Airbnb in Amsterdam: An empirical analysis effect of providing evidence of Airbnb activity on a potential positive housing prices in Amsterdam

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AIRBNB IN AMSTERDAM

An empirical analysis providing evidence of a potential positive effect of Airbnb activity on housing prices in Amsterdam

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Abstract

During an ongoing housing crisis in Amsterdam one potential determinant of the increase of housing prices is further analysed: Airbnb activity. Airbnb potentially increases housing prices by generating extra demand for housing to rent to tourists, and decreasing housing supply for residents because these houses are used to hosts travellers. Listing on Airbnb is interesting as potential profits are high. With less housing supply and more demand for housing, housing prices increase. Furthermore, Airbnb increases disposable income by increasing tourism, leading to more income available to spend on housing, Lastly, Airbnb hosts sometimes renovate houses, increasing the value of houses further. In the city centre these effects are heightened due to a lower increase of housing supply and extra demand for Airbnb listings. To research this phenomenon the central question in this paper is: *To what extend did Airbnb increase housing prices in Amsterdam in the time period of 2015-2019?*

Most papers researching the effects of Airbnb on the housing market have a bigger scope as Europe or the United States. This paper zooms in on one particular city: Amsterdam, in order to further estimate economic effects of Airbnb listings in one city. This paper can help policy makers identify the potential increase of housing prices through Airbnb and construct policy dampening the negative effects of Airbnb, while still keeping most of the benefits.

This thesis uses multiple fixed effects regression models to estimate the effect of Airbnb on the housing market. Amsterdam is divided over 22 GGW-areas which are used as research subject. The dependent variable in this thesis is WOZ-value, and the independent variable is the number of Airbnb listings. Housing supply, number of households, unemployment rate, and disposable income are added as control variables. As robustness checks social housing and maintenance level of houses are added. These variables have a low number of observations, thus could not be included in the primary models. To estimate the effect of Airbnb listings on the city centre of Amsterdam an interaction effect is added.

This thesis estimates that on average Airbnb activity increased the housing prices in Amsterdam between 2015-2019 with 3.4% and 13.9% in the city centre, identifying a potential increase of Airbnb listings on housing prices in Amsterdam. To lessen this effect building more houses, only allow a limited number of listings and increased enforcements are recommended. This thesis is mostly limited by a low amount of data and having limited insight in the mechanisms underlaying the effect of Airbnb on housing prices.

Table of contents

1. Introduction

In 2023 a housing crisis is one of the most prominent crises in the Netherlands (Boztas, 2023), during this time Airbnb has been taking the tourism market by storm and became the biggest short-term rental company of the world (Crommelin et al., 2018). In the Netherlands rent has increased with 12% on average and house prices with 47% in the period of 2015-2020 (CBS, n.d.). As the housing prices soar, middle incomes can no longer find affordable housing and are stuck between the expensive free rental sector and the high house prices (Boelhouwer, 2020; Nijskens et al., 2019). The consequences of the housing crisis are noticeable in 2023, since 2019 the number of homeless people has doubled, and a quarter of renters struggle to pay rent (Boztas, 2023) In eleven years, Airbnb grew to a worth of 31 billion dollars and is available in 81,000 cities across the globe in 191 countries (Thun, 2022; Sherwood, 2019). The correlation between the rise of Airbnb and the increase of housing prices around the globe has been fuel for discussion. Evidence suggests that Airbnb did increase housing prices, but also increased local economic activity. (Reichle et al., 2023; Lee, 2016; Balampanidis et al., 2020; Segu et al., 2020). During covid tourism decreased (NOS, 2022). Therefore, the Airbnb debate became less important. After covid tourism quickly rose again, and in 2022 the number of tourists in Amsterdam is higher than before the covid-19 pandemic (NOS, 2022), reopening the debate of regulating Airbnb to decrease the potential increase of housing prices due to Airbnb.

Housing prices remain high in The Netherlands. Housing prices in capital cities have an even higher tendency to overshoot, and spill over to other areas of the country (Nijskens et al, 2019). because the housing market in big cities is more sensitive to interest rates and credit conditions. If investments conditions are favourable less housing is built for middle-incomes and more for higher incomes because of higher profits possible from higher-income housing. Forcing middle incomes to look for housing elsewhere in the country slowly increasing housing prices because they are able to pay more than the locals elsewhere in the country. High living costs are a main problem in Dutch society and big cities have a ripple effect on the rest of the country. (Nijskens et al., 2019).

Amsterdam is one of the cities which has struggled with Airbnb for some time. Since 2018, the municipality has introduced several policies to limit the number of Airbnb listings. However, the policies had did not dampen the negative effects of Airbnb sufficiently, such as the perceived unfair competition in the housing market (NOS, 2021a). Schmid and Vols (2022) have even identified Airbnb as one of the causes of the housing crisis in Amsterdam. However, no empirical proof has yet been found that the activities of Airbnb have increased the housing prices in Amsterdam. Therefore, the main research question in this paper is**:** *To what extend did Airbnb increase housing prices in Amsterdam in the time period of 2015-2019?*

This thesis tries to assist policy makers in composing policy based on scientific evidence of the effects of Airbnb on the housing market. Extra evidence helps policy makers to compose efficient and effective policies to tackle the negative effects of Airbnb their cities face. This is not only important for Amsterdam, but also other cities which want to impose regulations on Airbnb. Secondly, housing protests are common in the Netherlands and can destabilize society (Boelhouwer, 2020). Even though a housing crisis is a complex phenomenon that cannot be solved by a single policy, gaining insight on the potential role of Airbnb in the housing crisis can help to decrease the urgency of the problems on the housing market.

Amsterdam especially is an interesting case because it is the capital city of the Netherlands, which has a unique housing market. Most research about the effect of Airbnb on housing prices has been done on macro scale on Europe or the United States. No reflective research has been done on Amsterdam or a North-European country or city (Lee, 2016; Crommelin et al, 2018; Farronato & Fradkin, 2018). Amsterdam has a highly regulated housing market with a high percentage of social housing, strict tenant protection and tax cuts for home-owners. The strong tenant protection means that increasing rent is limited by law and kicking someone out is only

possible through a judge (Nijskens et al., 2020; Schmid & Vols, 2022). This could lead to extra increase of housing prices due to renting on Airbnb being less regulated, giving the hosts less obligations (Guttentag, 2015). The Netherlands also has a high percentage of social housing compared to other European countries as seen in figure 26 in appendix. The Netherlands has 30% of social housing in 2019 compared to the average of 12% Europe (Napoli et al., 2022). Amsterdam has 41% social housing in 2019, identifying the higher-than-average social housing not only compared to Europe but also to the Netherlands. Potentially influencing the effect of Airbnb on the housing market.

The scientific relevance of this thesis is due to Amsterdam having strong regulations and the use of different methods and data compared to other papers (e.g., Segu et al., 2020 and Reichle et. al., 2023). Firstly, the data used in this thesis differs from other papers. This thesis uses more precise data compared to other papers. No micro analysis has been done smaller than city areas, while this paper zooms in further on almost neighbourhood level. This provides insight on the effect of Airbnb housing prices more clearly. Thirdly, the data provided in this paper is governmental data, while other papers use public databases to assess housing prices. Governmental data is more reliable than the databases used in other papers as Segu et al., (2020) and Reichle et al. (2023) used data citizens had to fill in themselves leaving room for possible errors. The governmental data is more reliable because the government needs reliable data to tax properly. Fourthly, this paper makes a clear distinction between the city centre of Amsterdam and other areas. Reichle et al. (2023) and Segu et al. (2020) did not define the city centre. Fifthly, this thesis also has housing supply data in comparison to other papers which did not.

In what follows, a literature review and theoretical framework will first be presented. Then the methodology of the research will be introduced, followed by the results of the analysis. This thesis ends with a conclusion and policy recommendations based on the findings.

2. Literature review

First literature is reviewed concerning the Dutch housing market and Airbnb. Identifying different aspects of both the Dutch housing market, Airbnb and how they are intertwined. In the theoretical framework the mechanisms identified in the literature are combined to form a theoretical framework identifying the mechanism through which Airbnb potentially increases housing prices in Amsterdam.

2.1. Dutch housing market

Figure 1

Allocation of the Dutch housing market between 2012-2022.
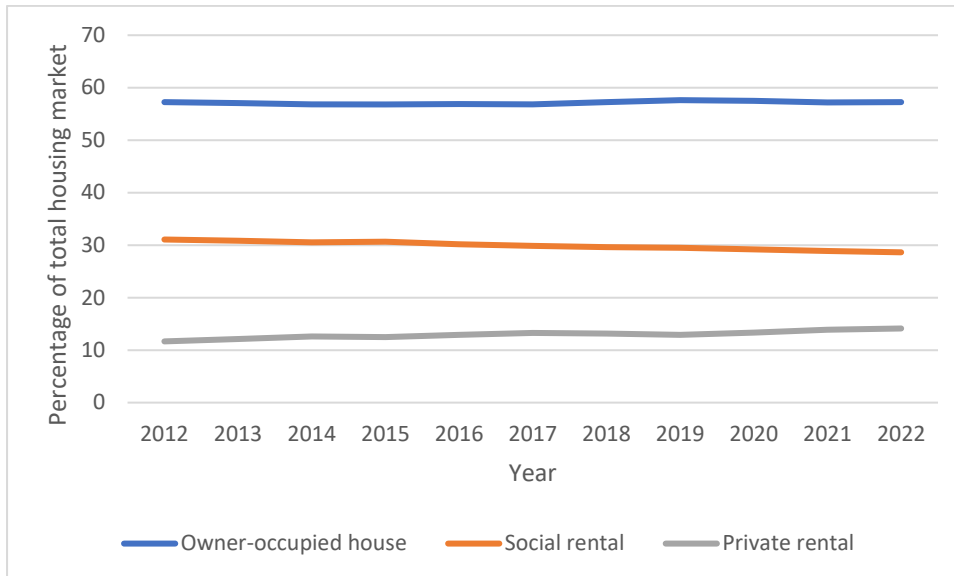
As seen in figure 1, The Dutch housing market is a mix of social housing, private rentals and owner-occupied houses. Most housing on the Dutch housing market are owner-occupied, on average 57% between 2012-2022. Dutch home owners can get a tax break if they have a mortgage for one house, people with multiple houses can only get a tax break for one of them, resulting in low housing costs for owner-occupiers. Which incentives buying a house (Boelhouwer, 2020). The rental market consists of social housing and private rentals. Social housing makes up most rental housing with averagely 30%, and 13% on average are private rentals. As seen in figure 1, social housing is slowly decreasing due to government policy only focusing on housing lower incomes, liberating the market (Schmid & Vols, 2022).

Social housing has a maximum amount of rent; all houses with a rent lower than this amount are classified as social housing (Waarderingskamer, n.d.a). The actual amount of rent depends on points gained from facilities, such as size, private bathroom and garden, but the rent for a house classified as social housing cannot be set above a maximum price. If houses have more points than the maximum amount the houses are no longer classified as social housing and the rent is no longer limited (Waarderingskamer, n.d.a). Landlords are then free to decide on the price. To be eligible for social housing a household income has to be below 44.035 euro for

singles and 48.625 euro for multi-person households in 2023 (Woningregio Utrecht, n.d.), which is around the average disposable income of households in the Netherlands of 46.800 euro (CBS, 2022). Furthermore, the waiting lists for social housing are on average 7 years in the Netherlands (NOS, 2021d), indicating that there is insufficient social housing supply available to house all eligible households. Private rentals on the other hand do not have a maximum price, which often leads to high housing costs (Boelhouwer, 2020).

Figure 2

Average house prices in the Netherlands over 2000-2022.
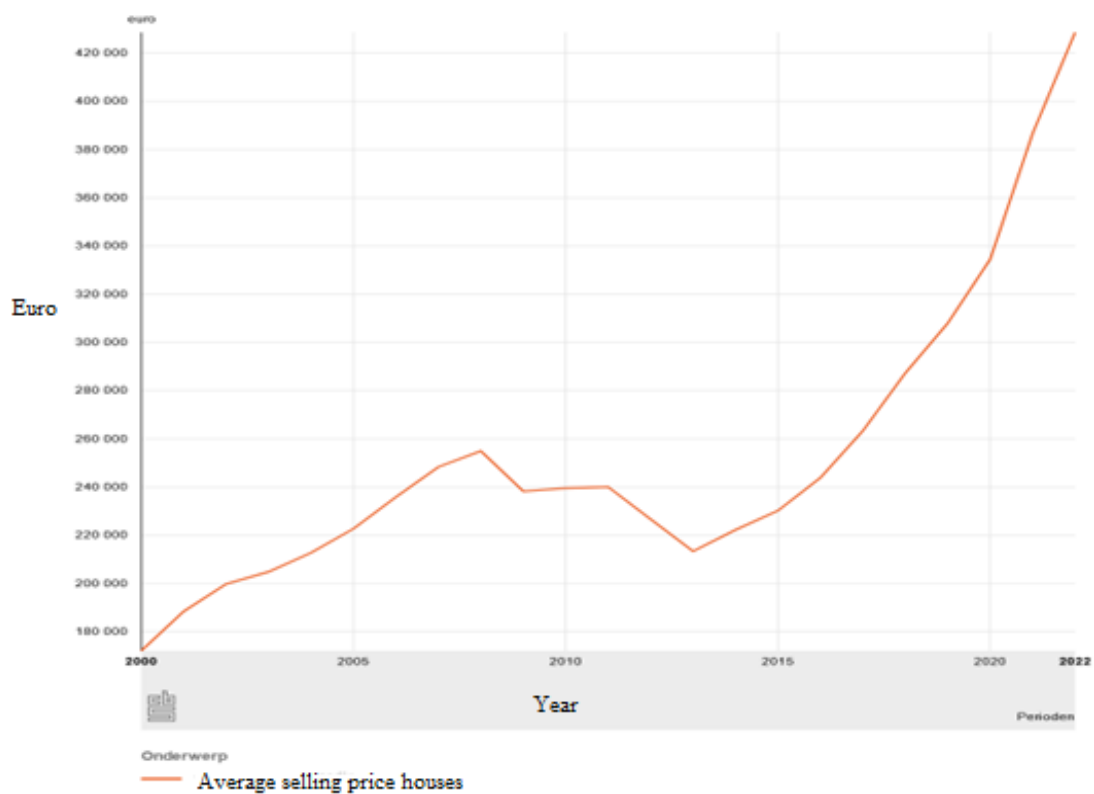
Note. Edited figure based on CBS, n.d.

Figure 3

Rental prices per m2 in the Netherlands over 2011-2022
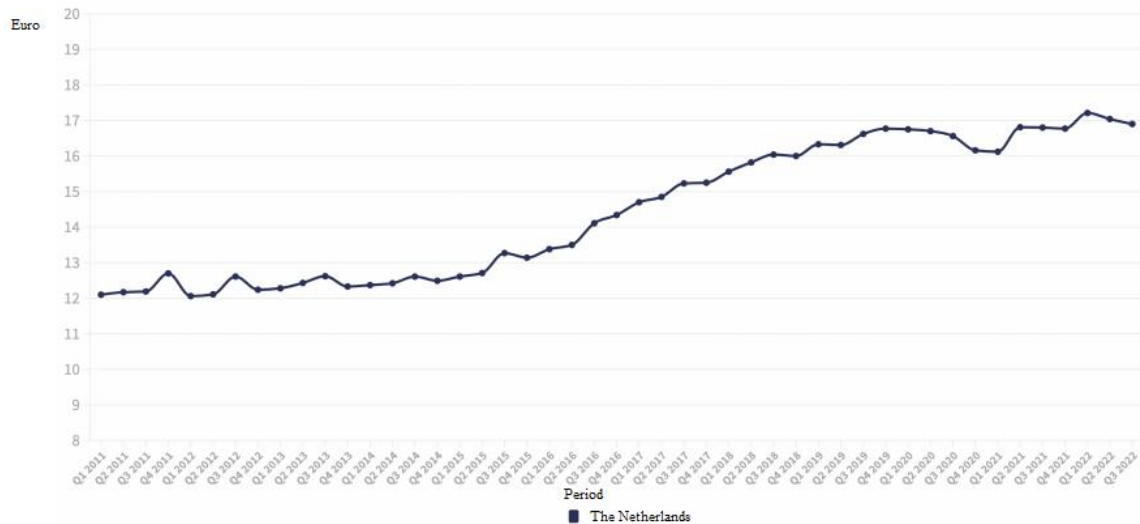
Note. Edited figure based on Pararius, 2022.

Figure 2 shows that in the Netherlands house prices have increased tremendously and almost doubled since 2013 (CBS, n.d.). Rental prices also increased a bit later from 2015 onward. Rental prices also show a substantial increase of 30% over 2015-2022, as can be seen in figure 3 (Pararius, 2022). Which is a lot higher than the approximately 1% of rental increase between 2011-2015. This is problematic for mostly the middle incomes who have difficulties paying housing costs (Boelhouwer, 2020; Jansen-Jansen & Schilder, 2015; Nijskens et al., 2019; Schmid & Vols, 2022). Since 2008 government policy changed resulting in stricter rules to obtain a mortgage. This left households with less resources to buy a house, leading middle incomes to be stuck between the high rental prices and high house prices, and with less resources to buy a house (Boelhouwer, 2020; Schmid & Vols, 2022; Jansen-Jansen & Schilder, 2015).

Figure 4

Housing supply and number of households in the Netherlands over 2012-2019
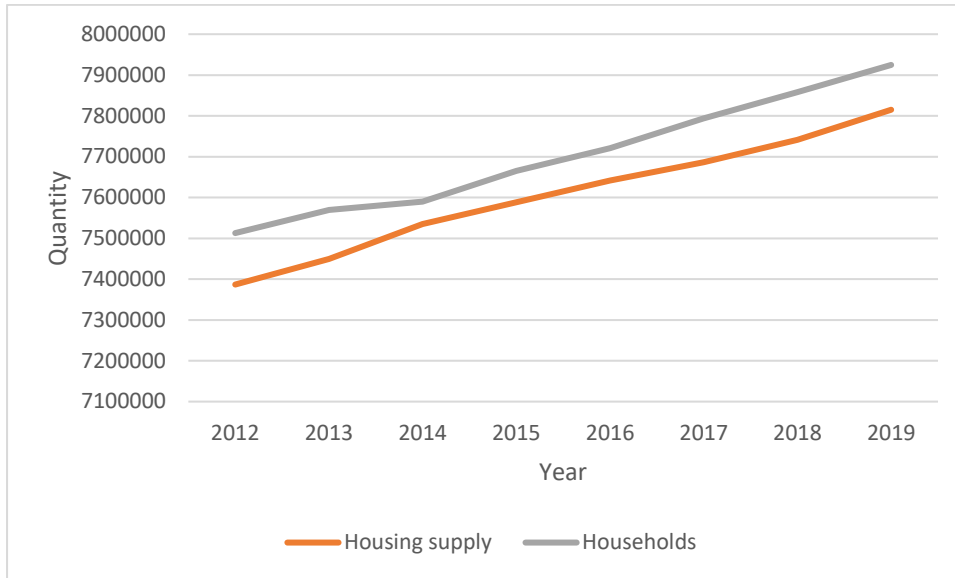
Another development in the housing market has been the tightened housing construction regulations resulting in increased time spent on obtaining licences to construct houses (Boelhouwer, 2020; Jansen-Jansen & Schilder, 2015). As seen in figure 4 housing supply increased slow during 2012-2019. Increase of housing supply has been in decline since 2013. The annual housing construction output in the period 2000-2008 was on average 79,000 homes (Boelhouwer, 2020). From 2013 till 2018 there was a sharp decline, on average 50,000 homes were built. Housing supply has not increased enough due to a lack of sustainable land, and bureaucracy surrounding licences (Nijskens et al., 2019; Schmid & Vols, 2022). The number of households on the other hand increased in this period, mostly due to a high level of immigration, flexible millennials and expats (Boelhouwer, 2020; Nijskens et al., 2019). This is visible in figure 4 as the gap between the number of households and housing supply increased over time. These developments resulted in a housing shortage of 3.2% in 2018.

Extra demand created by an increase of households while housing supply lagged behind lead to an increase of housing prices (Boelhouwer, 2020). Housing is also increasingly seen as an investment product to rent to tourists and residents. These further increases demand for houses, which worsens the housing crisis (Nijskens et al., 2019). While the number of households increased extra due to immigration (Boelhouwer, 2020). Because short-term housing supply is

very inelastic, prices rise directly as a sudden demand for housing increases (Nijskens et al., 2019). Thus, housing prices have increased due to less houses built and an unexpected increase of households. Investors increasing demand for housing extra due to profits to rent to tourists or tenants, resulting in difficulties to obtain a house for middle incomes as supply did not increase and the means were insufficient.

2.2. Housing market in Amsterdam
Figure 5

Allocation of housing in Amsterdam over 2011-2021
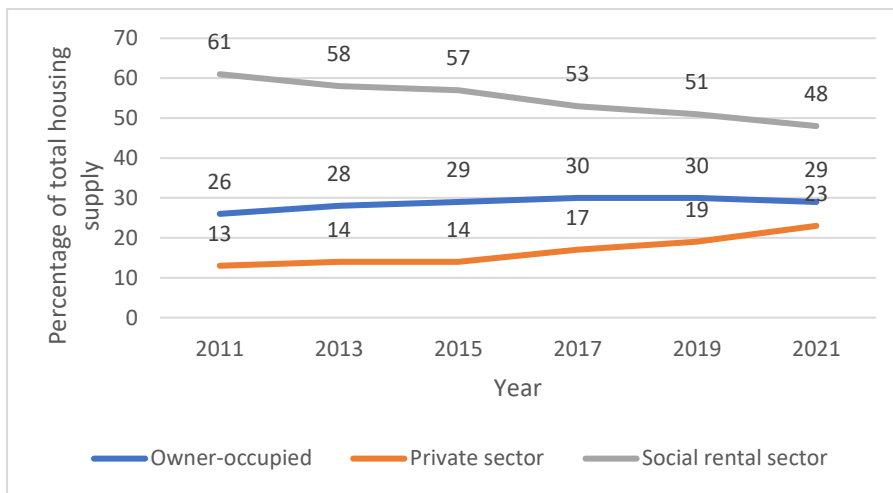
Note. Figure made with data provided by Gemeente Amsterdam, 2023a

Figure 6

House prices in Amsterdam between 2005-2019
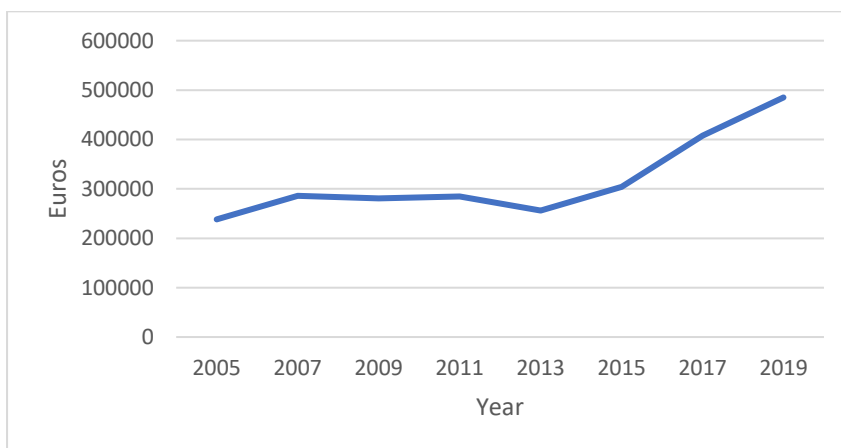
Note. Figure made with data provided by Gemeente Amsterdam, 2023a

Figure 7

Rental prices in Amsterdam between 2005-2019
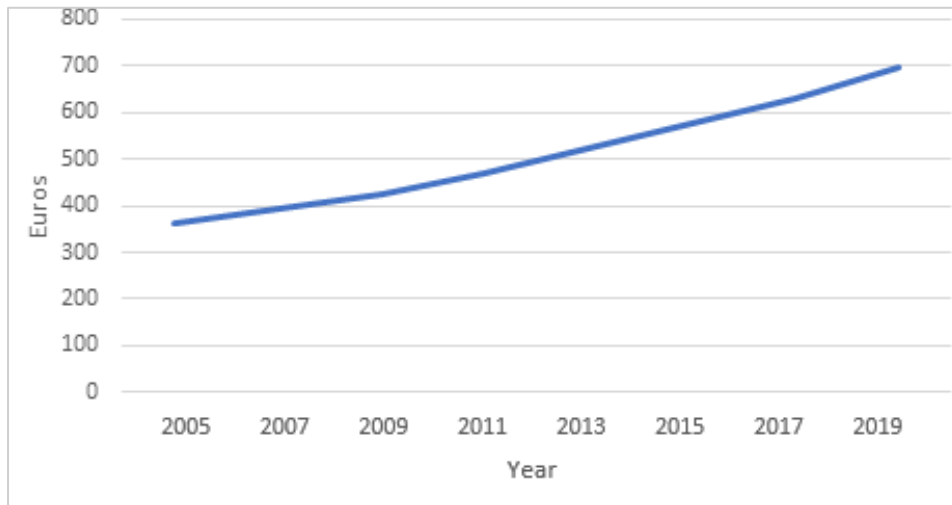
Note. Figure made with data provided by Gemeente Amsterdam, 2023a

Amsterdam has a different allocation of housing than the average in the Netherlands as visible in figure 5. Firstly, Amsterdam has more social housing (54%) than the average in The Netherlands (30%) and a small owner-occupied sector, 28% average compared to (57%) in The Netherlands. Private rental housing is slightly higher (15%) average compared to the Netherlands (13%). Private rental slightly increases more after 2017 in Amsterdam, most likely due to the decrease of social housing. The decrease of social housing is higher than average, as the social housing decreased with 61% to 48% compared to 33% to 29% on in the Netherlands. This is due to the high social rental market to begin with and corporations had to sell social housing for income to renovate or built new houses, due to insufficient subsidies to finance these operations (Koops, 2021). As seen in figure 6, house prices have increased immensely just as in the Netherlands, the house prices almost doubled since 2013. Rent in Amsterdam has increased more than in the Netherlands overall. In Amsterdam rent also almost doubled compared between 2015-2019, while the Netherlands had an increase of 30%.

Janssen-Jansen & Schilder (2015) state Amsterdam as the most dysfunctional housing market of the Netherlands. Amsterdam has a long waiting list for social housing. In the city centre it can take up to 14 years to find an apartment, while less popular neighbourhoods have a waiting list of around 8 years for a social rental apartment. On average the waiting time to find a social rental house in Amsterdam in 2023 is 13 years (Gemeente Amsterdam, n.d.), compared to 7

years in the rest of The Netherlands. Currently families are leaving the city as they cannot find proper housing in Amsterdam, while young people more often live in shared homes or small studios (Nijskens et al., 2019). All this indicates the dire state of housing situation in Amsterdam, which is worse than in the Netherlands as a whole.

Demand for housing in cities has been increasing all over the world (Nijskens et al., 2019). This is attributed to pull factors of the big cities like Amsterdam. Cities have invested in infrastructure and in cultural and recreational facilities (Nijskens et al., 2019). In major cities jobs, education and cultural events are often located. Also, the number of people living in the city attracts others who want to live close to family or friends already living in a city (Nijskens et al., 2019). Especially young people move to cities, immigrants looking for work, and communities with the same origin. Amsterdam is no exception to having these pull factors, which also increased the population over the years and resulting in further increasing demand for housing in Amsterdam (Nijskens et al., 2019).

2.3. Airbnb
In order to understand the effects of Airbnb on the housing prices, it is important to understand Airbnb itself first Firstly, the platform of Airbnb is explored, afterwards the effect of Airbnb on the housing market is explored.

2.3.1. The product of Airbnb
Airbnb is a website which people can use to list accommodations on for others to rent, mostly targeting tourists and travellers (Crommelin et al., 2018; Tussyadiah & Pesonen, 2016). The accommodations are varied, from extra space in a house which the host also lives in, entire apartments while the host is away or accommodations solely used for renting out (Guttentag, 2015; Crommelin et al., 2018). The accommodations can be shared with strangers or for a single person or group (Crommelin et al., 2018; Tussyadiah & Pesonen, 2016). Airbnb accommodations are often cheaper than a hotel, benefitting tourists (Guttentag, 2015). The median rates in 2013 of Airbnb accommodations are generally less than those of similar four and five-star hotels (Guttentag, 2015). Airbnb hosts can list for a lower price due to low costs (Guttentag, 2015). Most Airbnb hosts have no labour costs and are not fully dependent on the income of Airbnb (Guttentag, 2015). Next to the cheap prices Airbnb accommodations also provide other benefits: feeling like home, local advice, amenities such as a kitchen or washing machine, or staying in a less tourist area (Guttentag, 2015; Crommelin et al., 2018; Tussyadiah & Pesonen, 2016). The benefits of a varied choice of accommodations and lower costs led to extra travellers (Tussyadiah & Pesonen, 2016; Balampanidis et al., 2020 Farronato & Fradkin;

2018). Airbnb is the biggest company of the short-term rental sharing market. Other companies, like VRBO and HomeAway, have less listings available (Crommelin et al., 2018).

Renting out excess space or renting out bed-and-breakfasts is not new, this is known as the short-term rental market (Crommelin et al., 2018; Guttentag, 2015). However, the platform of Airbnb fundamentally increases the scale of this activity. Airbnb enlarged the short-term rental market through reducing the costs of maintaining a short-term rental, and increasing trust between hosts and guests. Especially low levels of trust led to low usage levels of traditional room sharing (Guttentag, 2015). Airbnb provides security for hosts and renters by acting as a middle-man; it carries part of the risks and ensures payment or repayment (Crommelin et al., 2018; Guttentag, 2015). Trust was further increased by extra systems as the reputation system and verification systems. These reputation systems are necessary for online transactions where parties have little experience with each other (Guttentag, 2015). Reviews can also help accommodations to improve the quality of their service. Trust furthermore grows due to the direct message system on Airbnb between hosts and guests, and through their profiles, photo identification, phone number authentication and linking a profile to Facebook or LinkedIn (Guttentag, 2015).

One major platform made it easy for hosts to post descriptions and photos of their accommodations to market, and for renters to find accommodations. This way the search costs, which hindered the short-term rental market before Airbnb, are decreased (Guttentag, 2015; Crommelin et al., 2018). Airbnb did the marketing and maintenance for the website, and created a system to accept payments and make reservations, leaving the hosts to only focus on marketing their accommodations on the website (Guttentag, 2015). Other major players in the tourism market did not view Airbnb as a threat because Airbnb only focused on the low-end market, a market that was not interesting to major players due to the low profit margins (Guttentag, 2015). Major players kept focusing on their own products and improving them through sustainable innovations (Guttentag, 2015). However, the moment major players tried to enter the lower-end market Airbnb was already too big and the major players could no longer compete (Guttentag, 2015). All in all, Airbnb made entering the short-term rental market easier for investors and home owners with excess space, resulting in cheap and accessible accommodations. Which in turn lead to more people being able to travel than before (Tussyadiah & Pesonen, 2016; Balampanidis et al., 2020 Farronato & Fradkin; 2018)

2.3.2 Airbnb and housing prices

Airbnb has certain benefits for tourists. However, housing is necessary to accommodate these tourists, resulting in less housing available for residents and residents moving away to different areas (Lee, 2016; Segu et al, 2020; Overwater & Yorke-Smith, 2021). Before Airbnb existed the short-term and long-term housing market had limited overlap. After Airbnb came to exist, the short-term rental market and long-term market became heavily intertwined. Airbnb opened the door to use houses for short-term rentals, resulting in investors bidding for the same houses as residents. However, investors could increase their bids due to higher profits possible via Airbnb (Lee, 2016). As some households no longer could afford bid up against investors in certain areas of the city, they moved somewhere else (Lee, 2016; Balampanidis, 2020; Segu et al, 2020). Further increasing demand for housing elsewhere and increasing of housing prices in these areas (Lee, 2016; Balampanidis, 2020).

Evidence shows that in Athens and Los Angeles the average housing prices have been increasing rapidly since Airbnb entered the market in Athens in 2013 and in Los Angeles in 2008 (Balampanidis et al., Lee 2016). In areas with the most Airbnb activity the housing prices have increased the most (Balampanidis et al., Lee 2016). Segu et al. (2020) used an OLS-regression to find an increase of housing prices in Barcelona of 4.6% on house prices and 1.9% on rent. Reichle et al. (2023) find even more evidence on the effect of Airbnb on housing prices. By conducting an OLS-regression with 25 European cities Reichle et al. find an increase of 5.2% of house prices and 3.84% on rent. Lastly, Liang et al find an increase of 3.6% to 4% of rental prices in Hong Kong since Airbnb entered the Hong Kong market. While the rent-to-income ratio also increased from 4% to 4.7%. Indicating that housing is more expensive. The effect of Airbnb on house prices is stronger than on rents (Reichle et al., 2023). Also, no empirical evidence is found that regulating Airbnb dampens the increase of housing prices by Airbnb listings. Thus, evidence from other cities suggest an increase of housing prices due to increased Airbnb activity.

2.3.3 Supply and demand shocks

Airbnb affects supply and demand of housing through two mechanisms. The first mechanism described is the sudden increase of demand for houses by investors due to the high potential profits on the short-term housing market (Lee, 2016). Housing supply stays the same but investors buy houses to list on Airbnb (Lee, 2016). Lee (2016) calls this hotelization. As extra demand for houses is generated to rent on Airbnb while the supply does not increase as much,

house prices increase. Thus, hotelization effects the demand side of the housing market, by suddenly increasing demand while supply lags behind, leading to higher housing prices.

The second mechanism is long-term housing supply is converted to short-term housing supply because of the higher profits made on the short-term rental market, making it more attractive for landlords to switch to the short-term renal market (Lee, 2016). Housing units that were first occupied by a resident, are now listed on Airbnb throughout the year (Lee, 2016). Thus, when landlords switch from the long-term housing market to short-term housing market, long-term housing supply decreases and short-term housing supply increases. As less long-term housing supply is available while housing demand stays the same, housing prices increases. This mechanism is called conversion (Lee, 2016)

These effects are visible in Los Angeles (Lee, 2016) and Barcelona (Segu et al., 2020) because households are replaced by Airbnb listings. A decrease of households and increase of Airbnb listings indicates that long-term housing is decreasing as current home owners sell their houses to Airbnb hosts, or landlords leave the rental market. Hotelization and conversion are the main mechanisms which negatively affect the citizens (Overwater & Yorke-Smith, 2021), especially in housing markets with low housing supply as Los Angeles (Lee, 2016) and Barcelona (Segu et al., 2020). Thus, Airbnb increases demand for houses through hotelization, and decreases supply through conversion resulting in higher prices in an already supply constraint city as Amsterdam.

The result of hotelization and conversion is households moving away from the city or to other areas of the city. Combined with richer people entering the city and lower incomes leaving due to the high prices (gentrification), the character of the city changes as a result of hotelization. The lower income residents can face longer commutes and lose access to essential community services. Most Airbnb listings are in wealthy districts, which have never been gentrified. However, when middle-income renters are displaced from wealthier neighbourhoods to cheaper neighbourhoods, the cheaper neighbourhoods become gentrified. However, more data is necessary to conclude if residents indeed move away from wealthy areas to poorer areas due to hotelization (Lee, 2016).

2.3.4. The effect of Airbnb on the local economy
Airbnb activity affects the local economy through different means, further increasing housing prices. The cheap and varied accommodations available on Airbnb results in an increase of

travellers (Tussyadiah & Pesonen, 2016; Balampanidis et al., 2020; Farronato & Fradkin, 2018). Extra tourists lead to extra money spent on for example restaurants or souvenirs. The owners of these businesses earn more profit and hire more employees to facilitate the tourists. These higher economic benefits lead to extra disposable income for locals. Local residents can rent their excess space to tourists, leaving them with more disposable income to pay for mortgage or rent (Reichle et al., 2023; Segu et al., 2020; Tussyadiah & Pesonen, 2016; Balampanidis et al., 2020). More disposable income for households means they also have more resources to spend on housing (Reichle et al., 2023; Tussyadiah & Pesonen, 2016; Balampanidis et al., 2020; Segu et al., 2020). This is further supported as unemployment and disposable income are predictors of housing prices (Belke & Keil, 2017). Especially in Amsterdam, disposable income is found as the strongest predictor of housing prices (Janssen-Jansen & Schilder, 2015), identifying importance of local economic growth for housing prices.

Airbnb has increased the number of tourists with a substantial amount. As 42% to 63% of the nights booked on Airbnb in 50 American cities would not have resulted in a hotel booking otherwise, missing out on $137 million of welfare (Farronato & Fradkin, 2018). Athens has improved from one-summer-day stopover city to a year-round city break destination which tourists stay multiple days since Airbnb entered the market. Between 2013 and 2016 tourism increased with 56% in Athens which is substantial compared to the decrease of 22% between 2007 and 2013. Of course, these fluctuations occurred after, during and before the financial crisis. However, the increase of tourism has never been as high as after 2013. To cater to these tourists an increase of Airbnb has created work and income for many occupations as: real estate agents, architect, engineers, graphic designers and advertisers (Balampanidis et al., 2020). Segu et al. (2020) adds that the more touristic areas in Barcelona had an extra decrease of unemployment and increase in local economy. Thus, Airbnb seems to have contributed to lower unemployment and increased income through the extra demand generated by tourists attracted by Airbnb.

Airbnb did not only increase local economy but competed against other hotel chains. However, to what extend Airbnb disrupts the short-term rental market is debateable. It is not clear if Airbnb directly competes with the traditional hotels. Secondly, Guttentag (2015) assumes that Airbnb can exist next to the traditional market and increase the size of the pie instead of taking a piece of the pie, by making traveling accessible to individuals who else were not able to pay for traveling. However, Airbnb decreased the revenues generated by hotels (Zervas et al., 2017). Especially low-priced hotels have experienced decreased revenue due to increased competition

from Airbnb (Zervas et al., 2017). In the end, Airbnb has a positive impact on the local economy as a whole, but can lead to lower revenue for lower-end hotels in particular.

2.3.5. Renovation of houses
Some Airbnb hosts renovate old houses to list on Airbnb, increasing the value of these houses (Xu & Xu, 2021; Balampanidis et al., 2020). Xu and Xu (2021) found that Airbnb increased renovation projects by 0.527% in Chicago. They constructed an instrumental variable exploiting the 2016 Chicago Shared Housing Ordinance, this restricted home-sharing for condominiums, and comparing this to renovation permits. Xu and Xu could only observe the renovations done which needed a permit. Thus, other renovations projects as carpeting, flooring, or painting could not be assessed, more renovations could have taken place and increased the housing value in Chicago. The increased housing value from Airbnb renovations was more noticeable in declining neighbourhoods, likely due to a lower investment cost than neighbourhoods which have been gentrified already. Thus, housing prices potentially increase due to renovation projects done by Airbnb hosts.

2.3.6. Decrease of housing prices
No scientific evidence is available that the negative side effects of Airbnb impact residents more than regular neighbours or lower housing prices. Mody, Suess and Dogru (2021) do not find empirical evidence that Airbnb has a negative impact on the lives of residents. Most residents view extra tourism and extra income as positive changes made by Airbnb. Furthermore, Airbnb listings do not create extra negative effects on the neighbourhood comparable to regular neighbours. Also, no relationship can be found between a decrease of quality of life and Airbnb concentration, while residents do see the positive sides of increased economic activity in their neighbourhoods. Thus, no evidence is found that Airbnb decreases housing value.

2.4. The city centre and Airbnb
Evidence from Barcelona (Segu et al., 2020), Athens (Balampanidis et al., 2020), Los Angeles (Lee, 2016) and 25 European cities (Reichle et al., 2023) identify an extra increase of housing prices in the city centre compared to other areas. The extra increase of housing prices is caused by extra difficulties to increase housing supply because of a shortage of land and higher demand from tourism. On average the city centre has a higher number of listings than other areas of cities (Reichle et al., 2023; Balampanidis et al, 2020). Tourists prefer to stay in the city centre close to touristic attractions and are willing to spend more money to stay in the city centre. Demand is higher for housing in the city centre than elsewhere due to extra demand from

tourists and higher profits to be made in the city centre as tourists are willing to pay more to stay in the city centre, increasing price further (Segu et al., 2020; Balampanidis, 2020; Reichle et al., 2023). Secondly, increase of housing supply is difficult in the city centre. Because most land has already been built on, old housing has to be demolished if new building are. So, the city centre is extra supply constraint (Segu at al., 2020; Reichle et al., 2020).

Hotelization is worse in the city centre due to tourists that are willing to pay a higher price to stay in the city centre (Segu et al., 2020; Reichle et al., 2023; Lee, 2016). This in turn increases the price an Airbnb host can ask for an accommodation in the city centre. Investors are willing to pay a higher price for a house in the city centre, because they can list it for a higher price too. Furthermore, the effects of conversion are increased in the city centre because it is only worth it for landlords to stay in the long-term market for a high price. Due to higher prices tourists are willing to pay, landlords have an extra increased incentive to rent out their property on the short-term market instead of the long-term market. Thus, stronger effects from conversion further increase housing prices.

3. Theory and Theoretical framework

3.1. Airbnb and housing prices in Amsterdam

Figure 8

Mechanisms underlaying the increase of housing prices due to Airbnb listings
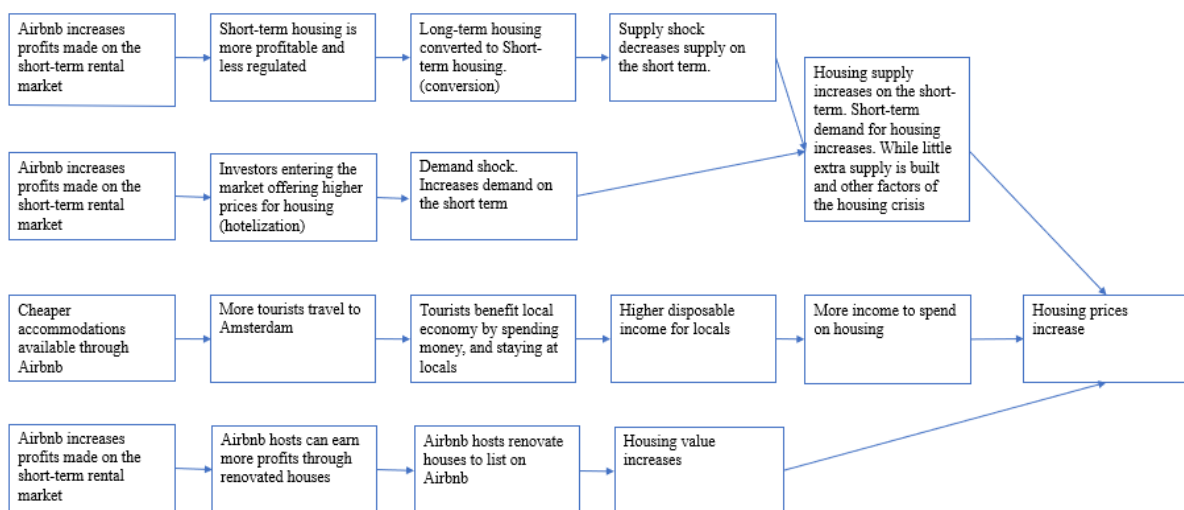
Note. Figure made based on theory of Reichle et al (2023), Segu et al (2020), Lee (2016), Xu & Xu (2021). The first row shows the mechanism hotelization, the second conversion, the third local economic boosts, and the fourth renovations.

Airbnb affects the housing prices through four different mechanisms, these are visible in figure 8. Amsterdam already has a shortage of housing as the housing supply, and housing supply increases insufficiently to close the gap, while the number of households keeps increasing (Boelhouwer, 2018; Schmid & Vols, 2022). Hotelization increases the demand for houses, while conversion decreases the long-term housing supply (Lee, 2016). Demand for housing increased rapidly due to investors interested in the potential profits of the short-term rental market, while supply lagged behind due to conversion and building houses is slow. Furthermore, extra tourism generated by lower prices for an accommodation led to extra tourists coming to the city. As tourist spend money on the local economy, the local economy increased, and in turn disposable income of residents of Amsterdam. Giving them more resources to spend on housing. As housing supply increased too little and the income of households in Amsterdam increased, the households spend more money on housing, resulting in higher housing prices. Lastly, Airbnb hosts renovate houses increasing value of homes. Thus, the four mechanisms, (hotelization, conversion, local economic increase, and renovation) lead to the following hypothesis:

Hypothesis 1: An increase of Airbnb activity increases the housing prices in Amsterdam.

3.2. Airbnb in the city centre of Amsterdam

Evidence suggests a higher increase of housing prices in the city centre compared to other areas of the city, due to a higher demand tourists have for accommodations in the city centre, and housing supply being extra constraint in the city centre (Segu et al, 2020; Balampanidis et al., 2020; Reichle et al., 2023). This exacerbates the decrease in supply for long-term housing and increasing demand for housing. A higher increase of demand while supply constraints are worse leads to higher housing prices in the city centre. Thus, Airbnb listings might have an increased effect on the housing market in Amsterdam Centrum, due to extra demand and obstacles to increase housing supply leading to the folowing hypothesis:

Hypothesis 2: An increase of Airbnb activity increases the housing prices in the city centre more than in other districts in Amsterdam.

4. Methodology

4.1.1. Dividing Amsterdam
Figure 9

Map of Amsterdam divided by city areas and GGW-areas
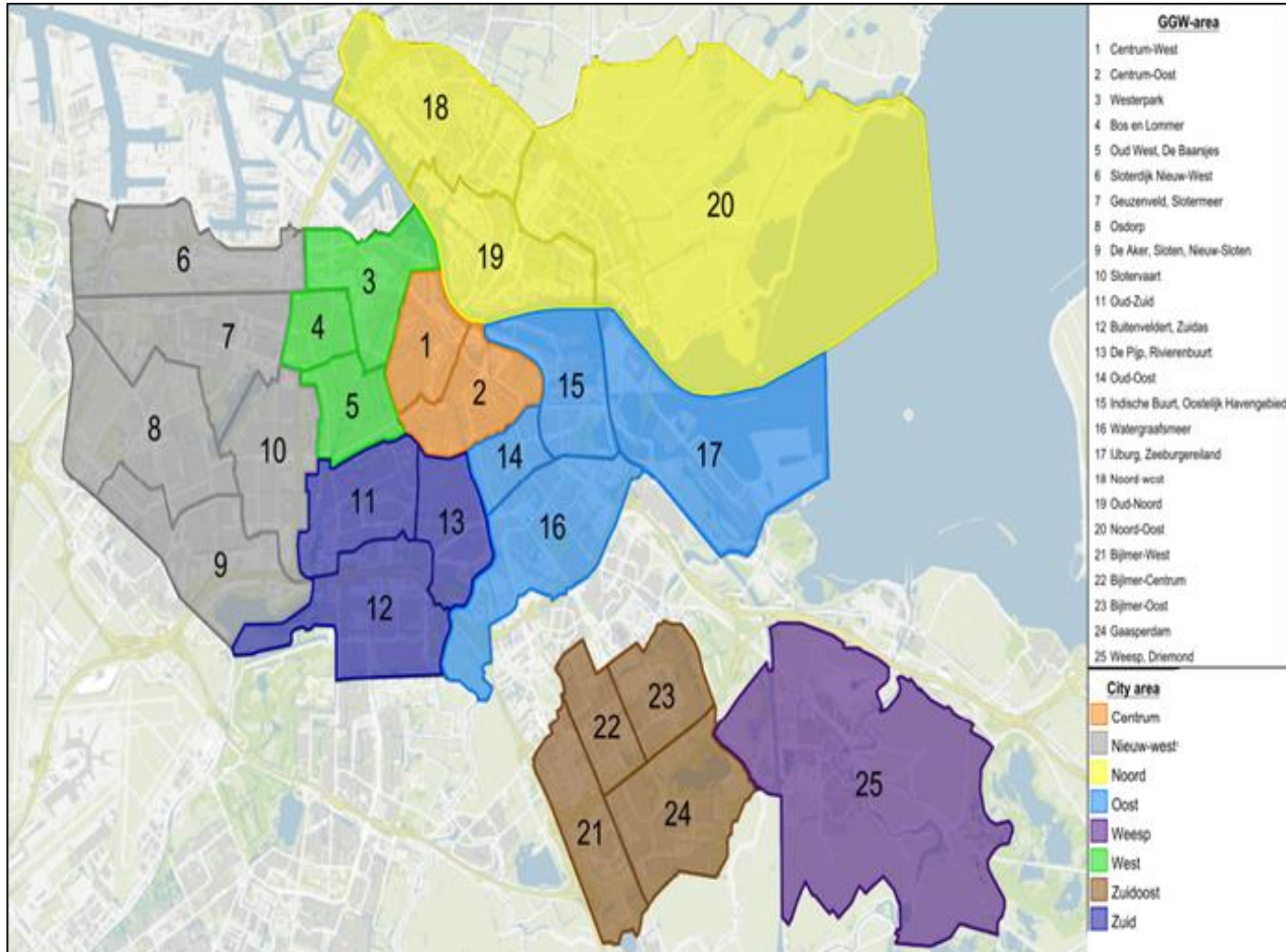
Note. Figure made with map provided by Gemeente Amsterdam, n.d.

To analyse the effect of Airbnb listings on housing prices in Amsterdam, the Gebieds Gericht Werken gebieden (GGW-area) of Amsterdam will be used as research subject. The municipality of Amsterdam divided Amsterdam in 25 GGW-area. These areas are observable in figure 9. The municipality uses these areas to increase the connection between locals and the municipality. The GGW-areas are a combination of certain neighbourhoods which have many similarities. Every GGW-area has a plan to tackle problems in the area and improve the city in cooperation with locals of the area. This cooperation is between different parties as:

municipality, residents, businesses, local parties, and NGOs. These 25 areas all have a difference in residents, facilities and housing (Gemeente Amsterdam, n.d.c.).

Only 22 areas will be used in this thesis. Weesp was not part of Amsterdam during 2015-2019 (Gemeente Amsterdam, n.d.c.). Sloterdijk and Bijlmer-West are not used because it mostly consists of companies and does not have a lot of housing or households living there as seen in table 7 in the appendix. Sloterdijk has 74 households and Bijlmer-west had 135 compared to the average of 18445 per GGW-area in 2015. Identifying the low number of households in these areas. Sloterdijk also has no Airbnb listings during the period of 2015-2019. Data in general is scare of these areas, and data indicating the housing prices is also not available for every year. Thus, Bijlmer-West, Sloterdijk and Weesp are not added in this thesis.

The GGW-areas can differ based on local legislations made by city area. However, the housing legislation is made by the municipality (Gemeente Amsterdam, 2023a). The GGW-areas are divided in nine city areas: Centrum, Nieuw-West, Noord, Oost, West, Zuid, Zuidoost, Weesp (Gemeente Amsterdam, 2023b). In figure 7 can be seen where these areas are in Amsterdam. Westpoort and Weesp are not included in this analysis. Westpoort mostly consists of companies as it is the harbour of Amsterdam (Gemeente Amsterdam, 2023a).

4.2. City centre

4.2.1. Amsterdam city centre
Segu et al. (2020), Balampanidis et al. (2020), Reichle et al. (2023) and Lee (2016) do not fully define the city centre. Giddings & Rogerson (2022) show in their book the ambiguous and contested notion of a city centre. They state that the city centre is historic or the hearth of the city, providing the city with a distinctive identity for residents and the pulls tourists to the city. The city centre shows how the city has developed economically, socially and culturally, having some of the most distinctive streets and spaces in the centre (Giddings & Rogerson, 2022). Lee (2016) views the city centre as the most touristic part of the city. Reichle et al. (2023) state that they are unsure about what their data views as the city centre. Reichle et al. (2023) do not define the city centre but trust the dataset to define this properly, but do state that the city centre is an area with a historic background, more tourism and not a lot of housing supply. Balampanidis et al. (2020) agree with the definition of a historic touristic in the middle of the city low land position. Segu et al. (2020) agree with this definition, only also add other touristic activities to their research as potential Airbnb magnets because of the high touristic activity outside of the city centre of Barcelona. As seen defining the city centre is difficult. For this paper the

definition of a the most touristic area with low housing supply and a distinctive part of the city will be used.

To define the city centre of Amsterdam, first tourism in Amsterdam will be assessed. Secondly, the historic and defining part of the Amsterdam is located. Thirdly, the housing supply of Amsterdam is analysed.

Figure 10

Touristic attractions in Amsterdam
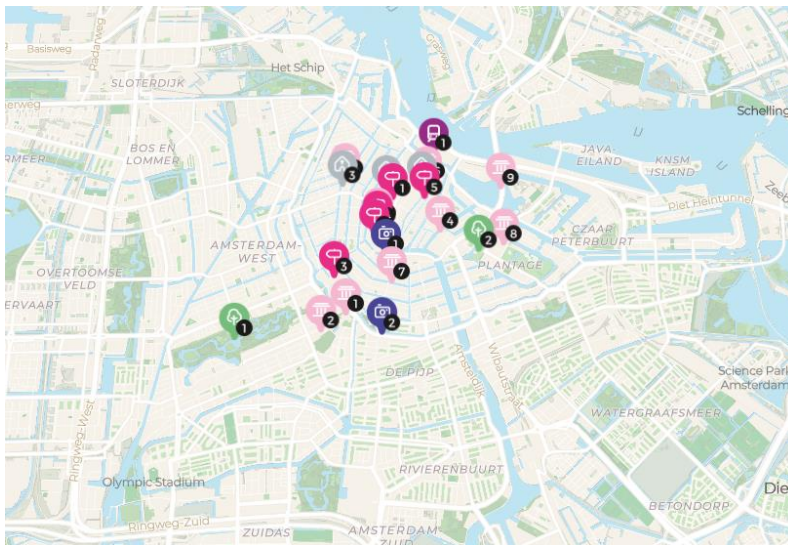
Note. Figure copied from Civitatis tours, n.d.

Figure 11

Touristic concentration in Amsterdam based on social media presence
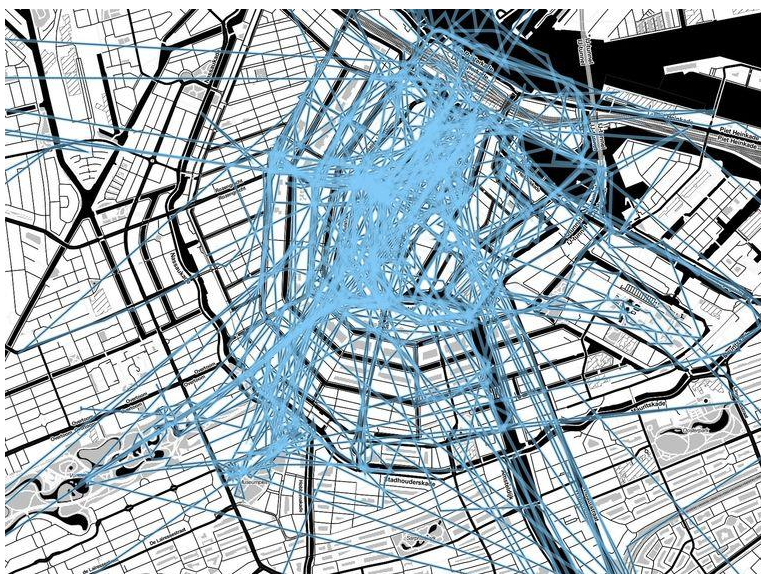

Note. Figure copied from Het Parool, 2015

4.2.2. Tourism in Amsterdam city centre

First tourism in Amsterdam is assessed to define which part of Amsterdam is the city centre. This will be done by identifying touristic paterns and touristic attractions in Amsterdam. First off, figure 10 shows a map by Civitatis tours (a travel agency), identifying the main tourist atractions in Amsterdam. Almost all of these attractions are based in city area Centrum. However, the famous museums (Van Gogh museum and Rijksmuseum) (Het Parool, 2015), are located in Oud-zuid, so not all tourism is based in Centrum. To further show touristic patterns a map from Het Parool (2015) is presented in figure 11, which shows tourstic movements based on social media paterns. This map shows the same pattern as figure 10. Almost all tourists stay around Centrum, or go to the famous museums in Oud-zuid. However, most do not go any further in the city (Het Parool, 2015).

4.2.3. Historic and defining place of the city

The hearth of the city is a vague concept and is defined by Giddings and Rogerson (2022) as the reason people go to a city, is historic and is defining for the city. Amsterdam Centrum has some of the most defining places, such as the UNESCO heritage certified canals of Amsterdam, the red-light district, Artis, Anne Frank huis, and Jordaan (Netherlands Tourism, 2020). However, some touristic attractions as: Van Gogh Museum, Rijksmuseum, and the Vondelpark are in the GGW-area Oud-Zuid. As seen in figure 9 all these activities are seen as touristic destinations by Civatis. Other areas of Amsterdam do not have these defining surroundings, thereby identifying Oud-Zuid and Centrum as defining historic areas for Amsterdam and with that pull factors for tourists (Netherlands Tourism, 2020). Indicating that Centrum-Oost, Centrum-West and Oud-Zuid can be defined as the city centre of Amsterdam.

4.3. Housing prices

To measure the housing prices in Amsterdam the Waardering Onroerende Zaken (WOZ-value) of houses is used. WOZ-value for houses is published and estimated by the municipality and used by government agencies to indicate the amount of taxes to be paid for income taxes, property tax and water system levy. The WOZ-value is also used in the calculation of the maximum rent a social rental building is allowed to have (Ministerie van Algemene Zaken, 2022a). WOZ-value is estimated without differentiating between rental houses owned houses, owned land or rented land, without any renovation done. It might be so that houses on the rental market are worth less than houses on the owned market (Waarderingskamer, n.d.b). Thus, WOZ-value is an estimation of housing value estimated and used by the Dutch governmental

agencies. Boelhouwer (2020) and Teulings (2015) also use WOZ-value to conduct research on the Dutch housing market.

The WOZ-value is estimated over groups of houses which are similar to each other in size, age and location. Secondly, extra estimations are made based on different criteria. The model used to appraise the WOZ-value is combined of certain variables between houses close to each other. This information is obtained through different means: the municipality uses building licences and aerial photos to indicate if a house has changed, and sometimes sends appraisers uses information from the interest, or ask the owner. The municipality keeps in mind that the new owner can renovate the house, so tries obtain the most recent information. Firstly, the houses are categorized on certain characteristics to compare. These characteristics are for example: detached house, size of the house, size of land, build year, and state. Secondly, all selling prices of recently sold houses are indexed. Thirdly, the asking prices for all houses currently on sale are assessed. Fourthly, the WOZ-value of the year prior is included in the model. These four steps create a combined computer model to indicate the new WOZ-value (Waarderingskamer, n.d.b).

Secondly the WOZ-value is an important indicator of the maximum rent a landlord is allowed to ask. The maximum rental price changes every year based on inflation. (Waarderingskamer, n.d.a). The maximum rent is calculated based on a point system called Woningwaarderingsstelsel (Waarderingskamer, n.d.a.). A rental receives points based on certain indicators, for example eco friendliness, size, garage, the size of the kitchen counter, washing facilities, etc. If a rental has more than 142 points, the house is no longer classified as social housing (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2022). Rental houses in the free sector are no longer restricted by a price maximum (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2022). Private rental houses are more profitable and less rules have to obliged by, because of this many private landlords want to have more points (NOS, 2022). Most social housing is indeed supplied by housing associations (Janssen-Jansen & Schilder, 2015).

The WOZ-value is always based on the value of the year prior on the 1st of January (Ministerie van Algemene Zaken, 2022b). Thus, the WOZ-value of 2023 indicates the housing prices in 2022. Thus, WOZ-value indicates the market value of a house, affects the maximum rent a landlord is allowed to receive in the social housing sector, and indicates if a landlord is allowed

to rent the house on the free sector. As WOZ-value interacts with all facets of the housing market it is a proper dependent variable to measure the housing prices.

4.4. Airbnb Listings

Airbnb does not provide data about the number of listings as macro data or micro data. Thus, data provided by secondary sources is needed to conduct research. Scrapers often provide data necessary for research. Scrapers are a third party, sometimes scrapers want to conduct research themselves, sometimes they only provide the data. Scrapers use software to observe all the listings available on Airbnb on one given day and save information about the listing offline. This information contains for example: the location of the listing, number of reviews, the host, and sometimes the price. Afterwards they save these listings and publish them online. Researchers like: Adamiak (2018), Anselmi et al (2021), Balampanidis et al (2019), Crommelin et al. (2018), Segu et al. (2020), Reichle et al. (2023), and Xie et al. (2017), also used data from scrapers to conduct research on Airbnb.

Two different scrapers are used in this thesis to indicate the number of listings of Airbnb. The number of listings over 2014-2017 were scraped by Slee. Slee is one of the first scrappers of Airbnb data and has written multiple scientific articles about the negative effects of Airbnb. Slee stopped scraping because he deemed Inside Airbnb as a better successor, and worked together with them (Slee, n.d.). The data for 2018 is provided by Inside Airbnb. Inside Airbnb is an organization which strives to facilitate research about Airbnb. Inside Airbnb wants to find evidence concerning the negative effects of Airbnb, and is used by other scholars to indicate the number of Airbnb listings in certain areas, for example Adamiak (2018), Anselmi et al (2021), Balampanidis et al (2019), Segu et al (2020), Reichle et al (2023), and Xie et al (2017). However, their data is only freely available over the last 12 months (Inside Airbnb, n.d.), so Slee (n.d.) is used for 2014-2017.

The only indication by Airbnb of the number of Airbnb listings in Amsterdam was given by a spokesperson of Airbnb. The spokesperson indicated that in January 2018, 19,000 Airbnb listings were available in Amsterdam on the platform (NOS, 2019). This aligns with the data scraped by Slee on December 2017, 18,723 listings, and the data scraped by Inside Airbnb on December 2018, 20,012. This seems to align with the trend started in 2016, before then Airbnb listings increased steeply while after 2016 the increase of listings slowed down. Shows that the scrapings give a realistic indication of the number of Airbnb listings, and the data is reliable and valid.

Another potential drawback of the data is that listings do not indicate the precise date they were bought. Thus, no direct relationship can be constructed between the data a house was bought and the increase of housing prices. Airbnb hosts can buy a house and first renovate the house before listing it on Airbnb. This can disturb the mechanism of hotelization (Lee, 2016). Buying a house can take on average 6 weeks in the Netherlands (Veul, 2022). This can disturb the data by 6 weeks. However, this does not seem to disturb the data a lot as the prices and listings are assessed over the entire year; at most disturbing a small part of the data. If conversion happens (Lee, 2016), repurposing a long-term rental to a short-term rental, the listing does not switch owners. Thus, the transaction period does not apply.

Both hotelization and conversion can be affected by renovating an accommodation. Listings can be bought earlier and listed at a later time. The long-term housing stock can be affected earlier than the accommodation is listed. No evidence suggest how often Airbnb listings are renovated before being listed. Hostaway (n.d.), management software for Airbnb hosts, suggests a list of possible renovations. These are: Painting, redoing the floor and changing the lights. All of these renovations can variate a lot how much time they take. WerkSpot (2022) (A website to hire handymen) states it can take up to two weeks depending on the amount of work. This does not seem to be a long timeframe. However, hosts need to find a handyman or do it themselves. This can also take some time. A handymen shortage is ongoing in the Netherlands during 2015-2019 (RTL Nieuws, 2018). However, hosts can list their accommodation and renovate later, if they have no bookings (Hostaway, n.d.). However, it is difficult to precisely asses if renovations do disturb the results. This does not seem the case based on the most common renovations and the fact that people list before renovating

Different supply shocks can happen which can skew the data. Hosts can only put up their listings for a certain amount of time, for example while they are on holiday. The yearly increase of listings is noticeable, but no certainties can be given because no number of listings can directly be traced back to when the building is bought and how much time there is between listing and buying, and the time an Airbnb is listed. Reichle et al (2023) shows that no extra listings are made available during major events, for example UEFA cup, in Europe. However, Fradkin & Ferronato (2018) do indicate an increase of supply during New-years even in New-York. Because the data is scraped in December extra listings can, temporarily, be added due to extra demand for Christmas and New-Years. However, visible in figure 27 in the appendix, in November, December, Januari and February tourism in Amsterdam is lower than during other periods of the year (Visitor Insight, n.d.). Thus, it seems unlikely that a supply shock happens

around this time. As the scrapings are from December it is assumed that only the listings are scraped which are available year-round, due to lower tourism in December. No certainties can be given that all year the same number of listings are available, because no monthly data is available. However, it does seem odd that hosts only host during a low period for tourism, most likely resulting in less revenue.

Lastly, listings can be fake, however fake listings are rare (Airbnb, 2019). Airbnb takes multiple steps to decrease the number of fake listings and states that it barely happens (Airbnb, 2019). Thus, the data is reliable and valid, because it is assumed that the number of listings indicate properly the demand Airbnb listings create during a year.

The time period of 2015-2019 is chosen because it is the only period for which data is available for all variables. The municipality of Amsterdam did implement new policies surrounding Airbnb during these years. In 2017 every night spend in an Airbnb should be notified in a register (NOS,2019) A year later, in 2018 new regulations for Airbnb were implemented, restricting the maximum number of days an accommodation is allowed to be listed (NOS, 2022). However, the restrictions were easily circumvented by making a new account, and poorly enforced (Blom, 2018; NOS, 2020) Thus, these do not seem to have impacted the housing market or Airbnb listings.

4.5. Control variables

Based on the literature three other variables are indicated as variables which can influence the effect of Airbnb listings on housing prices. The following control variables are identified which can influence housing prices: housing supply, number of households, disposable income, interest rates, and infrastructure (Belke & Keil, 2018; Segu et al., 2020; Reichle et al., 2023; Boelhouwer, 2020; Janssen-Jansen & Schilder, 2015). The data for housing supply (Including living boats and caravans), number of households, and disposable income is collected per city area from the municipality of Amsterdam measured at the 1st of January. The number of households is estimated based on population data and questionnaires. However, the number of households is often overestimated (Jonkers, 2022). Some households might be living together, but do not want to, for example: divorced couples or evictions. Others are in the process of trying to live together but have not found a proper house. Thus, the data is skewed to have a higher estimation of household than in reality live in an area (Jonkers, 2022).

No data is available to indicate the interest level on GGW-area. Because no reliable assumption can be made that interest rates are the same across all areas in Amsterdam based on country

wide mortgage interest data. Thus, interest rates cannot be added in this model. There is also no data available for infrastructure by city area. During the time period of 2015-2019, the Noord-Zuid line, a new metro line between Noord and Zuid making it quicker to travel between Noord and other areas of Amsterdam was constructed (Vervoerregio Amsterdam, 2019). This might have increased the housing prices in Noord. However, infrastructure was worse during the time of building this line (Vervoerregio Amsterdam, 2019) and housing might have increased in price because households anticipated the completion of the Noord-Zuid line, this cannot be added. Thus, it is also part of the yearly effects.

4.6. Robustness check
As stated in the theoretical framework Airbnb hosts sometimes renovate a house which increase the price of housing. Residents might also renovate their house which can also increase housing prices and be reflected in WOZ-value. A survey done by the municipality of Amsterdam every two years asks residents to grade the maintenance state of the homes in their neighbourhood. This is graded on a 1-10 scale. The results of the survey are added to indicate if houses have been renovated over time. Social housing can also dampen the housing prices as a maximum price is only allowed for social housing; resulting in less possible profits from renting out social housing. Thus, percentage of social housing is added. However, the data for social housing and the maintenance level is only available for 2015, 2017 and 2019. Thus, cannot be added as a control variable as 66 observations is too low to draw a conclusion, but can give some insight in the effect of renovations and social housing on housing prices and if the findings remain robust.

4.7. Model characteristics
Multiple linear fixed-effects regression models are made with panel data grouped by GGW-area from 2015-2019 to test both hypotheses. The dependent variable is WOZ-value, the independent variable is number of Airbnb listings. Different control variables are added which effect housing prices. Housing supply indicates the supply on the housing market. The number of households indicate part of the demand of housing. Unemployment and disposable income both indicate the local economy. As a robustness check social housing and maintenance level is added as a proxy for renovations. To test the second hypothesis an interaction effect is added between the city centre (Centrum-Oost, Centrum-West, and Oud-Zuid) and listings. Indicating that if a listing is placed in the city centre results in a higher increase of WOZ-value in comparison to other areas.

All data used in this paper are scraped in December. Thus, the data of December 2014 indicates more closely the number of listings in 2015 than 2014. While WOZ-value indicates housing prices of a year prior as the WOZ-value is used to pay tax over the year prior. Thus, the WOZ-value of 2016 indicates the housing prices in 2015. Due to this the scrapings of December 2014 fit more properly with the WOZ-value of 2016. Thus, the WOZ-value of 2016 is matched with the number of listings of December 2014 to give a more fitting indication of the housing value and number of listings in 2015. All data is equal for all city areas across the years 2015-2019. Thus, the dataset is balanced and has a total of 110 observations. Every city area has one observation for every year between 2015-2019. There are no missing values in this dataset.

The municipality of Amsterdam states in practice there is a difference between these areas (Gemeente Amsterdam, n.d.c.). Fixed effects can be necessary to control for unobserved heterogeneity between the different GGW-areas as: culture, infrastructure and interest rates for the locals. Some areas might have better infrastructure or the residents can get cheaper mortgage which can influence housing prices (Belke & Keil, 2017). A Hausmann test is used to identify if fixed effects are necessary to control. A Hausmann test checks if there is a correlation between unique errors and the variables in the model (Glen, n.d.). In a Hausmann tests the null hypothesis is that random effects are preferred. The alternative hypothesis is that fixed effects are preferred (Glen, n.d.) The p-value is 0.000 thus the null-hypothesis can be rejected; indicating that fixed effects are preferred and the difference in the models is systematic (lower than 0.05) (Torres-Reyna, 2007). This is in line with the theory described earlier in the methodology (Glen, n.d.).

Secondly, year dummies might be preferred due to unobserved heterogeneity between years which cannot be put in the models, for example: mortgage interest and infrastructure. Infrastructure might improve over time, and interest rates can increase or decrease over the years, which might affect housing prices (Belke & Keil, 2017). To test if time dummies are necessary a joint F-test over 2015-2019 is used. An F-tests indicates if the differences over time can be explained by the variance in years. The P-value indicates it cannot be accepted that the coefficients of the years are jointly together equal 0. Thus, time dummies are necessary (Torres-Reyna, 2007).

4.8. Equations

Equation hypothesis 1

$$Y_{at} = \alpha_a + \beta X_{at} + \gamma C_{at} + \delta_t + \mu_t + \varepsilon_{at}$$

$$WOZ - value_{at} = \alpha_a + \beta Airbnblistings_{at} + \gamma C_{at} + \delta_t + \mu_t + \varepsilon_{at}$$

Note. Equation based on Torres-Reyna, 2007

Equation hypothesis 2

$$Y_{at} = \alpha_a + \beta X_{at} + \beta(CC_t * X_{at}) + \gamma C_{at} + \delta_t + \mu_t + \varepsilon_{at}$$

$$WOZ - value_{at} = \alpha_a + \beta Airbnblistings_{at} + \beta(City\ Centre_t *$$
$$Airbnblistings_{at}) + \gamma C_{at} + \delta_t + \mu_t + \varepsilon_{at}$$

Note. Equation based on Torres-Reyna, 2007 and Mcgill, n.d.

The first equation forms the basis for the regression models to test the effect of Airbnb on the Amsterdam housing market. **Y** represents the outcome. α_a is the unknown intercept for each entity; the mean value of the dependent variable when the independent and control variables equal 0. X_{at} represents the number of Airbnb listings, the independent variable and is a vector of the predictors. β is the increase of the outcome, the effect of the independent variable. C_{at} the control variables. a symbolizes the specific GGW-area of Amsterdam and t for the year. γ measures the effect of the control variables. δ_t symbolizes the unknown coefficient for the time regressors controlling for time unknown effects. GGW-areas. μ_t indicates the within-entity error term controlling for unknown effects between areas. ε_{at} is the overall error term. The second equation is underlying to test the second hypothesis. **CC** symbolizes city centre. $\beta(CCt * Xat)$ is the interaction effect between Amsterdam city centre and the number of listings. This effect indicates if a listing is placed in the centre of Amsterdam by how much higher it effects the WOZ-value compared to other areas of Amsterdam (Torres-Reyna, 2007).

5. Descriptive Statistics

5.1. Descriptive statistics of variables

Table 1

Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
WOZ-value	110	318887.26	122325.18	122877	746105
Airbnb listings	110	647.382	766.582	0	3510
Disposable income	110	39540.836	8507.765	26000	70400
Housing supply	110	19580.255	7931.974	8537	40087
Unemployment rate	110	6.191	2.474	2	16
Households	110	20547.1	8192.37	8863	43482
Maintenance level	66	6.967	.409	5.8	7.8
Social housing	66	53.348	12.029	19	77

In table 1 the descriptive statistics are shown for all variables. The standard deviation indicates the observations can differ greatly between different GGW-areas. This is further shown through the minimum and maximum of all variables. As can be seen one area has 0 listings in one year, while the most listings in one year are 3,510. The standard deviation is 766.582, indicating that across the city areas and the years a difference is of 767 listings. Thus, the areas have a vast different number of listings. The same can be observed for WOZ-value, the least amount of WOZ-value in a given year is 122,877 while the maximum is 746,105 and a standard deviation of 122,325. This shows how in some areas housing is substantially more expensive than in other areas by quite a substantial margin. The control variables show, just as the dependent and independent variables, a substantial range between minimum and maximum with a high standard deviation. Furthermore, some areas have high level of maintenance with the lowest 5.8 and the highest 7.8 indicating differences of maintenance levels per area. Social housing also differs greatly. Some areas have only 19% of social housing while others 77%, almost fully consisting of social housing. Further confirming the differences between the GGW-areas.

5.2. Corelation matrix

Table 2

Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) WOZ-value	1.000							
(2) Airbnb listings	0.650***	1.000						
(3) Disposable income	0.858***	0.313***	1.000					
(4) Unemployment	-0.578***	-0.436***	-0.483***	1.000				
(5) Housing supply	0.497***	0.824***	0.227**	-0.315***	1.000			
(6) Households	0.442***	0.797***	0.179*	-0.292***	0.991***	1.000		
(7) Maintenance level	0.731***	0.389***	0.810***	0.245**	-0.425***	0.191	1.000	
(8) Social housing	-0.582***	-0.127	-0.777***	0.010	0.300**	0.029	-0.671***	1.00

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

The corelation matrix seen in table 2 shows some strong correlations. WOZ-Value and the number of listings corelate by 0.650, this is in line with the theoretical framework. This does indicate a strong correlation between the dependent variable (WOZ-value) and the independent variable (number of Airbnb listings). Secondly, disposable income correlates with WOZ-value by a high significant amount of 0.933. This can be interpreted as people with higher disposable income also have more money to buy more expensive houses. Especially combined with the correlation of unemployment on WOZ-value (-0.699) and unemployment on disposable income (-0.561). This indicates that people with a higher income are employed and live in more expensive houses, as theory indicated disposable income is one of the most important predictors of housing prices. Disposable income (0.313) and unemployment (-0.436) do not have a strong correlation with Airbnb listings. Identifying not a strong effects of Airbnb listings on the local economy.

Interestingly the housing supply and WOZ-value does not have a strong relationship, only 0.497. Most literature identified the importance of housing supply on the housing prices (Belke & Keil, 2018; Boelhouwer, 2020; Teulings, 2015). The correlation is still substantial, however not as strong as suspected. This does not lead to any problems in the analysis but is an interesting anomaly which can indicate that other variables affect the housing prices in

Amsterdam more than in other places, such as Airbnb. However, disposable income does also have a high correlation.

Four instances of possible multicollinearity are visible in table 2. Firstly, a strong relationship between the number of households and housing supply of 0.991. This relationship is too strong to add the variable in the same regression, which would lead to multicollinearity. The relationship is logical, because households need a place to live. Thus, in areas with a lot of households also a lot of houses are needed to be available for them to live in. This is not a substantial problem for this thesis. Because both are control variables and indeed cover mostly the same data two separate models are made. One model is made without housing supply, but the number of households added as a control. Another model is made without the number of households, but with housing supply added as a control. Because both variables (number of households and housing supply) indicate two different important characteristics of the housing market as housing supply identifies the supply on the housing market, and the number of households part of the demand for housing (Nijskens et al., 2019). This would mitigate multicollinearity and still provide a reliable estimation.

A strong correlation is observed in table 2 between housing supply and Airbnb listings. Housing supply correlates with 0.824 with Airbnb listings. This is somewhat logical because if the housing supply grows more houses can be listed on Airbnb. Thus, a correlation between both is expected. Multicollinearity can be a problem if both variables are used in the same regression. Secondly, the number of households also strongly correlates with the number of Airbnb listings (0.797). This correlation is weaker, but still strong. This correlation is also logical. Because more households mean more houses, and more houses means more potential places to list on Airbnb. This is further confirmed by the strong relation between housing supply and number of households. Thus, an extra fixed effect model is made without controls added for housing supply and number of households to mitigate multicollinearity, which would still provide a reliable estimation.

The maintenance level does show a strong correlation of 0.731 with WOZ-value. This does indicate that the state of a house matters for the price. At the same time maintenance level also correlates with disposable income strongly indicating that people with more disposable income can maintain their house. The number of Airbnb listings do not correlate as strongly with the renovation level. Indicating that the number of Airbnb listings do not necessarily increase the maintenance level.

Social housing also shows some correlations expected by theory. A correlation of -0.582 between social housing and WOZ-value show that in areas with a high level of social housing WOZ-value is lower. Secondly disposable income is strongly negatively correlated with -0.777 social housing. This is because only people with low disposable income are allowed in social housing. In combination with the descriptive table in figure 7 shows that some areas have more social housing than others. Furthermore, a weak correlation between the number of listings and social housing is noticeable. Showing that social housing most likely does not decrease the number of Airbnb listings in an area (-0.127).

5.3. Further analysis of variables

5.3.1. Analysis of WOZ-value and Airbnb listings
A couple of figures are used to further analyse the effect of Airbnb listings on housing prices. These figures are made per city area to keep readability as 22 lines are difficult to follow and the nine city areas still show the broad mechanisms.
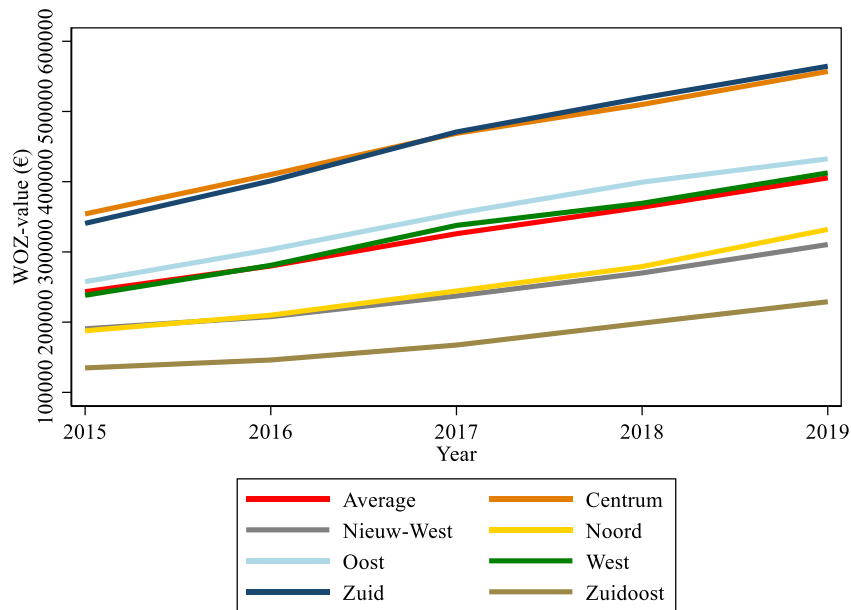
Figure 12

Number of Airbnb listings across seven city areas of Amsterdam
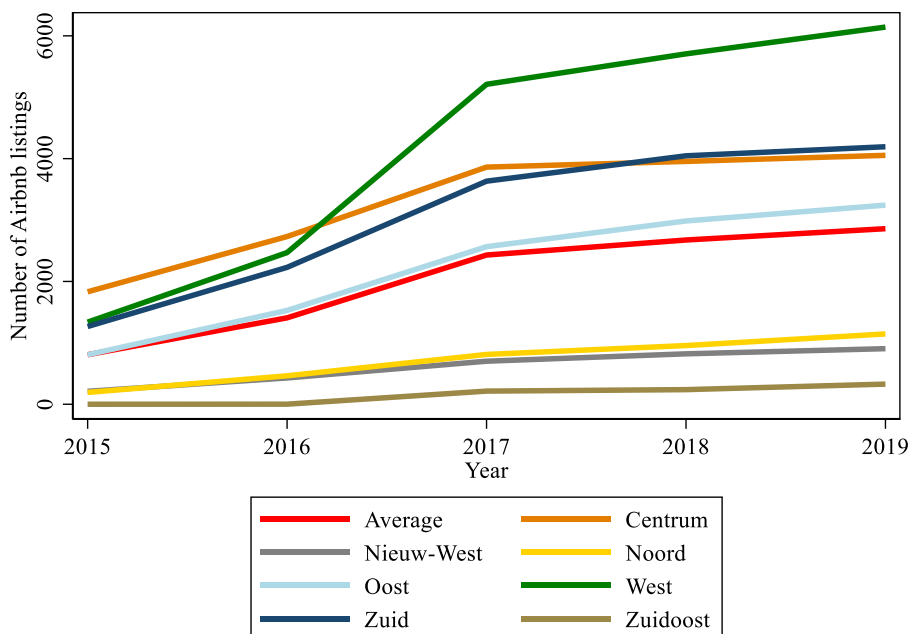
Note. Figure made with data provided by Slee, n.d and Inside Airbnb, n.d

Figure 13

WOZ-value across seven city areas of Amsterdam

Figure 14

Percentage increase of Airbnb listings across seven city areas of Amsterdam between 2015-2019.

Figure 15

Percentage increase of housing supply across seven city areas of Amsterdam between 2015-2019

Note. Figure made with data provided by Gemeente Amsterdam, 2023a

Figure 16

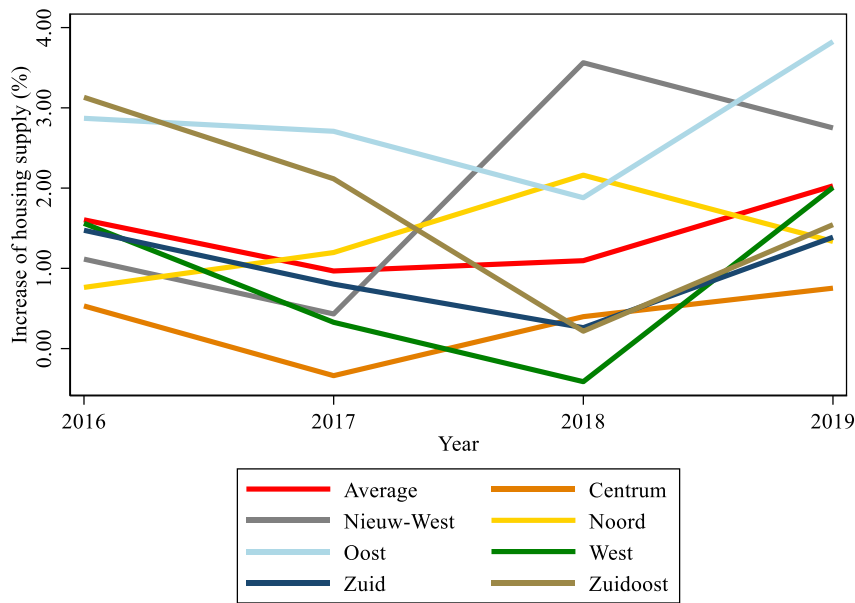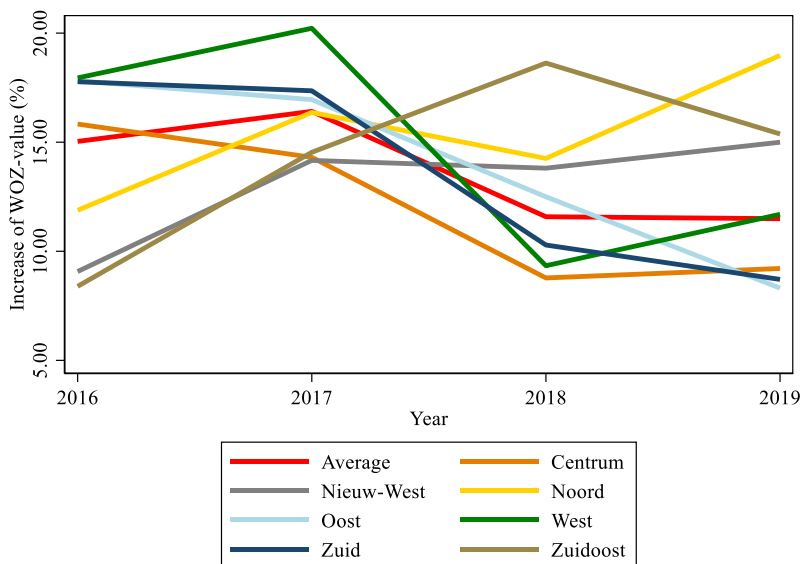*Percentage increase of WOZ-value across seven city areas of Amsterdam between 2015-2019*

Note. Figure made with data provided by Gemeente Amsterdam, 2023a

In figure 12 the number of listings per city area are observable, and in figure 13 the WOZ-value per area. Both figures show an increase over the time period of 2015-2019. For all areas a steeper increase in listings and WOZ-value can be observed in 2015-2017, afterwards the line flattens, as written in the methodology, This can be due to the increased restrictions added by the Muncipality of Amsterdam in 2018. In 2017 it was already known that the muncipality was taking extra restrictions against Airbnb listings because every night booked in an Airbnb should have been registred at the muncipality (NOS, 2019). Thus, potential Airbnb owners could already expect that extra restrictions were following soon. This is outside of the scope of this paper, extra research should conclude if indeed the policy changes made by the municipality of Amsterdam dampened the effect of Airbnb listings on WOZ-value.

All areas with a higher than average WOZ-value also have a higher than average number of listings, and all areas with a lower than average WOZ-value have a lower than average number of listings. Indicating a correlation between the number of listings and WOZ-value. Because areas with a high number of Airbnb listings also have expensive housings. This can also be due to different reasons as it might be a more popular area to live. When the increase of WOZ-value (Figure 16) is combined with the increase of Airbnb listings (Figure 14) this effect is further visible. Especially in 2017-2018 a substantial dip in increase of Airbnb listings is at the same time as a same level of dip at the increase of WOZ-value. Thus, indicating that the number of Airbnb listings and WOZ-value do correlate. Regression analysis in the next chapter is used to analyse this further.

The other peculiar trend is a decrease of listings, occuring at the same time as an increase of WOZ-value. For example in Noord from 2018-2019 the WOZ-value increased steeply while the Airbnb listings decreased steeply. In Zuid-Oost the WOZ-value decreased while the number of Airbnb listings increased in 2018-2019. This can be explained by the increase of housing supply. In figure 15 the increase of housing supply is shown. Firstly, Noord had a dip in increase of housing supply from 2018-2019. Less supply equals a higher price whenever demand stays the same. This can explain the increase of WOZ-value. Secondly, the contrary can be seen for Zuidoost. Zuidoost has a high increase of housing supply in 2018-2019 which could dampen the increase of WOZ-value due to an increase of Airbnb listings. Because if demand does not grow as quick as supply, prices lower. On average this effect is also observable in 2016-2017. WOZ-value increased more than the increase of Airbnb listings. However, the housing supply had a low level of increase. Thus increasing prices as supply was less than demand. Comparing these figures it is observed that on average WOZ-value increased

(figure 16), if the number of listings increased (figure 15) more than the supply (figure 14) increased.

5.4. Underlaying mechanisms

5.4.1 Housing supply in City-centre
Figure 17

Percentage change of housing supply between 2016-2019 in Centrum and Zuid on average in Amsterdam
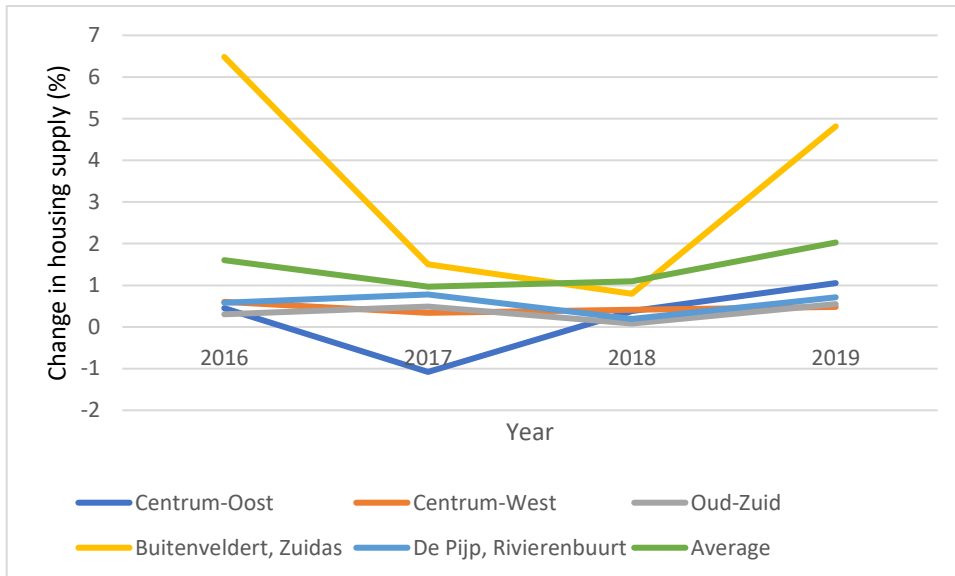
Note. Figure made with data provided by Gemeente Amsterdam, 2023a

As seen in figure 17, Centrum-west has by far the lowest increase of housing supply than other areas in Amstedam. On average the housing supply increased from 2015-2019 with 5.8%, in Centrum there was only an increase of 1.3%. The areas with the lowest increase of housing are indeed Centrum-Oost, Centrum-West and Oud-Zuid, identified as the city centre in the methodology. These areas all have a clear lower than average increase of housing supply. Identifying that housig supply is even more constraint in the city centre which is one of the mechanisms which increases housing prices in the city centre.

5.4.2. Replacement of households

Figure 18

Percentage increase of households across seven city areas of Amsterdam between 2015-2019.
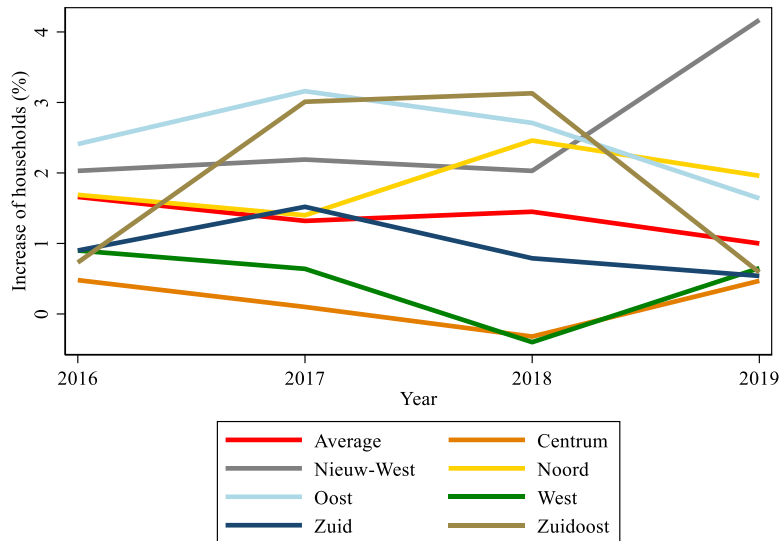
Note. Figure made with data provided by Gemeente Amsterdam, 2023a

Figure 19

Percentage of Airbnb listings compared to housing supply across the seven city areas of Amsterdam between 2015-2019
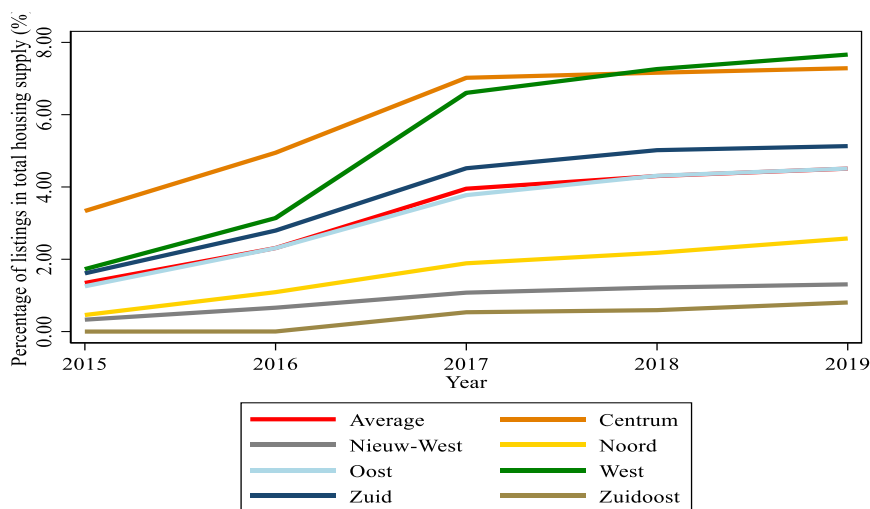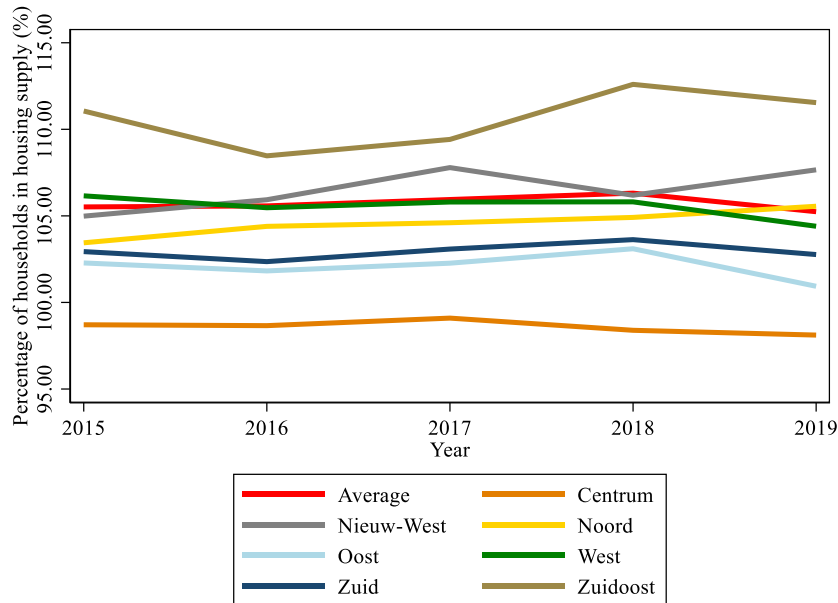

Note. Figure made with data provided by Gemeente Amsterdam, 2023a; Slee, n.d.; Inside Airbnb, n.d.

Figure 20

Percentage of households to housing supply across the seven city areas of Amsterdam between 2015-2019

Note. Figure made with data provided by Gemeente Amsterdam, 2023a

Hotelization and conversion should lead to a lower number of households whenever Airbnb listings increase. Households cannot pay the higher housing prices as investors pay higher prices due to the higher profits on the short-term rental market (Lee, 2016), resulting in households moving away from the city as Airbnb listings increase. This should be observable by a decrease of households whenever Airbnb listings increase; this trend is visible in figure 12 and 18. The figures show that the number of households indeed grew less in areas with an increased number of Airbnb listings on average. This effect can best be seen in 2017-2018 as households increase more during this time period than other years, while the increase of the number of Airbnb listings decrease drastically, and the increase of housing supply stays roughly the same. The contrary effect can be seen on average in 2018-2019, the increase of the number of listings and housing supply increased again more and housing supply directly has a dampened increase of household. This indicates indeed a correlation between a decrease of households and an increase of Airbnb activity.

This same effect is also visible if the number of households are divided by housing supply (figure 20), and compared with the number of Airbnb listing divided by housing supply (figure 19). On average it is visible that in areas with more listings per supply have less households per supply (Centrum, West and Oost). This is more visible the other way around, in Zuidoost

and Nieuw-West, the listings in supply is low and the households in supply is high. Indicating that households might be replaced by Airbnb. Giving some proof for the conversion and hotelization theories of Lee (2016).

5.4.3. Local economy

Figure 21

Unemployment rate across the seven city areas of Amsterdam between 2015-2019
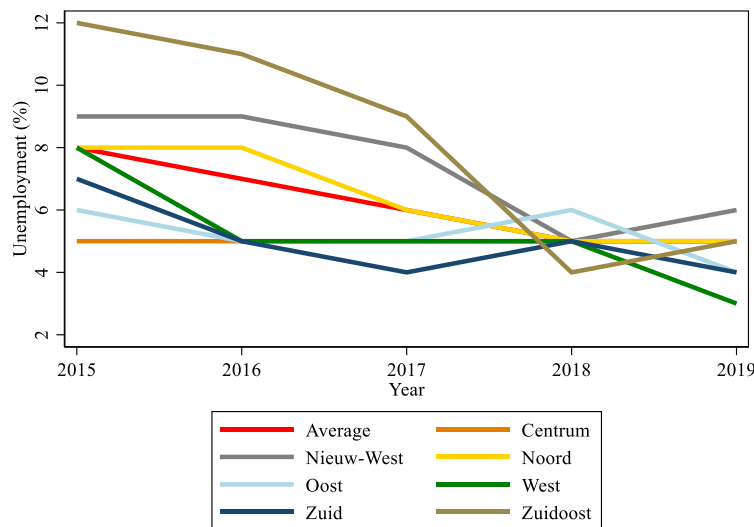
Note. Figure made with data provided by Gemeente Amsterdam, 2023a

Figure 22

Increase of disposable income in euros across seven city areas of Amsterdam between 2015-2019
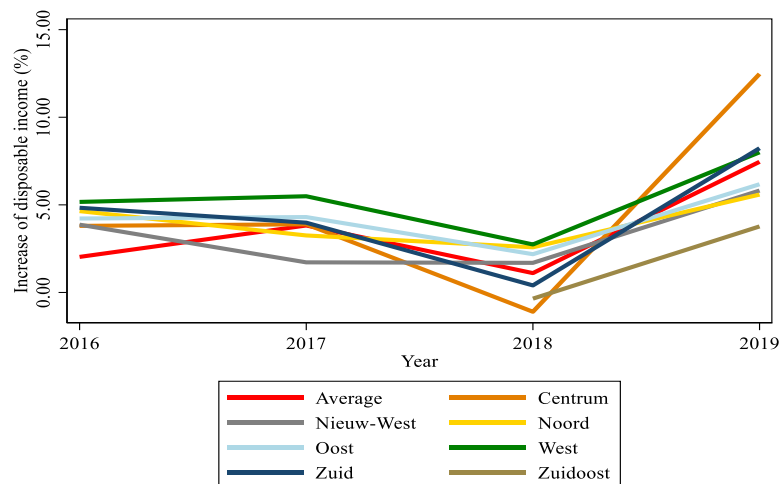
Note. Figure made with data provided by Gemeente Amsterdam, 2023a

To assess the effect of Airbnb on the local economy the unemployment rate (figure 21) and disposable income (figure 22) are used to provide limited insight in this mechanism. In figure 21 it is observable that in all areas the unemployment rate is lower in 2019 than in 2015. During this time the number of Airbnb listings also increase as seen in figure 12. Secondly, in figure 22 the increase of disposable income in Amsterdam is observable. The increase of disposable income has overlap with the increase of Airbnb listings. The same average trendline is visible with a higher increase between 2016-2017, lower increase in 2017-2018. However, disposable income does increase tremendously in 2018-2019 while the number of Airbnb listings does not increase as much. While for Zuidoost the same trend is visible in increase of disposable income and increase of Airbnb listings. Thus, there seems to be a correlation between local economic indicators, Airbnb listings and housing prices. Providing some proof for the mechanism that Airbnb boosts the local economy, which increases the housing prices. However other underlaying effects cannot be rejected sucha as unemployed moving away from the city.

5.4.4. Renovations
Figure 23

*Maintenace level of houses based on public opinion in seven city areas of Amsterdam between 2005-2021*
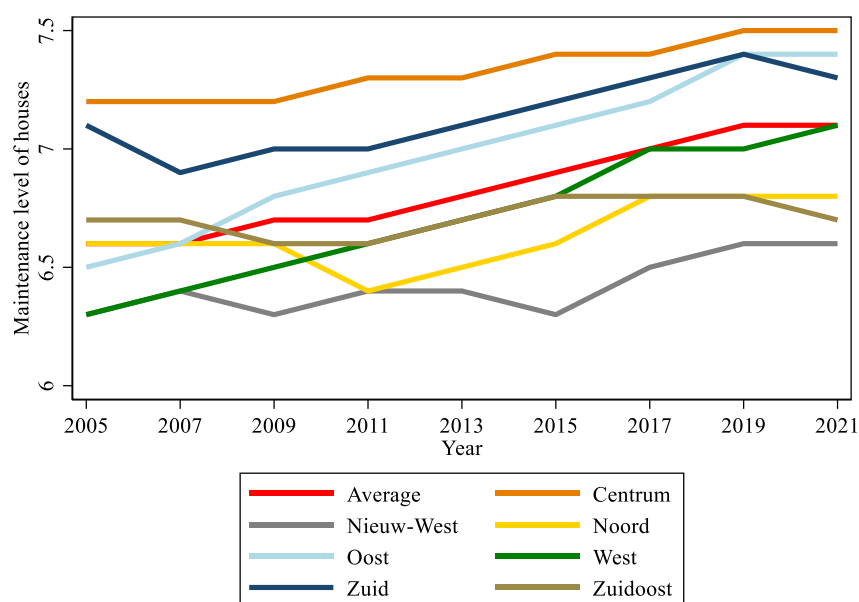
Note. Figure made with data provided by Gemeente Amsterdam, 2023a

In figure 23 the maintenance level of houses is seen. Intrestingly the maintenance level does increase substantianly more between 2011 and 2019. This is during the time on average most Airbnb listings are listed, as seen in figure 23. Secondly, in areas like Centrum with most Airbnb listings, the level of maintenance is higher than other areas and increases suddenly after 2009 the year Airbnb entered the market while staying the same the year prior. However, the same cannot be observed in Zuid-Oost. On average the maintenance level of housing increased with 0.3 since Airbnb entered the market in Amsterdam. This is not enough to state that extra Airbnb lead to a higher level of renovations because other reasons such as increase of gdp and income cannot be rejected.

6. Results

To analyse the hypothesis made in the theoretical framework chapter, multiple mixed-effects effects regression models are made. As stated in the methodology four fixed effects regression models are made to analyse the first hypothesis: an increase of Airbnb listings increases housing prices in Amsterdam. In these models the dependent variable is WOZ-value and the independent variable is the number of Airbnb listings. The first regression model is made without control variables. The second regression model is made with controls for disposable income and unemployment rate. The final two regression models are made separately due to the strong correlation between the number of Airbnb listings, housing supply and households, as stated in the descriptive statistics, this could lead to multicollinearity. However, these variables are deemed important indicators of the housing market, thus tested separately. To test the second hypothesis an interaction factor is added between Airbnb listings and the city centre to estimate another four regression models to tests if Airbnb activity has an exacerbated effect on housing prices in the city centre compared to other districts. Afterwards robustness checks are done by adding percentage of social housing and maintenance level of houses.

6.1. Hypothesis 1

6.1.1. Results hypothesis 1

Table 3

Results of linear fixed effects regressions for hypothesis 1. Dependent variable WOZ-value, grouped by GGW-areas in Amsterdam, between 2015-2019

VARIABLES	(1)	(2)	(3)	(4)
Airbnb listings	35.80***	17.59***	17.58***	18.32***
	(6.754)	(6.188)	(6.231)	(6.390)
Disposable income		12.27***	12.26***	12.26***
		(2.152)	(2.188)	(2.162)
Unemployment		2,635***	2,636***	2,594***
		(952.5)	(964.4)	(960.5)
Housing supply			-0.0296	
			(3.486)	
Households				1.552
				(3.105)
2016	28,388***	14,150**	14,164**	13,359**
	(5,741)	(5,644)	(5,927)	(5,887)
2017	61,340***	37,737***	37,762***	36,265***
	(6,591)	(7,739)	(8,314)	(8,314)
2018	96,519***	70,445***	70,479***	68,392***
	(6,883)	(9,137)	(10,040)	(10,057)
2019	137,430***	78,005***	78,058***	75,551***
	(7,124)	(14,134)	(15,540)	(15,024)
Constant	230,977***	-233,925***	-233,269**	-264,484***
	(4,318)	(77,493)	(109,801)	(98,989)
Observations	110	110	110	110
R-squared	0.928	0.954	0.954	0.954
Number of id	22	22	22	22

Standard errors in parentheses

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

Table 3 shows the results of linear fixed effects regression. All coefficients of Airbnb listings (independent variable), are significant at a p-value of 0.01. The first regression model (column 1) is made only with dependent variable (WOZ-value), and independent variable (Number of Airbnb listings) resulting in a coefficient of 35.80. After adding control variables in the second, third and fourth model, the coefficient steeply decreases to around 18, the significance level

remains 0.01. The standard error of around 6 identifies that the effect of Airbnb listings on housing prices is different across areas.

Disposable income, number of households, and housing supply affect housing prices as theory indicated. A higher disposable income increases the price of housing, because people can spend more money on housing. Disposable income significantly increases WOZ-value with a coefficient of 12.26 with a p-value of 0.01. Interestingly unemployment shows a contrary effect to what was hypothesized. An increase of unemployment increases the price of housing, this effect is significant to 0.01. This might be due to people not accepting jobs if the pay is not significant enough to pay for their mortgage costs. Or they might earn money through different means while officially being listed as unemployed, for example black market work or social security earnings. Thus, these people stay unemployed but still live in expensive housing while earning income through different means, but are listed as unemployed. No reason why this effect happens is known and this is outside of the scope of this research.

The r-squared for the first model, as expected without controls, is lower than the other models (0.928). Thus, having less explanatory power than the other models. The other models all have R-squared values of 0.954. Indicating the models can explain around 95.4% of the variance of the dependent variable, indicating strong explanatory power. These models are more likely to explain the effect of Airbnb listings on WOZ-value. The significance level remains stable at 0.01 throughout all the models, thus the null hypothesis can be rejected and the hypothesis can be accepted that Airbnb listings did increase the average housing prices in Amsterdam between 2015-2019.

6.1.2 Interpretation of results
Figure 24

Percentage increase of WOZ-value because of Airbnb activity in Amsterdam, between 2015-2019.
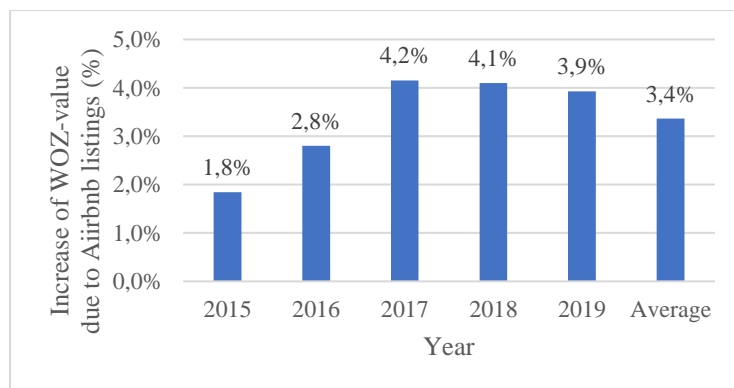
Note. The average increase of Airbnb listings on WOZ-value based on a coefficient of 17.5 is divided by WOZ-value.

The regression models estimate a coefficient of approximately 17.5. This coefficient is interpreted as every extra Airbnb listing increased the housing price by 17.5 euro averagely between 2015-2019. At first this does not seem like an enormous increase. However, taking into account that in 2015 the average number of listings in Amsterdam are 257. This means that averagely in 2016 Airbnb listings increased WOZ-value by 4490 euro in Amsterdam, this can be seen in figure 28 in the appendix. The average WOZ-value in 2015 was €242,367. So, 4490/242367= 1,8%, indicating that the WOZ-value in Amsterdam averagely increased by 1.8% in 2015 due to the number of Airbnb listings. In figure 24 the average effect of the number of Airbnb listings on WOZ-value can be further observed. On average the number of Airbnb listings increased the average WOZ-value in Amsterdam by 3,4% between the years 2015-2019.

6.2. Hypothesis 2

6.2.1. Results hypothesis 2

To analyse if Airbnb affects city centre housing prices more than in other areas an interaction effect is added between city centre and Airbnb listings. The same linear fixed effect regression models are used to test the second hypothesis, only the interaction effect is added. In all models the dependent variable is WOZ-value, the independent the number of Airbnb listings. The first model is estimated without control variables, the second, third, and fourth models have different control variables added to minimize multicollinearity. The results of these fixed effects regression models can be seen in table 4.

Table 4

Results of fixed effect regression to test hypothesis 2, dependent variable WOZ-value, grouped by city areas of Amsterdam between 2015-2019

VARIABLES	(1)	(2)	(3)	(4)
Airbnb listings	28.37***	14.61**	14.65**	16.66***
	(6.316)	(5.843)	(5.858)	(5.880)
Disposable income		10.93***	11.10***	10.70***
		(2.046)	(2.062)	(2.023)
Unemployment		2,016**	1,906**	1,772*
		(907.0)	(920.1)	(905.4)
Housing supply			2.595	
			(3.325)	
Household				5.345*
				(3.004)
Interaction effect Airbnb in city centre	50.99***	35.63***	37.36***	41.47***
	(11.41)	(9.988)	(10.26)	(10.39)
2016	26,904***	14,344***	13,091**	11,652**
	(5,190)	(5,276)	(5,527)	(5,421)
2017	58,586***	37,729***	35,560***	32,658***
	(5,978)	(7,233)	(7,766)	(7,686)
2018	93,791***	70,266***	67,256***	63,167***
	(6,239)	(8,540)	(9,390)	(9,324)
2019	134,862***	81,505***	77,013***	73,628***
	(6,452)	(13,246)	(14,473)	(13,800)
Constant	227,567***	-183,209**	-238,281**	-280,128***
	(3,970)	(73,811)	(102,250)	(90,954)
Observations	110	110	110	110
R-squared	0.942	0.960	0.960	0.962
Number of id	22	22	22	22

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

In table 4 the estimations based on the fixed effects regression models are seen. Firstly, the estimations are significant with a p-value of 0.01, indicating that the null-hypothesis can be rejected. As seen at the previous hypothesis the coefficient for the first regression model (50,99) is higher than the second (35.63), third (37.36) and fourth (41.47) models. The highest coefficient again is observed whenever households are added. However, the most reliable

estimation remains the second model as the third and fourth model potentially estimating higher estimations due to multicollinearity.

The first model has again a lower r-squared (0.942) compared to the other models around 0.962. This shows that the variance in the dependent variable can be explained almost fully by all the models however, the first model has the weakest explanation strength. The effect of Airbnb listings on the housing prices in the city centre is estimated at 50.24, the coefficient of the independent variable (14,61) + the interaction effect (35.63). Thus, every Airbnb listing added in the city centre of Amsterdam increases the WOZ-value with 50,24 in the city centre of Amsterdam.

6.2.2. Interpretation results hypothesis 2

Figure 25

Percentage increase of WOZ-value because of Airbnb activity in Amsterdam city centre, between 2015-2019.
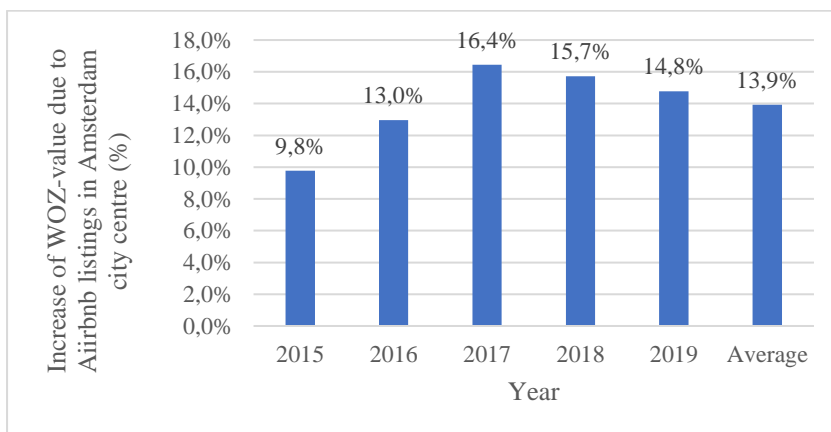
Note. The average increase of Airbnb listings on WOZ-value based on a coefficient of 50.24 is divided by WOZ-value.

As seen in table 4 the coefficient estimated is 50,24, identifying that Airbnb activity increased housing prices more in the city centre than other areas. On average the number of Airbnb listings Centrum-Oost, Centrum-West, and Oud-Zuid is 787 in 2015. Which lead to an increase of WOZ-value of 38,400 (787*50,24). To further clarify the effect of Airbnb listings on WOZ-value in the city centre the average WOZ-value will be included. The average WOZ-value in these three areas in 2015 was 392,591. Thus, increase of WOZ-value by Airbnb listings (38400) divided by the average WOZ-value (392,591) results in an effect of 9.8%, as seen in figure 25. As seen in figure 25, the average increase of WOZ-value due to Airbnb listings is on average 13,9% in the city centre of Amsterdam between 2015-2019.

6.3. Robustness checks

Table 5

Results of fixed effect regression to test hypothesis 2, dependent variable WOZ-value, grouped by city areas of Amsterdam between 2015-2019

VARIABLES	No interaction effect			Interaction effect		
	(1)	(2)	(3)	(4)	(5)	(6)
Airbnb listings	16.52**	14.94*	14.93*	14.42*	12.44	12.43
	(7.780)	(8.190)	(8.287)	(7.700)	(8.087)	(8.204)
Disposable income	16.42***	16.53***	16.49***	15.18***	15.22***	15.21***
	(2.736)	(2.727)	(2.762)	(2.772)	(2.751)	(2.790)
Unemployment	2,019	2,102	2,198	1,401	1,611	1,598
	(1,594)	(1,593)	(1,636)	(1,599)	(1,573)	(1,631)
Maintenance level	-3,747		-9,206	7,286		1,027
	(25,204)		(27,029)	(25,470)		(26,992)
Interaction effect Airbnb in city centre				21.80	22.42*	22.53*
				(12.93)	(12.56)	(13.05)
Social housing		-623.0	-773.6		-954.2	-939.0
		(1,210)	(1,301)		(1,191)	(1,271)
2017	25,080**	22,594**	23,129**	25,028**	22,718**	22,659**
	(9,830)	(10,204)	(10,443)	(9,600)	(9,923)	(10,178)
2019	50,572**	46,570**	47,711**	53,071***	49,793**	49,681**
	(19,230)	(19,471)	(19,984)	(18,839)	(19,020)	(19,504)
Constant	-355,114*	-349,405***	-276,784	-382,399*	-280,463**	-288,232
	(201,370)	(113,348)	(242,100)	(197,326)	(116,792)	(235,965)
Observations	66	66	66	66	66	66
R-squared	0.972	0.972	0.972	0.974	0.974	0.974
Number of id	22	22	22	22	22	22

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

To check if the results are robust the percentage of social housing and level of maintenance are added to the fixed effects regressions, these results are visible in table 5. These estimations are less accurate due to a lower level of observations (66). However, they do give insight if the results are altered by adding extra variables. The first three columns show robustness checks without the interaction effect added between city centre and Airbnb listings, the final three show estimations with the interaction effect added.

The first three columns in table 5 show that the result have a lower p-value than the estimations without robustness checks added, but do remain robust. The coefficients are also in line with

the results without the robustness check visible in table 3, but slightly weaker. Indicating that renovations and social housing do play a role in housing prices. However, this can also be due to the low number of observations. The results for the second hypothesis are less robust. The results are no longer significant and show a lower coefficient than in table 4. However, the data is low and extra research if necessary if social housing and renovations affect the housing prices differently in the city centre.

Social housing does seem to decrease the WOZ-value but does not lower the effect of Airbnb listings on WOZ-value. Interestingly however is that the level of maintenance of buildings decreasing the WOZ-value. This might be because the data is obtained by conducting surveys and people living in richer neighbourhoods expect a higher level of maintenance. If the maintenance level is added then the effect of listings on WOZ-value increases. Identifying that this might be a mechanism through which Airbnb affect WOZ-value by renovating building before listing them. However, social housing and level of maintenance have too low p-value to be significant and no conclusion can made if renovations or social housing affect housing prices.

7. Conclusion

In Amsterdam housing prices have increased rapidly at the same time as the rapid expansion of Airbnb. Due to the correlation between housing prices and Airbnb expansion public debate opened up about the potential regulations of Airbnb to decrease the negative external effects of Airbnb. Amsterdam is an interesting case with strong tenant protection, subsidies for home owners and a high social rental sector. Furthermore, Amsterdam has a highly dysfunctional housing market with already high prices. To analyse the effect of Airbnb on the housing market the main research question in this thesis was: *To what extend did Airbnb increase housing prices in Amsterdam in the time period of 2015-2019.*

Airbnb potentially increased the housing prices by 3,4% in Amsterdam and in the city centre by 13,4%. The results of this thesis are in line with the finding of Reichle et al (2023) and Segu et al (2020). Reichle et al. (2023) estimated an effect between 2.9% and 5,2% per 1% increase of Airbnb listings over 25 European cities, and Segu et al. (2020) 6,2% to 17% of increase of housing prices in Barcelona. This seems to indicate that stronger regulations, high percentage of social housing and tax benefits for owner-occupiers do not seem to change the effect of Airbnb on housing prices.

Airbnb potentially affects the housing market through four different mechanisms: Hotelization, conversion, local economy, and renovations. Hotelization is the phenomenon that investors buy

houses to list on Airbnb, creating a demand shock. Conversion is the switch from landlords from the long-term rental market to the short-term rental market, a supply shock. These effects increase the gap between supply and demand leading to increased housing prices. More tourists travel to cities because of cheap and varied accommodation. These tourists spend money on the local economy, benefiting the locals through more income and jobs, resulting in higher disposable income for locals. Which provides locals a higher willingness to pay for housing, leading to increased housing prices. Lastly, Airbnb hosts potentially renovate houses, increasing housing value. These effects are expected to be exacerbated in the city centre due to less room to increase housing supply and the extra demand created by tourists preferring to stay in the city centre.

Some proof was found in the descriptive statistics that the number of households decreased in Amsterdam while the number of listings increased, thus identifying consequences of conversion and hotelization. The difference between hotelization and conversion is difficult to identify, because it is not known if a house is listed by the same owner or by a new one. These findings remain correlations and no evidence is found for causation, because these people might have left the city for other reasons. The local economy has increased in Amsterdam in places with more Airbnb listings. However, this could also be for other reasons as poorer people no longer being able to pay the high housing prices. Lastly, some small increases of housing maintenance have been found in areas with high levels Airbnb activity. Especially noticeable during the years before Airbnb entered the housing market and after the average of maintenance state increased by 0.5. However, not enough proof is found that this did not occur because of locals improving their homes or other reasons. However, too little data was known to give a definitive answer.

These methods used in this thesis differ from other papers by only analysing one city, zooming in further than other studies have done and using other variables as housing supply and using governmental data and having a clearer definition of city centre. A fixed effects panel data regression researching 22 GGW-areas of Amsterdam was used to assess the effect of Airbnb on the housing market. The dependent variable was the WOZ-value of houses as a way to measure housing prices and the independent variable was the number of Airbnb listings. Control variables: were housing supply, number of households, and unemployment (Nijskens et al., 2019). Robustness checks were done with less data on the maintenance level of housing and social housing. The effects on the entire housing market remained robust, albeit with a

lower significance level. While the effect on the city centre no longer remained robust, most likely due to the low amount of data.

The increase of housing prices can result in displacement of households (Boelhouwer, 2020), while Airbnb also increases economic activity in Amsterdam. Similar to Boelhouwer (2020), Nijskens et al. (2019) and Schmid & Vols (2022) propose, extra housing supply is the first step to decrease housing prices. Supply constraints worsen the effect of Airbnb listings on the housing prices. Thus, it is imperative to build extra houses in Amsterdam. However, as building houses in the short-term remains difficult other solutions need to be taken into account (Nijskens et al., 2019; Schmid & Vols, 2022). Strong tenant protection might incentivize landlords to enter the short-term market, decreasing these protections can dampen the effects of conversion. Adamiak (2018) and Reichle et al., (2023) find evidence that stronger regulations on Airbnb activity do not necessary work. However, some strong measures and enforcement can change this, as Overwater & Yorke-Smith (2021) state more households will be displaced if Airbnb is not regulated. Banning Airbnb in the city centre can be a start. Licensing the number of Airbnb listings or taxing Airbnb profits higher are also solutions. Taxes decrease the extra profits made by short-term rentals compared to the rental market, resulting in less incentive to enter the short-term rental market. However, this might create spill over effects to other parts of the Netherlands. Thus, it might be more efficient to work together on province level to decrease the negative external effects of Airbnb. Boelhouwer (2020) also notes that increasing social housing and making it accessible for middle incomes again might help to at least house people who have difficulties finding housing momentarily.

8. Limitations

Most limitations concerning this paper are related to data constrains. The data of the number of listings on Airbnb is not publicly available. However, scrapers do create insight regarding the number of Airbnb listings, but this data is not flawless. The scrapings are done during a specific moment and have no indication if someone lives in the house or not, or if the listings are listed all year round. The data is limited and extra data from the entrance of Airbnb in the Amsterdam housing market can provide further insight in the potential increase of Airbnb on the housing market. Because if housing supply does keep up with extra demand, then Airbnb can have a smaller effect on the housing market in Amsterdam. Secondly, dividing house prices and rental prices can further indicate if housing prices are affected differently. Thirdly, no

counterfactual is available. Thus, not all variables can be controlled for, leading to possible disturbance in the data by omitted variables.

No distinction can be made between the mechanisms, some mechanisms can affect the housing prices more than others. The data also does not show if no indication is given if Airbnb hosts live in the same building or not. If hosts live in the building, then hotelization and conversion can have different effect, because if the hosts also live in the house, it is not removed from the rental market, thus the increase of pricing can be lower. Secondly, if conversion or hotelization happens is unknown, because the data does not indicate if the Airbnb listing is sold. The reasons why they move away can be different, it is unclear if this is because of regulations or simply higher profits. Long-term rentals are more stable which might be a reason for them to stay in the long-term market. No indication is given if houses are sold before listed or otherwise.

Extra data of housing values compared to Airbnb listings on a monthly basis can further asses the effects of Airbnb listings on housing prices. Further research can focus on the effect of different accommodations available on housing prices, or if hosts stay in the same building. Other interesting effects are the potential spill over effects from the increase of the housing price in Amsterdam to other areas in Amsterdam or other cities. People could decide to live in other areas of Amsterdam or Airbnb listings could increase in other areas as the city centre becomes full, because the market of Airbnb listings in Amsterdam would be saturated. These effects can be further analysed. Other areas might be differently affected by the extra demand created by Airbnb. Also, this thesis finds a peculiar effect of unemployment increasing housing value. This cannot be explained and can be further explored by others.

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Appendix

Figure 26

Social housing in Europe in 2019.
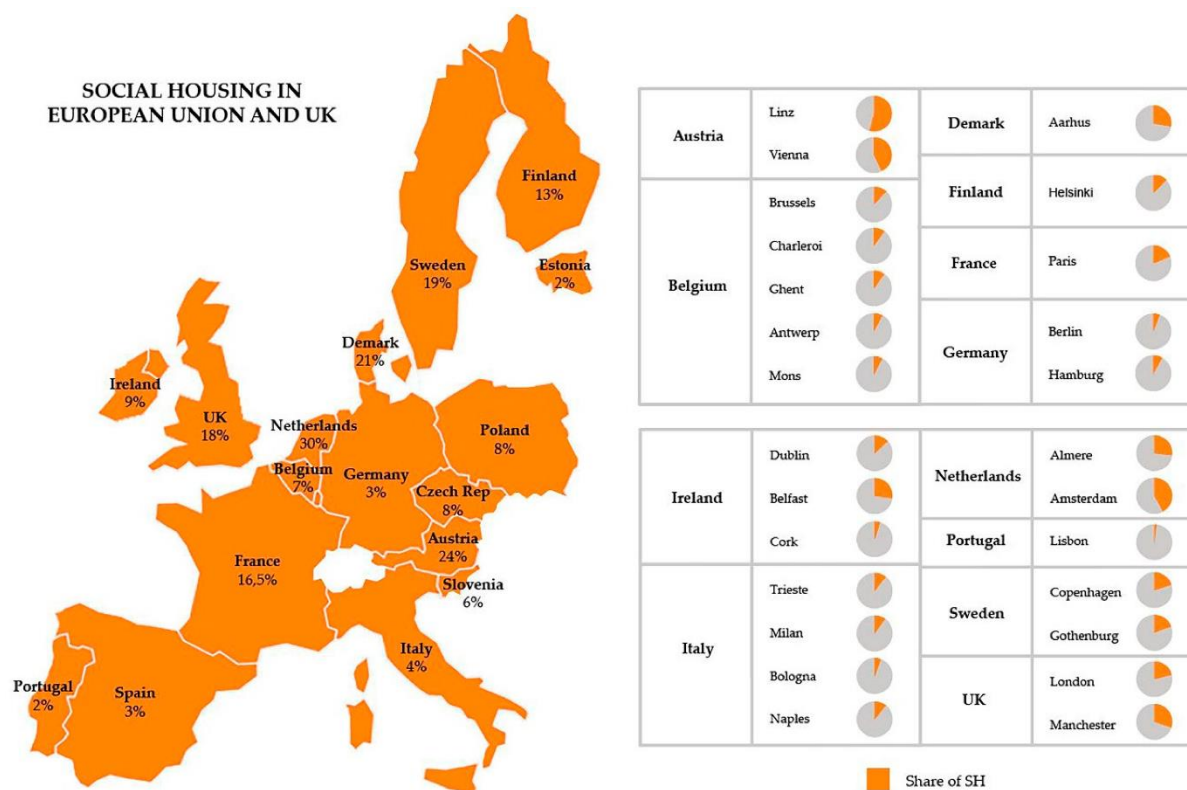
Table 6

Households in Amsterdam

Area	2015	2016	2017	2018	2019
Centrum-West	28077	28148	27871	27932	28158
Centrum-Oost	26380	26365	26470	26665	26875
Westerpark	22121	21702	21640	21690	22222
Bos en Lommer	17730	18413	18346	18533	18703
Oud West, De Baarsjes	43105	43374	43167	43470	43482
Sloterdijk Nieuw-West	74	76	104	466	716
Geuzenveld, Slotermeer	20254	20686	20687	20838	21044
Osdorp	18622	18905	19096	19168	19097
De Aker, Sloten, Nieuw-Sloten	11957	12149	12176	12203	12212
Slotervaart	17762	18358	19534	21908	22530
Oud-Zuid	29546	29677	29678	29448	29433
Buitenveldert, Zuidas	13214	14146	14728	15367	15374
De Pijp, Rivierenbuurt	38891	39068	39140	39186	38935
Oud-Oost	19204	19698	19962	20256	20419
Indische Buurt, Oostelijk Havengebied	21435	21418	21567	21631	21744

Watergraafsmeer	17883	19235	19608	19580	20514
IJburg, Zeeburgereiland	8863	9162	10260	11103	11846
Noord-West	16766	17075	17358	17388	17582
Oud-Noord	14007	14085	14800	15623	15802
Noord-Oost	13522	13755	13863	13911	14084
Bijlmer-West	135	292	518	544	502
Bijlmer-Centrum	12434	13115	13463	13529	13450
Bijlmer-Oost	13659	13920	14731	14857	15077
Gaasperdam	16303	16483	16468	16520	16626

Note. Table made with data obtained from Gemeente Amsterdam (n.d.)


Table 7

Housing supply in Amsterdam

Area	2015	2016	2017	2018	2019
Centrum-West	28386	28552	28646	28766	28908
Centrum-Oost	25546	25665	25380	25494	25770
Westerpark	21346	21563	21593	20988	21781
Bos en Lommer	16571	17224	17364	17457	18094
Oud West, De Baarsjes	39086	39424	39508	39764	39911
Sloterdijk Nieuw-West	44	42	42	42	646
Geuzenveld, Slotermeer	18728	18971	19063	19216	19325
Osdorp	17672	17722	17523	17447	17421
De Aker, Sloten, Nieuw-Sloten	11014	11020	11021	11096	11111
Slotervaart	16388	16806	17189	19354	20507
Oud-Zuid	28349	28436	28576	28599	28756
Buitenveldert, Zuidas	13215	14073	14285	14397	15091
De Pijp, Rivierenbuurt	36674	36886	37175	37247	37515
Oud-Oost	18221	18555	18890	19072	19391
Indische Buurt, Oostelijk Havengebied	20368	20261	20433	20489	20926
Watergraafsmeer	16791	18078	18374	18437	19617
IJburg, Zeeburgereiland	8454	8754	9733	10702	11414
Noord-West	15713	15900	15998	16069	16202
Oud-Noord	13222	13240	13911	14342	14833
Noord-Oost	12622	12738	12451	12834	12802
Bijlmer-West	14	187	362	362	397
Bijlmer-Centrum	10875	11780	11849	11858	12180
Bijlmer-Oost	11954	12084	12671	12751	13004
Gaasperdam	15148	15131	15130	15128	15138

Note. Table made with data obtained from Gemeente Amsterdam (n.d.)
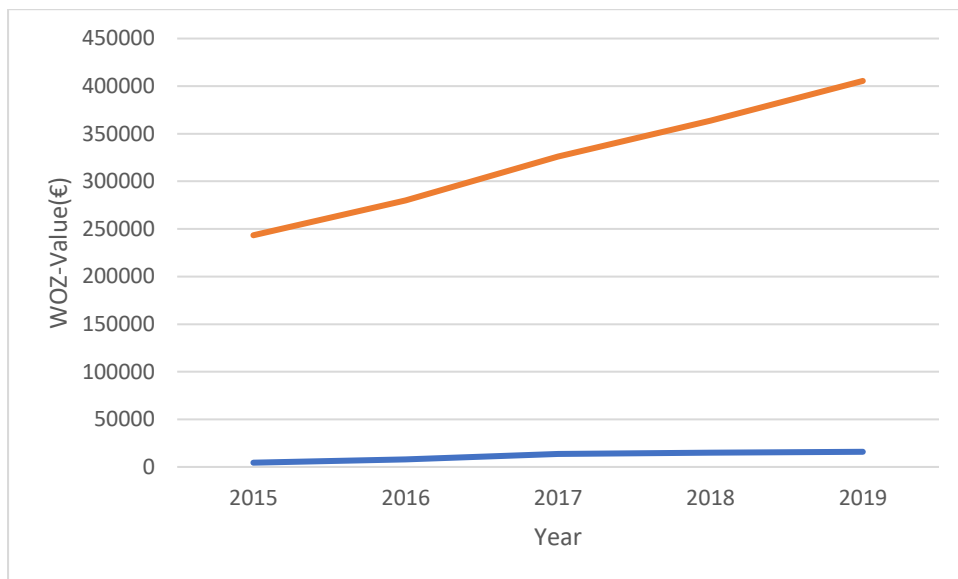

Figure 27

Hotel guests in Amsterdam
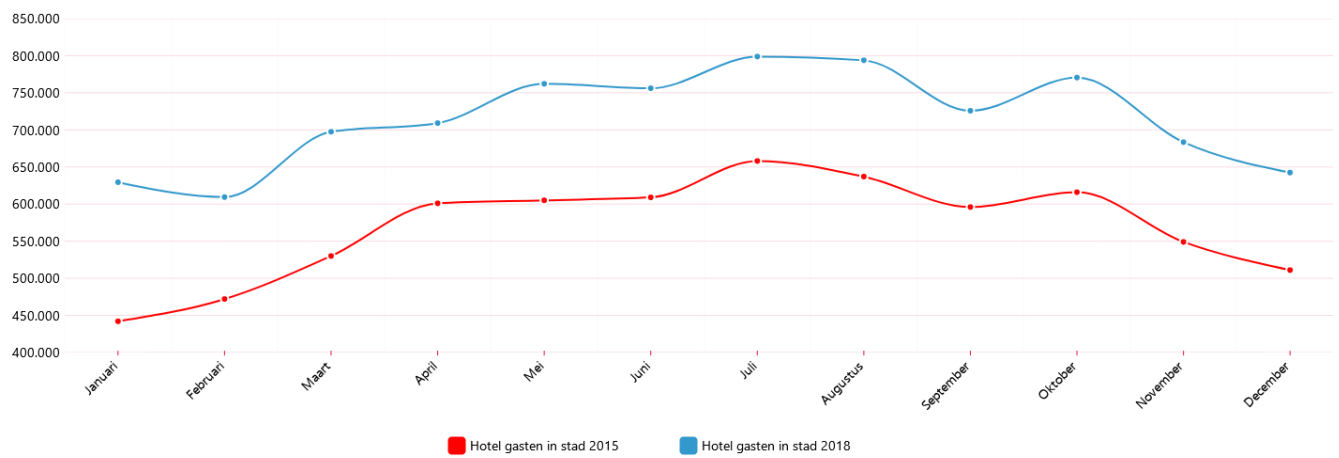
Note. Figure copied from Visitor instight (n.d.)

Figure 28

Increase of WOZ-value because of Airbnb listings in Amsterdam on average in euros, between 2015-2019.

Note. Data provided by Gemeente Amsterdam (n.d.) based on a coefficient of 7.5