

	(1.91e-06)	(6.22e-06)	(1.68e-06)	(5.33e-06)	(5.35e-06)	(5.33e-06)	(5.33e-06)
Distance to Historical Building	-7.00e-05***	-1.98e-05*	-8.47e-05***	-1.24e-05	-1.45e-05	-1.29e-05	-1.39e-05
	(2.17e-06)	(1.13e-05)	(2.02e-06)	(9.88e-06)	(9.89e-06)	(9.88e-06)	(9.86e-06)
Distance to Public Transport	-5.18e-05***	4.64e-05***	-6.45e-05***	2.98e-05***	3.13e-05***	3.11e-05***	3.07e-05***
	(2.05e-06)	(8.56e-06)	(1.87e-06)	(7.29e-06)	(7.31e-06)	(7.30e-06)	(7.30e-06)
Busy Road	-0.0572***	-0.0439***	-0.0547***	-0.0437***	-0.0434***	-0.0436***	-0.0435***
	(0.00427)	(0.00370)	(0.00388)	(0.00331)	(0.00332)	(0.00331)	(0.00331)
Constant	8.652***	9.271***	9.449***	9.865***	9.895***	9.873***	9.888***
	(0.0975)	(0.0760)	(0.0724)	(0.0631)	(0.0636)	(0.0632)	(0.0628)
Control for year	No	No	Yes	Yes	Yes	Yes	Yes
Control for Neighbourhood	No	Yes	No	Yes	Yes	Yes	Yes
Observations	53,363	53,363	53,363	53,363	53,363	53,363	53,363
R-squared	0.837	0.893	0.868	0.918	0.918	0.918	0.918

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

cheaper units. In this case, it is negative, which leads us to think that these units attract tourists of a lower category, whose negative externalities are higher. This effect is also seen in the 500 meters radius. Thus, the impact of the Airbnb is reduced. High availability units, which can be considered to be acting as informal hotels that avoid regular local legislation, also has a negative and significant impact. In this case, the externalities of this kind of Airbnb reduces the impact of prices. Finally, expensive units have a positive and significant impact. This lets us think that, on the contrary of cheaper Airbnbs, these units attract better tourism. In the appendix, there are the graphs of the error distribution of the model 7th and 14th.

4.2 Panel data

Now, the panel data models will be presented. Four models for each radius have run, this is, one for fixed effects, one for random effects, one with just the number of Airbnb units around and finally another one with the characteristics of the Airbnbs. Of course, each pair of fix effects and random effects model have been checked with Hausman tests and in the four cases, the result has been no significant difference. Thus, only fix effects models will be plot.

Table 4

VARIABLES	250 meters Model 1	500 meters Model 2	250 meters Model 3	500 meters Model 4
Num of Airbnb units	0.00355***	0.00107***	4.38e-05	0.000116
	(0.000177)	(5.16e-05)	(0.000334)	(8.91e-05)
sq num of Airbnb units	-1.14e-05***	-1.01e-06***	-1.60e-07	-6.76e-08
	(8.82e-07)	(7.68e-08)	(1.24e-06)	(1.03e-07)
% of Entire Airbnb			0.0366	0.00204
			(0.0263)	(0.0263)
% of High availability Airbnb			0.0117	0.00306
			(0.0209)	(0.0208)
% of Cheap Airbnb			0.0256	-0.00130
			(0.0318)	(0.0262)
% of Expensive Airbnb			-0.0345	-0.000371
			(0.0408)	(0.0416)
lnm2	0.796***	0.797***	0.728***	0.733***
	(0.0202)	(0.0201)	(0.0904)	(0.0777)
Lift	0.00716*	0.00685*	0.00205	0.0176
	(0.00415)	(0.00415)	(0.0165)	(0.0144)
Num of Bedrooms	0.00541***	0.00542***	0.0449***	0.0294***
	(0.00182)	(0.00182)	(0.00858)	(0.00732)
Constant	7.923***	7.963***	9.605***	9.972***
	(1.407)	(1.405)	(0.390)	(2.895)

Observations	21,526	21,526	3,080	3,826
R-squared	0.911	0.911	0.818	0.799
Number of newid	9,289	9,289	2,240	2,749

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In table 4, the results for the fix effect models can be seen. In this case, model 1 and 3 are for 250 meters radius, while 2 and 4 are for 500 meters radius. The first two models only have the number of Airbnb in each radius and the correspondent squared. These models keep the results of the previous ones, which means that the number of Airbnb has a positive and significant effect on the prices. Even more, it confirms the negative marginality of these effects, thus meaning that the greater the number is, the lower the effect of another one. Now, the average house of Amsterdam (with 88 and 300 units in 250- and 500-meters radius, respectively) is 30% and 31% more expensive due to the Airbnb.

Nevertheless, when the characteristics of the Airbnb are included, the effects switch to not significant, although they are positive. However, both the R^2 and the number of observations (in this last case especially) are reduced.

Most of the models that have been presented show a positive and significant relationship and the range of the impact goes from 3.4% to 31% higher prices in the average house (2017), cp. The last two models, although they have all the controls, some observations have been lost.

5. Discussion

5.1 Research result

The results are in line to what Sheppard (2016) found for the city of New York. The introduction of the Airbnb is an explanatory variable for the increase of prices that the city of Amsterdam is facing right now. Having controlled for distances and neighbourhood fix effects, it has been proved through several models and techniques that Airbnb acts as a sign of the yields that short-term rental market for tourists produces. Hence, either small or big investors are able to see the higher rent they get for their real estate property and how easy it is (just by listing on internet), so they can decide to list it on the informal economy that, at aggregated levels, it changes the normal conditions of the market.

These higher rents at the property market, either for an increased demand or a reduction of supply, are transferred in a determinant point to the asset market. Considering the exogenous factors of the capitalization rate (because they affect all yearly transactions in the same way) constant, it pushes up real estate prices in Amsterdam. In the longer term, these higher prices should push up as well as the construction of new houses, boosting the stock of space, increasing the supply and hence reducing the rents. However, this is a long-term prediction according to DiPascuale model.

On the other hand, the marginal effect of an Airbnb unit is lower time after time. The squared number of Airbnb variable, negative and significant in all models, makes that the negative externalities of tourism overcome the income streams produced. However, this turning point is very high.

Also, some characteristics of the composition of the Airbnb units around have a small effect on prices. In the case of cross-sectional data, in 250 meters models, only the variable that represents the ratio of cheap Airbnb over the total has a significant, although negative, effect. This might be due to the fact that cheaper Airbnb units attract lower category tourists, reducing the income stream and increasing the negative externalities. In the case of 500 meters, the ratios that become significant are all except the entire house one. While cheap Airbnb keeps negative (like in 250 meters) and expensive ones are positive and significant

(due to higher income streams that can overcome the negative effect of tourism), high availability ratio, representing those that are listed more than 60 days (thus not following the rules of the City of Amsterdam and hence acting as an informal hotel), is also negative and significant. In this last case, the costs of tourism reduce the positive revalorization that a certain house can have due to the signalling coming from the number of Airbnb units around.

These effects can be seen in two ways. From one side, it is negative for those that want to buy a new property for living, because it reduces their capacity to acquire it. Also, it reduces the affordability for those that want to rent it. However, it is also good for those that already own a house. Since they have an asset that has been revalorized, their wealth is also greater (which is called as income effect). Also, those that have listed an Airbnb unit have income streams that would not have had otherwise. In this case, wealth is better distributed through different layers of the society.

Having said the direct effects of high prices in the housing market, there are adjacent consequences that must be considered too. Although it has been stated that Airbnb produces an income to those that list, there are other people that do not list properties and. Therefore, the costs that they face, caused by the negative externalities of tourism, increases. Crowdedness, reduction of daily amenities, more expensive life in terms of bars, etc, may expel them from their neighbourhood, what causes a loss of personality in the long term. This can also cause a monocultivism of just one economic activity, something that policymakers try to avoid. Venice is an example of these negative effects.

Uncontrolled, massive and informal tourism do have a direct effect on public administration balance sheets. For instance, more people mean more security spending, more cleaning services and more public transport (in the case of bigger cities) that are not defrayed by these tourists because they are hosted in Airbnb. Since they are outside of the regular systems, such as hotels, it makes more difficult to make them pay the taxes.

Hotel chains can also be affected by this unregular tourism. If Airbnb units are more affordable than hotel rooms, there can be a part of this market that decides to go to Airbnb instead of hotels. Still, there are some cases, such as Barcelona, that both the public administration and

the private sector have joined forces to create a company in charge of a good marketing campaign for the city. This is something good for both parts because the hotels will host higher level people, while the city will be rewarded with a better reputation. This arises a problem of moral hazard since there is a part of the private sector that decides to take advantage of the good job, the good reputation that attracts tourism, of other companies with participating in the costs, the cost of the campaign or the agency. On the other hand, the reputation for which the hotels and the public administration have been paying for can be hurt by the negligent behaviour of Airbnb units.

Other layers of the society can be negatively affected by Airbnb units. Many services, such as the cleaning ones, can be hired in the informal market, lowering their rights as workers and thus increasing the inequality. Moreover, if we take into consideration that those that own a house tend to be in better economic position. Additionally, social cohesion can be hurt if the neighbourhoods become ghettos due to income levels, something that already exists because of ethnic or minority ghettos and that policymakers are aware of.

Finally, the tourist's rights are reduced, since they are not protected by laws. For instance, there are no quality controls for those units listed.

5.2 Policy recommendations

Many aspects could be improved in terms of economic policy. Transforming older buildings with non-residential uses in the city centre to residential uses would allow a reduction of the pressure that the real estate market faces. These new housing could be promoted by the public administration. Along with that, the city council should ensure that non-touristic stores locate there, as well as open some public amenities. This would allow poorer people to go to the city centre and reduce gentrification. However, the public administration should make clear that these houses are for people and not allow them to become Airbnb units. Close to the previous one, it could help to reduce prices increasing the construction of new homes, as well as higher (then from a small plot, many square meters are put in the market).

Another solution would be to legalize a certain number of short-term rental units in each neighbourhood, being able to track then the economic activity and recollect the taxes of it.

Those that are not been legalized could be strongly chased by the law. This should be a decision taken along with the platforms, who should open their database to control it easily. Following this decision, the opening of Airbnb outside the city centre (always under control) could be promoted, which would bring also the positive part of tourism to those neighbourhoods.

On the side of the demand, the government could try to reduce the number of tourists that arrive by applying higher touristic taxes. This idea is not that unrealistic as it might seem. Certainly, in macroeconomic theory, when the economy seems to be overheating, either central bank should increase the interest rate or government should reduce the spending (or increase taxes) to cool down the economy. The final idea is to cool down the demand.

Finalising the public policy recommendations, making cheaper the construction of buildings could also be a good solution. New materials and new techniques are being introduced with this idea. One of these materials could be the tinder, is already being used in some cities, such as London, which could be promoted in big scale, along with prefabricated houses. At the same time, this could also help to develop other parts of the country or world. It has been stated before that a house is not tradeable. However, it could enlarge local economies in, for instance, the poorer part of the Netherlands or in some poor country if these places “lodge” a housing factory for Amsterdam.

5.3 Further research

In terms of research, I would suggest introducing the financial conditions of the mortgage contracts. In this way, it would be easy to determine whether the effect is due to a higher demand or to a lower supply of space. Also, it could be interesting to see how the introduction of the Airbnb affects the inequality, either if it reduces or increases. It is one of the arguments of those that are in favour of these new platforms. This research could be focused not only on wealth distribution of the incomes but as well the impact of labour market or little stores in touristic zones. In case it happened the same as in the housing market, reducing the capacity of entrepreneurs to open in certain zones of the city, which means reducing their impact, would mean that only the multinationals are able to compete.

6. Conclusions

In this research, it has been proposed to analyse whether the introduction of the Airbnb platform in the Amsterdam has triggered an increase of prices in the real estate market as like Sheppard (2015) found for New York. It also proposed to see, in the case to be positive, which is the amount of the impact and if the heterogenic characteristics of the Airbnb affected differently.

To do so, all the transactions occurred in the city since 1986 and performed by any broker of NVM have been used and have been calculated the number of Airbnb units in 250- and 500-meters radius. The number of Airbnb has been taken as a signalling of possible income streams in the touristic market. Thus, this number is an environmental factor that, considering the hedonic price model, and using cross-sectional and panel data models, it has been possible to find the marginal effect on real estate prices.

Having controlled for time and location fix effects, for the location and for the physical characteristics of the houses, the results show that the effect is positive and significant. Taking the average number of Airbnb for each house sold in Amsterdam in 2017, the effect ranges from 3.4% to 31% increase prices, cp. Adding the percentage of Airbnb units according to certain characteristics, such as entire houses Airbnb or expensive ones, results keep positive and significant, although not in panel data. This might be caused by a lower number of observations. In this last case, the dataset with more than 160.000 observations is reduced to only 2749 observations. Most of them are just two observations of the same house.

Finally, the recommendations for policymakers that have been proposed might be useful to solve the problem of unaffordability of housing that might be facing Amsterdam, or other cities that are being affected by this new phenomenon, such as Barcelona or Berlin.

7. Limitations

This research has some limitations due to the lack of data. Although endogeneity problems have been solved by adding controls for neighbourhood and year, and all the controls, a deeper understanding of whether the increase of prices is caused either by a reduction of supply or an increase of demand could be established. This would have been easier if it had been possible to achieve the terms of the mortgage or the rent paid per month.

On the other hand, Inside Airbnb, where the data of the Airbnb comes and whose data used in this project was updated during December 2017, do not provide when the units were listed or if there were units that were listed at a certain point but had already been taken out. This means that the picture provided by the web is that on December 2017 there were 17.849 Airbnb units listed in the city of Amsterdam, from which a part of those listed that day, there were units listed for the first time from 2009 until 2017. For the first problem, it has been solved by considering the date that the host signed on the platform. This is a valid hypothesis since most of the units are linked to a host that has only one unit. For the second issue, it has been hypothesized that once one Airbnb is listed, it is never unlisted anymore. In this sense, Airbnb is cumulative (in 2017 there are the units listed in 2017 plus those listed before). Nevertheless, due to the structure of the data, there might be an overestimation of the effect of the Airbnb, because an effect that was caused at a certain moment by 10 units of Airbnb, it will appear as if it was done by 5 units. However, other pages, such as dwarshuis.com, provide an evolution of the implementation of the Airbnb in several cities (one of them is Amsterdam) and, also considering pretty hard to see the evolution of the implementation, the amount of Airbnb no more available seems low. On the contrary, if it was the case, it would be a small and marginal number.

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9. Appendix

The variables used for the model and their source are explained:

-**Ln of Price**: It is the price of the transaction in logarithms. The source is NVM

-**totalAirbnb250**: number of Airbnb units around a house within a radius of 250 meters. The source is a combination of NVM and insideAirbnb.com.

-**total250_2**: squared number of Airbnb units around a house within a radius of 250 meters. The source is a combination of NVM and insideAirbnb.com.

-**totalAirbnb500**: number of Airbnb units around a house within a radius of 500 meters. The source is a combination of NVM and insideAirbnb.com.

-**total500_2**: squared number of Airbnb units around a house within a radius of 500 meters. The source is a combination of NVM and insideAirbnb.com.

-**_pEntire250**: percentage of Airbnb units that are a full house within a radius of 250 meters. The source is a combination of NVM and insideAirbnb.com.

- **pEntire500**: percentage of Airbnb units that are a full house within a radius of 500 meters. The source is a combination of NVM and insideAirbnb.com.

-**_pHigh250**: percentage of Airbnb units that are listed on Airbnb more than 60 days per year within a radius of 250 meters. The source is a combination of NVM and insideAirbnb.com.

-**_pHigh500**: percentage of Airbnb units that are listed on Airbnb more than 60 days per year within a radius of 500 meters. The source is a combination of NVM and insideAirbnb.com.

-**_pCheap250**: percentage of Airbnb units that are cheaper than 72 euros within a radius of 250 meters. The source is a combination of NVM and insideAirbnb.com.

-**_pCheap500**: percentage of Airbnb units that are cheaper than 72 euros within a radius of 500 meters. The source is a combination of NVM and insideAirbnb.com.

-**_pExpensive250**: percentage of Airbnb units that are more expensive than 225 euros within a radius of 250 meters. The source is a combination of NVM and insideAirbnb.com.

-**_pExpensive500**: percentage of Airbnb units that are more expensive than 225 euros within a radius of 500 meters. The source is a combination of NVM and insideAirbnb.com.

-**lnm2**: square meters of the house sold in logarithms. The source is NVM.

-**Lift**: dummy whether the house has a lift.

-**Number of bedrooms**: the number of bedrooms that the house sold has. The source is NVM.

-**Year of Construction**: dummy that classifies in which year was built the house sold. The groups are “before 1500”, “1500-1905”, “1906-1930”, “1931-1944”, “1945-1959”, “1960-1970”, “1971-1980”, “1981-1990”, “1991-2000” and “after 2001”. The source is NVM.

-**Year of transaction**: dummy that classifies in which year the house was sold. The years are from 1986 until 2018. The source is NVM.

-**Type of house**: dummy that classifies what type of house or apartment is the house sold. The groups are “Terraced”, “Semi-Detached”, “End of corner”, “Detached”, “Duplex”, “Ground Floor apartment”, “First Floor apartment”, “Multiple Floors apartment”, “Aparment with closed of stair section”, “Apartment with outside entrance”, “Special Care apartment”, “Ground and First Floor apartment”. The source is NVM.

-**Historical Dummy**: this is a dummy that classifies whether the house sold is a historical building. The source is a combination of NVM and data.amsterdam.nl (City Council Amsterdam).

-**Neighborhood**: dummy that classifies in which of the 388 neighborhoods the house sold is located. It is the smallest administrative division that the City Hall of Amsterdam does. The source is data.amsterdam.nl (City Council Amsterdam).

-**Parking**: dummy that specifies if the house sold has a parking. The source is NVM.

-**Busy road**: dummy that specifies if the house sold has is on a busy road. The source is NVM.

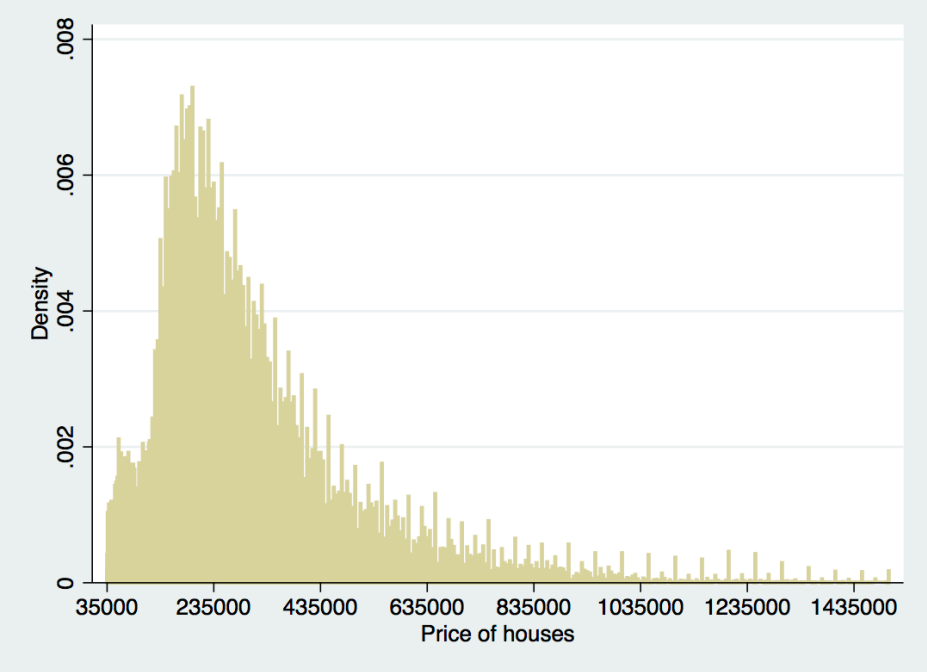
-**Distance to Park**: this is the distance to the closest park from the house sold. The source is data.amsterdam.nl (City Council of Amsterdam).

-**Distance to Dam** and **Dam2**: this is the distance and the distance squared to the center of the city, Dam Square. It is important to have the second parameter, as people want to be close to the center but not in the proper center, as it tends to have negative and localized externalities.

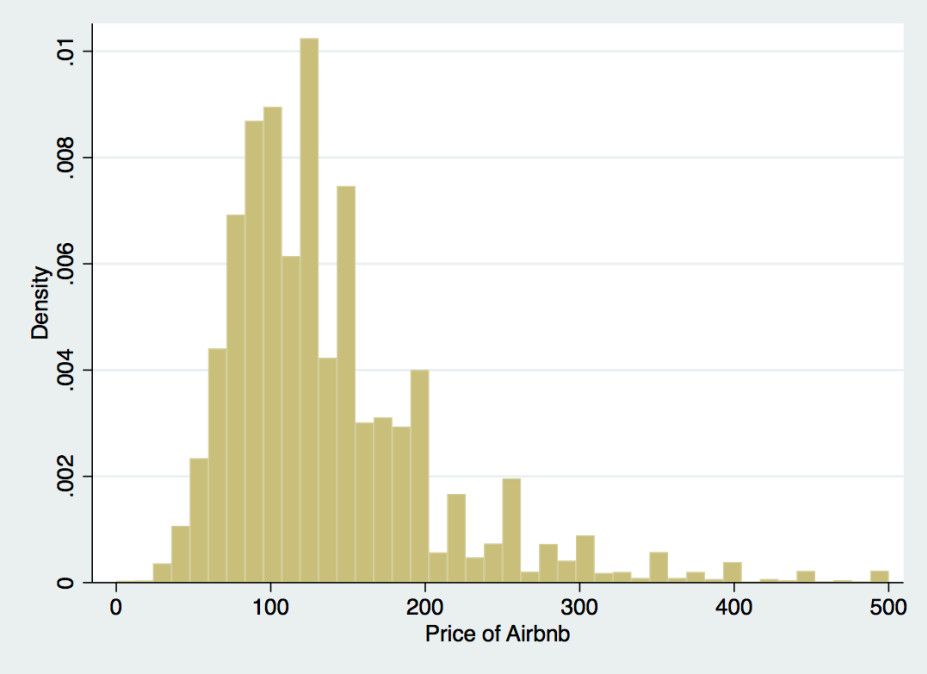
-**Distance to Historical Building**: this is the distance to the closest historic building that the house sold has. The source is data.amsterdam.nl (City Council of Amsterdam).

-**Distance to Business Park**: this is the distance to the closest business park (as a measure of job source) that the house sold has. The source is data.amsterdam.nl (City Council of Amsterdam).

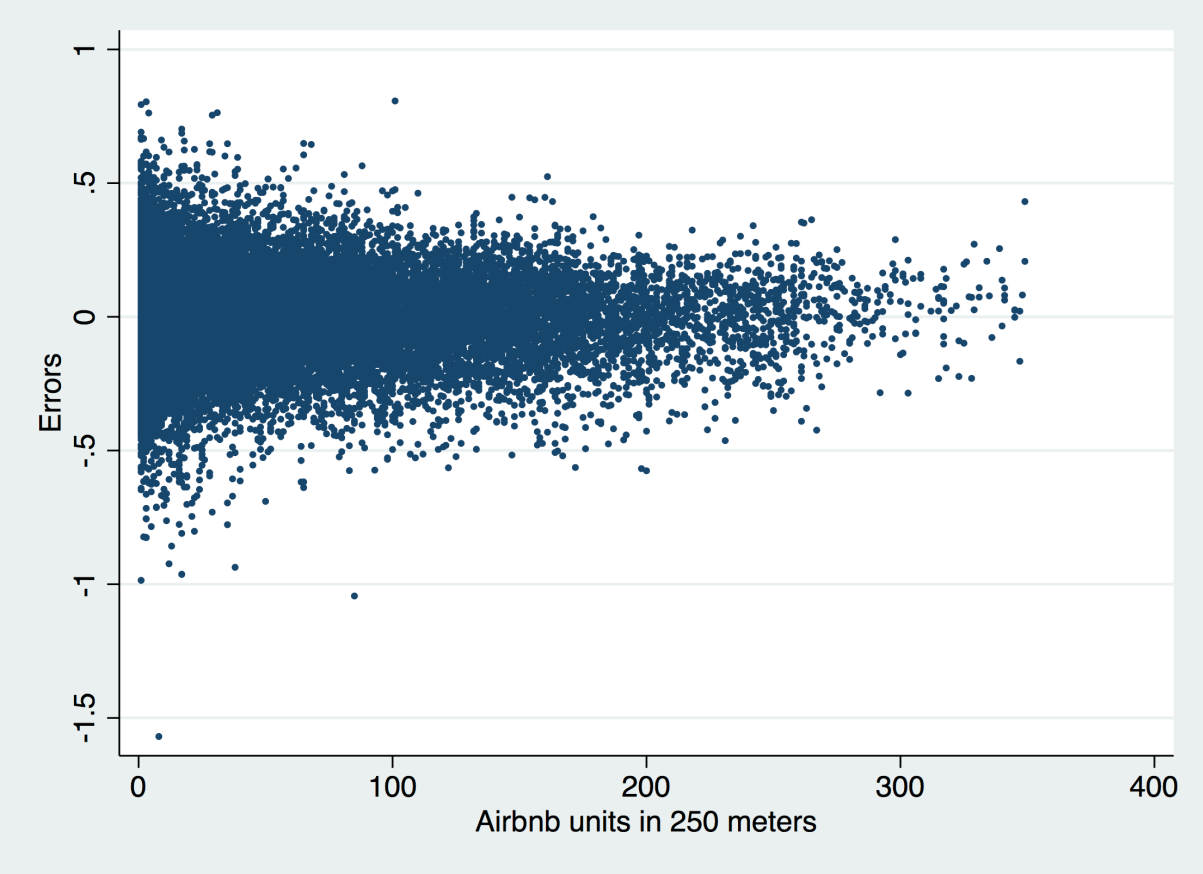
-**Distance to Public Transport**: this is the distance to the closest tram or metro that the house sold has. The source is data.amsterdam.nl (City Council of Amsterdam).



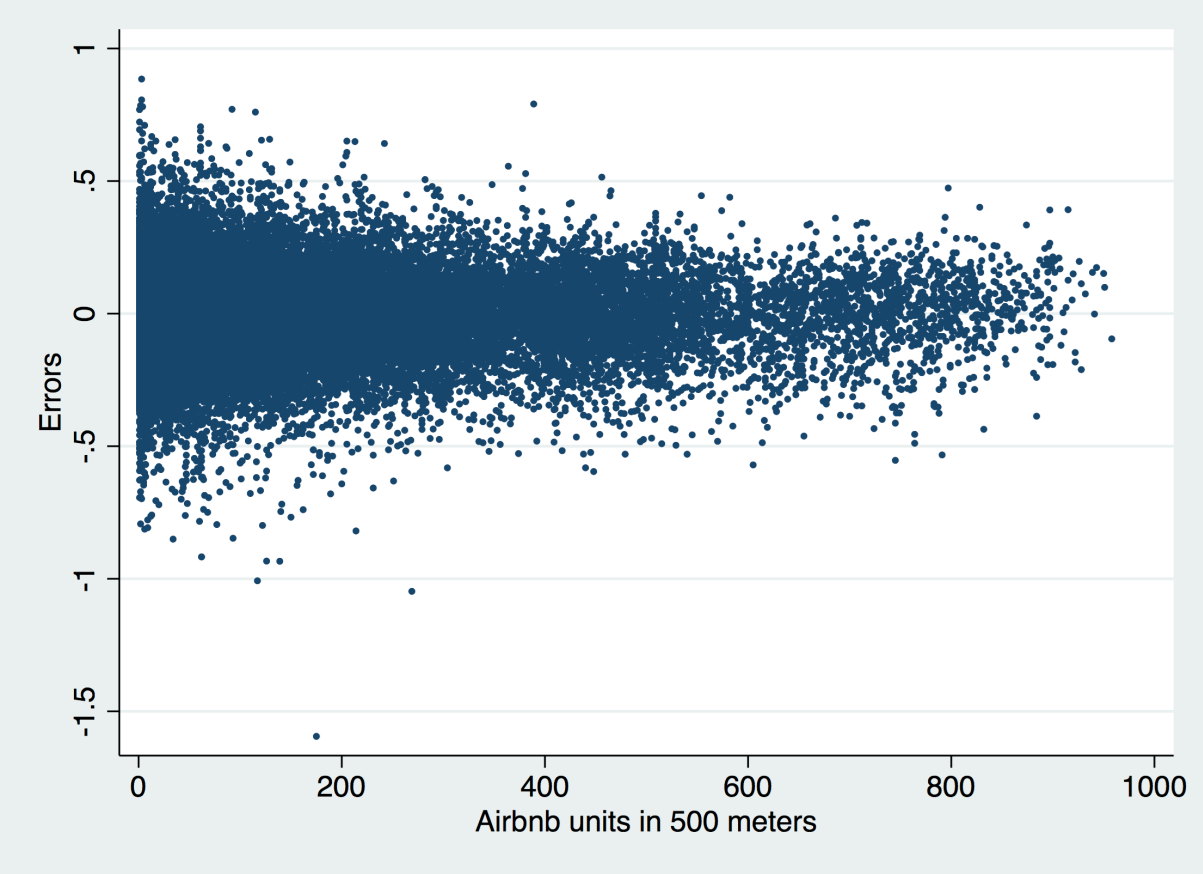
Graph 1: Distribution of the prices of houses



Graph 2: Distribution of the prices of Airbnb



Plot 1: Error distribution of the 7th model



Plot 2: Error distribution of the 14th model