

CHARLES UNIVERSITY
FACULTY OF SOCIAL SCIENCES

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**The Effect of Airbnb on Prague Housing
Market**

Master's thesis

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Declaration of Authorship

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Prague, July 27, 2021

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Abstract

This thesis studies multiple topics but its main purpose is research of the effect of home-sharing platform Airbnb on house prices and rents in Prague. Sharing economy in general is still a new sector and it is very hard to uncover and correctly analyze it and therefore there are not yet that many studies on this topic. Using very contained and detailed datasets of Airbnb listings, house transactions and renting, we prove that there is a relationship between Airbnb activity and house prices. The results suggest that the increase of Airbnb listings by 1% leads to a 0.01% in house price. We also look at COVID-19 and its impact on house prices and rents. This part will be very theoretical since the pandemic is still an actual topic and its real effect might not be fully visible yet.

JEL Classification C23, C52, R20, R21, R31
Keywords Airbnb, Housing, Market, COVID-19, Short-term, rent, price
Title The Effect of Airbnb on Prague Housing Market

Abstrakt

Tato práce studuje několik témat ale jejím hlavním posláním je výzkum efektu home-sharovací platformy Airbnb na ceny nemovitostí a nájmy v Praze. Sdílená ekonomika je nový sektor a je velmi složité odkrýt a analyzovat ho a proto zde stále není příliš mnoho studií na toto téma. Za použití velmi rozsáhlých a detailních datasetů o Airbnb, transakcích bytů a nájmech dokážeme, že existuje vztah mezi aktivitou Airbnb a cenami nemovitostí. Výsledky naznačují, že nárůst počtu listingů na portálu Airbnb o 1% vede k nárůstu cen nemovitostí o 0.01%. Dále se také podíváme na COVID-19 a jeho dopad na ceny nemovitostí a nájmy. Tato část bude spíše teoretická, jelikož pandemie je stále velmi aktuální téma a její pravý efekt ještě ani nemusí být plně viditelný.

Klasifikace JEL C23, C52, R20, R21, R31
Klíčová slova Airbnb, Bydlení, Market, COVID-19, Krátkodobý, nájem, cena
Název práce Vliv Airbnb na Trh Nemovitostí v Praze

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Acronyms

UNTWO United Nations World Tourism organization

HSO Home-Sharing Ordinances

ČSU Český Statistický Úřad

MPSV Ministerstvo Práce a Sociálních Věcí

Master's Thesis Proposal

Author	Bc. Daniel Ondruška
Supervisor	Mgr. Petr Polák MSc. Ph.D.
Proposed topic	The Effect of Airbnb on Prague Housing Market

Motivation Airbnb was founded in 2008 to provide a platform to accommodate guests from all around the world in hosts house or apartment. It did not take long, and people started to see this as an opportunity for business and suddenly, Airbnb was successfully operating in every bigger city all around the world offering more bedrooms than any hotel chain in the world. As the activity of Airbnb was growing, so did the attention it was getting from governments, competition, like hotel services, but also from ordinary people that started to be influenced by this service even though they have no role in it.

In past few years, there is a growing amount of literature studying the inequality in competition and taxation of Airbnb like Dogru et al. (2020) and the attention it was given caused cities like Amsterdam or London to regulate and restrict Airbnb in order to keep competition fair. In this work, my first task is to study the relationship between prices of Airbnb and apartments in Prague and compare them with results from other big cities, where in order to relieve the pressure on housing prices from Airbnb, the regulations already took a place. This work should give us a vision of how profitable Airbnb is and whether it became such a big player that it can drive the housing prices up that much that certain steps should be taken in Prague as well. There are couple works with different opinion. Jiao and Bai (2020) claim, that Airbnb is a problem, mainly for city centers, while for example Ayoub et al. (2020) think, that the effect of Airbnb is too small to influence housing prices and there is no need to pay too much attention to it. For Prague, there is not such an empirical analysis yet, the only studies are theoretical newspaper articles so I will try to examine situation in Prague and come up with results that could be useful for future research in the Airbnb area.

Covid-19 undoubtedly influenced global economy for following months, in some economy sectors even for a couple of years. Some sectors got hit harder than the

others and my second task will be to study its effect on short-term rentals, mainly on Airbnb since most of the countries restricted traveling in at least some way and the tourism for Czech Republic and other countries stopped at all, both for our citizens to travel abroad and for foreigners to arrive here. This already suggests that all the sectors related to tourism are severely affected. In some cases of short-term rentals, this led to a transfer to a long-term rental causing the supply to overflow the demand and the price of rents went down by tens of percent in Prague.

Hypotheses

Hypothesis #1: The price of housing is correlated with price of Airbnb

Hypothesis #2: How hard of an impact Covid-19 had on Airbnb and housing market

Hypothesis #3: Airbnb in Prague is way too profitable. What are the main factors of profit?

Methodology As already mentioned, there are just general analysis of Airbnb in Prague studying questions like what the price determinants or in the overtime development of Airbnb are general. In this work I would like to go little bit deeper, and I would like to study the relationship between Airbnb prices and prices of housing. There are already similar studies on this topic from United States that prove that there is certain drive from Airbnb on prices of housing. For this purpose, I will use dataset of short-term lease in Prague containing price, availability, location, rating, capacity and many other important variables from previous 5 years. Second dataset will be dataset of prices and rents of apartments in Prague distinguished by their location. I am going to use similar model as Kyle Barron et. Al (2018) who assumes that the price or rent of apartment in location i and time t is dependent on Airbnb supply and time-varying characteristics like average household income, population, share of population having at least Bachelor's degree and employment rate in location i and time t . In addition to the mentioned variables, they include google trends as instrumental variable to address the issue of correlation of unobserved time-varying factors and Airbnb activity. Their results suggest that the increase of rents and price of houses is caused by relocation of housing units from long-term to short-term renting market.

Covid-19 had undoubtedly huge impact on housing market and with the dataset from Airbnb.com I am going to study this problem and how much it damaged this sector and what can be expected in the future. I will do the same research in long-term leases as well as for the apartment prices in Prague to see which part of the housing market is the most damaged one by using data about number of

infected people both in Czech Republic and worldwide. Furthermore, after creating a model describing the pressure of Airbnb activity on housing prices, while having all these datasets, I will create profitability model and percentual return based on different parameters of property and furthermore I will compare these results with performance of Airbnb in other cities.

Expected Contribution Main goal of this thesis is to show how much of an influence on housing prices comes from the activity of Airbnb in Prague. If this pressure is too strong, it is possible that in near future local people could not afford living in Prague because of the limited supply of long-term rents caused by the shift to the potentially more profitable short-term. Covid-19 is current problem that has not been here ever before and therefore its effect on this housing market has not been studied yet so I want to contribute by this research to understand little bit more what happened, what might happen in similar scenarios and whether it relieved the pressure from Airbnb on housing market in Prague. Second part of this thesis should show the profitability of apartments based on specific parameters and therefore could help in deciding on where and how to regulate in order to ease the pressure but keep Airbnb viable.

Outline

1. Motivation: There are analysis of many other big cities or whole countries like United States where some claim that there is relationship between Airbnb and housing prices while others claim that there is no relationship. There is not such an analysis of Airbnb in Prague so I would like to contribute by clarification of situation in Prague and by comparing it with other cities.
2. Literature review: I will go through Airbnb analysis of other authors and make use of important findings they came out with.
3. The legal side of Airbnb: I will make a summary of legal side of Airbnb in order to show the boundary in which Airbnb can move
4. Data collection: I will briefly explain from where and how I will download the data and which method I will use to proceed.
5. Methods: I will do calculations, including research of correlation between Airbnb prices. Special attention must be paid to possible unobserved effects.
6. Discussion over results: I will discuss results and connect them with theoretical questions about this topic.
7. Conclusion: I will summarize my results and based on these results I will propose possible future research in order to clarify this topic even more.

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Chapter 1

Introduction

The sharing economy is still relatively new sector, but the rate at which it is growing is incredible. As its name already suggests, it is a peer-to-peer model based on providing and sharing of surplus goods like cars, bikes, apartments and services like food delivery or driving service to others directly between producer and consumer to achieve a profit. All this products are often offered for lower price than companies specialized in this sector are demanding which makes it very popular but also very competitive for original companies that are not able to keep pace with such prices and therefore the opinions on this kind of service are different and many do criticize it.

There is a lot of controversy about sharing economies and discussion about positive and negative impact on society and economy are raging over and over again. There exist many different types of sharing economy subjects and platforms in a lot of different sectors from car sharing to financial services like loans or investment. Main topic of this thesis will be home sharing platform Airbnb and its effect on housing market in Prague. There is a lot of criticism of home sharing services because of multiple reasons but the main two reasons are the accusation of an increase of real estate prices and rents because of the activity of Airbnb as well as the negative externalities of such a service like noise or pollution. We will focus on the quantitative side of this problem which is something most of the studies are avoiding not only in Czech Republic but worldwide and where we would like to open this topic for future research and to encourage other studies to work on it. The hardest part and therefore the biggest problem of this work is preparation of data in order to be the most suitable for our model so the results are as much trustworthy as possible.

In this work I am studying two topics. First one is the effect of current pandemic COVID-19 situation on short-term renting sector and on housing sector in general. At the time of writing of this work it is more than 1 year since the first case of COVID-19 appeared in China and later on in the whole world including Czech Republic. Since its first appearance this virus went through many mutations and it becomes stronger and stronger every day, however vaccine, hopefully effective, is already developed and being distributed all around the world so if everything goes according to plans, in a few months situation should be stabilized. Every single country and bigger city was hit by this crisis in its own way. Some governments managed to handle this situation well while others did not. At the beginning, Czech Republic had very low number of sick people but later on situation here became one of the worst among countries, with the highest share of sick people per one million inhabitants. This worsening situation resulted in other countries forbidding arrivals for not only Czech but also many other citizens from countries that were hit hard by this pandemic. These restrictions and flight bans obviously caused tourism to fall to levels very close to zero.

With no tourists, big part of short-term landlords moved to long-term rentals causing the rents sometimes go down by tens of percent which might cause lots of trouble since it is quite common, that apartments are under mortgage and owners were expecting to cover its payment by rent, but now they are not able to meet obligations to banks and they might even have to end their business and lose their property. Right now both short and long-term rental prices dropped down quite dramatically by tens of percents and we cannot certainly say whether they will be able to recover to its previous values once the tourism is restored or whether they were artificially stimulated to such a numbers that they could be considered overpriced. Price of housing in general seems not to be influenced yet that significantly, in some cases the price of houses went up against all the odds and one can only guess whether the effect will be the same in the future as it is in the renting sector right now.

Second topic of this thesis is the problem of the possible connection between growth of the popularity of Airbnb, number of its listings in particular, and the growth of the rents and housing prices in Czech Republic, specifically in Prague, which is a very tourist town, mainly its city center. Unlike other big

cities like Amsterdam or London, Airbnb in Prague has not been regulated yet and hosts are able to rent their properties 365 days a year under no additional special conditions except for having a trade certificate and for obligation to pay taxes. Regulations in the form of restriction of days available for rent have been submitted to the government but so far hosts have relatively free hands in their business. There are around 700 000 housing units in Prague from which approximately 10 000 is being used for short-term rents through Airbnb platform. It is not uncommon that there are owners who are listing more than one apartment, actually more than 50% of lessors own more than one property, up to the extremes, where specialized companies own more than 100 flats or rooms they use for this business. For the purpose of this work I am going to use comprehensive dataset provided by Adam Nedvěd from Blahobyty.cz including all the properties listed on Airbnb site since 2016. This dataset contains apartment's costs, location, rating, number of beds, number of reviews, availability and many more important information. From this data I construct a panel dataset based on location, year and month when the listing was published. Apart from Airbnb data set we will be using two more datasets that were provided by Společnost pro Cenové mapy ČR s.r.o where first one will contain house prices since and second will contain data about prices of rent since 2015.

We will study this problem by constructing fixed effect model including dependent variables house prices, rents and price-to-rent ratio and independent variables like average income, population, proportion of population with bachelor's degree or higher, proportion of unemployed people and of course the Airbnb activity. Our model is based on data between January 2015 and December 2020 and we will be searching for three main relationships – the effect of number of Airbnb listings on house prices, rents and price-to-rent ratio and for the calculation of active Airbnb listings we will be using three different methods of how to decide whether a listing is active or not since not every listing on Airbnb site is actually really active and available but we will look deeper into this problem later on in section explaining our data. We will also create second dataset excluding the time period of COVID-19 since we believe that these data might negatively influence our results because it is yet unclear what effect this pandemic on economy and our used variables had and whether this effect can be included.

We estimate that the increase of Airbnb listings by 1% leads to increase

of house prices by around 0.01%. We found that huge impact on house prices comes from average income. Using all the data we estimate that increase of average income by 1% causes house prices to increase by 1.2% and using dataset containing only pre COVID-19 data we get results of 0.9% increase of house prices for every 1% increase of income. The rents are by our model estimated not to be influenced by Airbnb activity at all and the biggest driver of rents seems to be the income which in both cases makes absolute sense and this outcome was expected. For price-to-rent ratio we estimate similar impact of Airbnb like in house prices since the effect on rents was close to zero and it is equal to around 0.01% for 1% increase of Airbnb listings. Our results prove that there is certain relationship between Airbnb activity and housing market but the effect mainly on the rents is not as significant as one would guess and that the increase of rents might have its origins somewhere else. We proved that the number of listings has direct impact on the house prices which might be caused by raising interested in buying of the property for the rental purpose in order to build kind of passive income as well as investment into the value of real estate itself.

Apart from our two main studied topic, we will include one last part that will focus on current profitability of Airbnb. This part is included mainly to show the possible ways of development of Airbnb in Prague by showing which districts are the ones with the highest potential and therefore might attract new investors causing the Airbnb activity go up and which, on the contrary, are overpriced and therefore it is expected that the Airbnb activity will go down as well as the house prices in general. This part of the work will show the possible surplus of providing an apartment for short-term rentals instead of long-terms, how long it takes for an apartment to be repaid solely by its short-term income and the development of prices and rents. Obviously the more the apartment is situated in the city center more can its owner ask per night but we show that city center locations like Josefov are actually the least profitable and it might be worth buy an apartment in location like Troja or Vinohrady in order to achieve the biggest profit.

Chapter 2

Home-sharing literature

Peer-to-peer markets including Airbnb are very rapidly growing sectors which are drawing a lot of attention and the amount of literature studying it is rapidly growing as well. Sharing economy is a socio-economic system that tries to most efficiently exchange goods and services that are being unused between individuals and organizations (Munoz & Cohen 2017). The first part of this work studying COVID-19 situation has significantly less literature cover since this pandemic is something still quite new for our society and there are only few researches studying effect of it on both short and long term renting. Most of researches studying the relationship between short-term and long-term rentals study American cities, but literature about European cities is slowly emerging aswell. These studies most often use price of Airbnb and price index of apartments or rents as their main variables but each individual study adds their own variable they consider to be important either by their will or because of its importance for the studied city like number of total and vacant housing (Bao & Shah 2020), number of tourists (Patatu 2020) or criminality rate (Schwarzova 2019). This section will at first go through literature about sharing economy in general, afterwards will go into a detail of home sharing in United States and in Europe to see the difference and the last part will go through the literature studying COVID-19 and its impact on the housing market and economy in general. There is only a few quantitative works studying the European cities but still the biggest amount of this literature comes from United States and therefore this work might be very important for development of European literature studying this topic.

2.1 Peer-to-peer Literature

A peer-to-peer economy is a decentralized model with two main factors - buyer and seller. These two individuals interact between themselves without any third-party intervention. There are two main sectors in such an economy where the first one lets the demanders/buyers search product on their own and lets them decide which specific product for which price from which supplier/seller they want to buy (Proserpio & Tellis 2017). This group includes platforms like Airbnb or eBay. The other one connects demanders and suppliers directly through servers of provider in order to achieve the most efficient connection and satisfaction (Uber, Bolt, DameJidlo) by choosing best possible matches in order to maximally satisfy both buyer and seller.

Not only because of the peer-to-peer markets but thanks to the advent of the internet and technologies in general, the gap between local and global economy is still shrinking and the opportunity of doing business has grown enormously. Advertisement targeting gets easier every day and there is no need of great know-how in order to start your own which encourages small suppliers to enter (Leoni 2020). Peer-to-peer economy is viewed as an alternative to a capitalism where firms take care of production and distribution of their final product and for this purpose, they hire necessary labor. This does not mean that peer-to-peer economy and capitalism should not be able to coexist. Capitalist economy can produce large amount of product thanks to its efficiency opposed to peer-to-peer market where everyone owns his own small business. On the other hand, peer-to-peer business does not have to pay so much attention to sharing of the information about quality of their products, since they are most often rated back through online platform by its own costumers (Einav *et al.* 2016) and therefore, they are able to offer prices lower than the business in capitalist model. In general, peer-to-peer market gives an opportunity to share excess of either goods of services that could possibly be unused otherwise, with demanders for a short-term (Ferrerri & Sanyal 2018).

Today, in multiple industries figures at least one of peer-to-peer service, but it is not uncommon that there are more than one like in ride sharing sector Uber, Lyft and Bolt. eBay was one of the first platforms that instead of selling its own asset made it possible for its users to sell any kind of product all around the world for just a little fee (Proserpio & Tellis 2017). It did not

take long and the success of eBay dragged attention of large companies, most often from Asia, China in particular, which took over this platform and made from business friendly peer-to-peer market their own platform by making the prices of their products noncompetitive for small sellers thanks to their mass production pushing their costs much lower than other producers. Is this to be an expected scenario for other peer-to-peer services like deliveries or rides? These models might not be the winning ones either for economic, regulatory or economic reason but at least for some time these are going to be an interesting area to pay attention to (Einav *et al.* 2016). Sharing of vehicles or drivers is another huge part of sharing peer-to-peer economy. Biggest platform in this sector is, without any doubts, uber. This platform was founded in 2009 and now after 11 years is operating in more than ten thousand cities all around the world. Apart from its main source of service which we can say is proposing of taxi drivers services, uber is also well known for its feature of food delivery. At first uber drivers did not have to meet any conditions in order to drive for this company and everyone with driving license was able to download the application into his mobile phone and earn decent amount of money for his services. In most of the capital cities, including Prague, taxi drivers expressed their disagreement by organizing a protest against this platform since the conditions of competition were noticeably unbalanced. In multiple countries Uber was declared illegal which was in some cases cancelled few years after this ban was accepted because of the disagreement on the side of uber drivers. However, many countries like Czech Republic, Germany or some states of United States of America found this service legal under the condition that the drivers acquire special or taxi licences for their business and therefore they must obey same laws and fees as taxi drivers. Mishel (2018) claims, that uber drivers under current conditions earn less than 90% of working population in the United States so the question is where is the real problem and whether some kind of general regulations of this particular sector should not be taken instead in order to achieve some balance.

Peer-to-peer platform Airbnb has grown into the point where it can be considered the largest hotel chain in the world. Even though Airbnb is not a hotel chain in a true sense, studies found that it has significant effect on the hotel prices and occupancy rates (Zervas *et al.* 2017), (Choi *et al.* 2015), (Koster *et al.* 2021) but we must be cautious because this effect is different for different type of hotels (Dogru *et al.* 2020) and for example taxation is big

game changer for this relationship (Vinogradov *et al.* 2020) since it is one of the main factors that affects the gap between Airbnb and hotels. People who own a property that is being vacant might be looking for usage of it in order to generate additional income. At first there was mainly the usage for long term renting or simply for the purpose of growing real estate prices but with the emerge of peer-to-peer markets the possibility of little higher income through short term lending was real (Lutz & Newlands 2018). This effect of short-term renting is visible on the long-term renting market as well because of the transfer of apartments from the long-term to short-term renting the rents and real estate prices are being pushed up (Robertson *et al.* 2020). We will be studying such a relationship in this work since the prices and rents are increasing very fast almost every month in past few years and the question is whether the Airbnb is one of the factors that has its own effect on it or if the effect is so small that it is not even worth mentioning it. Some experts point out that what was at first just possibility of a side income from unused residence or apartment began to be abused and professional companies or individual entrepreneurs are operating more than one property as their main job (Adamiak 2019) which stands even for Prague where there are multiple subjects or companies holding tens of apartments and using them for short-term rentals.

2.2 American Literature

American literature is very wide and is studying many U.S. cities, states and a countries. Paper focusing on the entire United States and is an inspiration for many other papers including this Master thesis is Baron *et al.* (2020). This study is very complex and instead of focusing on one single city they use dataset of Airbnb listings from the entire United States. They show that there is a positive impact on housing prices and rents. Results of Fixed Effect model they are using shows that 1% increase in listings leads to 0.018% increase in rents and 0.026% increase in house prices. They also test hypothesis that the total supply of housing is affected by the entry of Airbnb which proves to be false. The fact that the Airbnb and other home sharing services has such an effect on housing prices leads to a criticism of it because it might be causing the costs of living higher than it is necessary. Mainly in city centers this hypothesis is supported by fact that housing supply is very inelastic because of the shortage of land where new houses could be built and therefore growth of demand cannot be satisfied even in a long term and the only possible answer is shift of prices (Horn & Merantea 2017)(Patatu 2020). Before the arrival of Airbnb people could either buy house or flat for themselves or obtain it as an investment renting it for a long term but after the introduction of short term house sharing internet platforms that made this kind of sharing very easy the possibility of switching between these two kinds of utilisation of their property influenced the housing market. The question is whether the effect is so big it is worth making actions against it, or whether the short-term rentals are small portion of total rents and they have not impact on housing prices. It is clear that some long-term landlords might have switched to short term with the vision of higher profits but on the other hand there are apartments that would be uninhabited and using this kind of apartments for short term rents has no effect on housing prices. Other paper using dataset from whole the United States is Jiao & Bai (2020). They focus on 40 major cities meaning their dataset contains only like 1/10 of listings compared to the previous paper. For their study they use common variables like price, reviews, number of beds and star rating. Their results proved that closer the apartment is situated to the city center, higher listing prices and more listings. Other important variables are services that are situated near the apartment. Bars, restaurants, buses or subways have also great impact on the popularity and price. This supports the findings of Yang *et al.* (2012) that studies the hotel locations and uses similar

method and shows that most important variables in hotel industry are nearby public services, star ratings, years open and accessibility to tourism site.

United States are both in its population and area among the largest countries of the world and therefore it might be more accurate to focus on specific cities rather than take it as whole. Horn & Merantea (2017) study the effect of home sharing on rents in Boston. They point out that the biggest problem is the restricted residential housing supply caused by limited resources — mainly shortage of land to build new houses. This inevitably must lead to an increase of prices simply because of the rules of market where in this case supply will no longer be able to satisfy the demand and therefore locals might not be able to find affordable living (Lee 2016) and this scenario is similar for most of the biggest cities in the world. They prove this statement even empirically — one standard deviation leads to a 0.4% increase in local rents. Other finding they made is that only around 50% of listings are owned by residents that have no other listings in Boston. It is hard to say how many of them are short-term renting their apartment because it has no other use but it is clear that most of the other 50% have bought other real estates than they actually need just for the purpose of profit. In cities like Los Angeles in order to reduce the pressure of short term renting on housing market, so-called Home-Sharing Ordinances (HSO) were implemented (Koster *et al.* 2021). HSO means that short-term renters sharing whole properties are under same regulations as for example hotels in order to shrink the difference in conditions for both sectors. In their opinion there are three effects of short-term renting on housing market – idle spaces are used to generate additional income which increases value of these properties, long-term rentals might be switching to short-term rentals in order to generate greater value than they do and last effect, creation of negative externalities like noise or criminality increase that might cause a decrease of property value in the neighborhood. Los Angeles was at the time of writing in top 10 cities of the world with most Airbnb listings and second in the United States. With the implementation of HSO, number of listings is reduced by 70% and house prices dropped by about 3% on average and similar impact can be observed in long term rents. This effect is stronger the closer the property is to the city center up to the 10%. San Francisco came up with different approach. Only permanent residents, in this case those who reside in their unit for at least 275 nights per year, can short-term rent property that is their primary residence. They also need to register and pay a fee of \$250. Even when they

fulfill these requirements, they are allowed to lend their apartment for maximum of 90 days per year and are obligated to pay a 14% hotel tax from all the rents otherwise they might be fined S.Fishman (2015).

There are three main ways for authorities to deal with airbnb - Do nothing, implement regulations or to strictly ban it. New Orleans came with the most radical solution and prohibited short-term renting in one of its quarters – the French Quarter and regulated all the others Valentin (2021). There were many effects at once. First one is obviously decrease of listings on Airbnb. However, around the area, where the short-term renting was completely banned, spillover effect took a place and because of the increase in the demand, prices and revenues went up – Monthly there was an increase of almost 1400 booked nights and around 200 dollars in revenue per housing unit. The biggest effect could be observed in the ban zone. Complete ban of short-term renting decreased housing prices by 30 percent which is quite alarming number. On one hand authorities managed to increase the long-term supply and therefore long-term rent rates by suppressing the short-term supply but on the other hand decrease in value of housing unit by 30 percent is mainly for the owners of these units very unpleasant and in the future some kind of slower approach should be considered in order to avoid shock like this.

Airbnb does not mean only negative effects on local economy. In countries that have big portion of their income in tourism short term renting might bring even more tourists and boost the economy. Mexico is one among those countries that profits a lot from tourism where 10% increase in tourism revenues in certain location leads to increase of 2.5% in local employment and 2% increase in local population (Faber & Gaubert 2019) and Airbnb is easy and comfortable way to boost tourism by making it more affordable for foreigners to visit the country while making it possible for locals that are very often below the level of poverty to make some extra income and make their livelihood more comfortable.

2.3 European literature

England was facing a problem of very difficult housing affordability already at the time when Airbnb was not such a phenomenon it is today. It was hard, almost impossible, for young generation to afford decent housing particularly in London and south of the country (Hilber & Vermeulen 2014). Prices of the houses were one of the highest in the world. Prices were growing much faster than the incomes and that cause young workers to not be able to afford their own living. Financial crisis in 2007-2008 released the pressure a little bit and made the housing more affordable even for poorer population however they point out that the inadequate increase in demand compared to supply will keep on causing problems and will make the gap between housing prices and income rates bigger and bigger.

Barcelona is another city that has experienced big boom in tourism in past 20 years. Many landlords especially in city center moved from long-term renting to short-term renting via Airbnb with the vision of greater profit. This transfer of supply caused prices of long-term rents to go up by almost 2% and housing prices by almost 5% and in the most tourist areas this effect is almost three times greater (Garcia-Lopez *et al.* 2020). However, effect of Airbnb can be observed also in cities with less developed tourism. Good example of such a city is Helsinki where the number of listings is only about 2500 which is approximately four times less than there is in the Prague. The biggest difference compared to other cities where the tourism is more developed is the opinion of the residents who are just silently watching the situation and do not know yet what to expect from that since right now, they cannot feel any serious change that would affect them. The only difference to pre-Airbnb era might be visible in the very city center which lost its intimacy (Jokela & Minoia 2020). So far, the Airbnb is quietly developing in the background and no regulation steps had to be taken yet.

This work is going to study housing and Airbnb situation in Prague. Similar situation to Prague can be found in our neighbours - Germany, their capital city Berlin in particular. This city has almost the same supply of Airbnb listings of whole flats and houses as Prague. It is necessary to mention that in Prague there are only very few shared bedrooms or flats listed on Airbnb while in Germany almost half of the supply of short-term rents are shared bedrooms

Duso *et al.* (2020), so Germany has almost twice the number of listings as does Prague have. (The highest number of listings in Europe is in London). Berlin underwent through several reforms and regulations already that caused mainly the entire home lenders trying to promote the original idea of Airbnb – sharing of the free rooms that would otherwise be empty and that are not bought just for the purpose of this business. Their results suggest that an entire new home listed on Airbnb might cause an increase of rents in the radius of 250meters around this housing unit of at least 7 cent per month. In the case of very active listing, this effect can be even double. Their results also suggest that this effect can be little higher in the areas with lower Airbnb density.

2.4 Czech Literature

Czech literature is not yet that much wide since the Airbnb is properly operating in Czech Republic for only five years. Talking about Czech Republic, in this case we mean mainly its capital city Prague, that had before the corona crisis around ten thousand listing on Airbnb site. During this period, Airbnb managed to get a lot of criticism from local residents but also businesses that felt to be negatively influenced by raising popularity of Airbnb. So far, there are no significant regulations of Airbnb in Prague, but regulations about maximum number of days per year that the rooms can be occupied are now being discussed in government. Lukova (2019) in her study analyzes taxation of airbnb and concludes that current situation influences mainly smaller entrepreneurs while the bigger ones that started their business in Airbnb while it was paid no attention at all. She points out that the biggest difference to other countries and cities is the absence of regulation in the terms of number of days that can be occupied during the year. Her results emphasize that this number of days should be restricted to at least 150 days for the city center, in this case Prague 1, 140 days for the locations up to 2,5 kilometers far from the city center and 135 days for the apartments that are located further than 2,5 kilometers from the city center. This might result in an increase of Airbnb prices and therefore the market should be observed and eventually another steps and regulations might be considered.

Němec & Marianovská (2018) study the Airbnb in Prague as well. They focus on the supply side of this market. From around 11 000 Airbnb listings, 30 percent of hosts are offering more than 1 listing and the average occupancy

rate is around 60 percent. Mainly the share of hosts, which are most often specialized companies, that own more than one property is quite alarming and compared to other European cities it is one of the highest. Apart from pointing out about common problems like growth of housing prices and availability of living in Prague for locals, they warn about the possibility of transfer of city center's residential areas into commercial and therefore changing the whole nature of this city. Other problem is presence of grey economy and taxes that are denied to the city treasury because of the functionality and transparency of this service. Couple more articles about Airbnb and sharing economy can be found, but these are the most important works for this thesis.

2.5 COVID-19 Literature

Whole world suffered a lot from current COVID-19 crisis. Almost everyone was influenced in some way and there is rapidly growing amount of literature studying the economic effects of COVID-19. Some countries were hit much harder than the others and the same rule goes for different economic sectors. Online business has experienced its boom while public services, education or entertainment experienced huge decline. Many businesses and mainly office workers changed their working mode to home office which was something almost nobody was familiar with before. Actually only 4,2% of all the workers worked from home Delventhal *et al.* (2021) in 2019. At first this transfer was nothing so exceptional because companies still had to pay fixed costs but since the productivity of workers did not decrease, it is expected that even after the pandemic employers leave their employees at home office at least a few days a week. This will allow companies to reduce their costs for work space since there will be less employees present at one time and some spaces can be rented to someone else or even sold, but also energy charges or parking which are connected with space reduction. Since workers will not have to complete the journey to work every single day they will be able to choose their residence differently and not so dependently on where they work causing the demand for living in city central neighborhoods (Liu & Su 2020). This transfer from highly dense areas might be caused by several factors. Main reason is that people do not need to live near their jobs since they are able to work from home no matter how far their workplace is and therefore it is much more economical to buy house somewhere it is cheaper. Because of the uncertainty but also the possibility of staying home which is associated with reduction of usage of many

everyday used goods and services like car, public transport or restaurants in the United States COVID-19 led to an immediate decline in the aggregate spending and increase in savings (Bachas *et al.* 2020). Obviously another main reason for decrease in spending is restrictions of many public services but it is interesting that these cuts of spending are much higher for high income households while low income households are recovering faster and start spending earlier again.

Tourism is a sector very vulnerable to crises (Reddy *et al.* 2020) no matter its origin. It can be economical, political or health crisis including the current problem of COVID-19 that might cause the potential fear of traveling or even travel bans and flight cancels (Farmaki & Kladou 2020). D'Lima *et al.* (2020) work on one of the first studies documenting the impact of pandemic and shut-down responses on the real estates in the USA. His results show that there is certain price effect just after the lockdowns but in long term the prices are growing following the pre-COVID trend. Only difference is in the volume of transactions where it can be seen a decrease in the number of sales and listings caused by reduced supply due to seller's aversion to a risk arising from uncertainty of the market. This statement is supported by Yoruk (2020) who records lower supply and demand activity in fifty major cities in the United States. Studies documenting similar supply and demand effect come from real estate markets for example in Turkey (Tanrivermis 2020) and India (Bhoj 2020).

Chapter 3

Sharing Economies and Airbnb

Some kind of basic sharing of goods and services has been present since the very beginning of mankind but the advent of the internet and its evolution to its current form where almost everyone has access to it and is able to use it, made it easier for sharing economy to become such a phenomenon it is right now, since it is much faster and cheaper way to advertise than on any other platform. Because of this, many researches have been made, studying the development and the effect on society and market in general but most of them are only theoretical without any numerical background since the data needed to conduct such an analysis are both very difficult to obtain and mainly very difficult to adjust for the best possible results and therefore work like ours is as we believe more than welcome in order to expand the knowledge about this type of economy. There exist tens of different sectors in which sharing economy operates and there are both positive and negative opinions on all kind of these sectors from home sharing to food delivery. Food delivery or ride sharing are one of these that are used far more often than for example crowd-funding or lending and most often those that are used more than the others are as well much more criticized .

Criticism of all kind of peer-to-peer platforms is hot topic and motivation for all kind of studies and researches in order to find the real positive and negative impact on society and economy. For example hotel revenues would be 1,5% higher without Airbnb service but on the other hand around 50% of nights booked via Airbnb would not be spent in hotel (Farronato & Fradkin 2018) so we have to always look at both sides of the problem. Big issue with peer-to-peer is what Schor (2017) criticizes and that is that most of the time

participants of sharing economy are very well educated and are using these platforms to expand their already high earnings and so they create even bigger gap between poor and rich. This problem however holds only for certain peer-to-peer services like Airbnb where individuals with enough spare money are able to buy new apartments that are further rented and generate even higher profit but there are tons of other sharing economy sectors and for example in service sharing like food delivery, drivers can offer their time and manual work only and therefore there is no advantage for those with money, creating fair competition and job opportunity. Talking about fair competition, we get to next problem. If we talk either about Airbnb host, or about an Uber driver, they are both supposed to have one thing in common – permission to operate. Both an owner of a hotel and a taxi driver has to go through very difficult and time consuming process of acquiring a license to be legally able to do his job. But how about peer-to-peer business? It takes few days, even few hours in some cases, to be able to start their business and many times in many countries they even encounter lower fees than regular businessmen. In many countries this imbalance could not be overlooked anymore and citizens publicly showed their disagreement with such an injustice and regulatory steps were made in most of these countries where peer-to-peer services were operating. Talking about protests, Czech Republic was not an exception and in 2018 there was so far the biggest protest when taxi drivers did not like the unequal conditions for them and peer-to-peer services like Uber and Taxify and blocked the streets of Prague with their cars for a couple of days. Their effort resulted in all peer-to-peer drivers being obligated to have a taxi driver license.

Home sharing platform Airbnb will be the main topic of this thesis. It is an online rental marketplace that provides a possibility for landlords to accommodate guests for short period of time, mostly tourists, in the apartments they are not using at that time and which would be vacant otherwise. The origin of this idea came from two students from San Francisco in 2008 who bought air mattress and placed it in their living room as a bed and breakfast tool. In 2012 first apartments from Prague started to pop up on home sharing platform Airbnb.com but the amount of them was kept very small up until 2015 and 2016 when Prague experienced its biggest boom and the number of listings grew up by more than 300%. Decade ago it was common for travelers to be accommodated either in a hotel or to travel blindly to their destination and hope that when they arrive they find some accommodation other than hotel mainly

for two reasons - firstly because very often it is much cheaper and secondly the feeling of home-like environment they get from such an accommodation. After the introduction of Airbnb this procedure changed and hotels moved to seclusion. There are obviously exceptions in touristic destinations like Egypt, Tunisia or Canary Islands since people still want to get all inclusive experience which they can get only in hotels or luxury resorts and which cannot be supplemented yet by any peer-to-peer service yet.

The biggest problem of Airbnb in a past few years is the accusation that its increasing popularity leads to a transfer of long-term rents to short-term which might cause the decline of availability for local residents to afford a long term rent for affordable price because the supply of housing units is very limited and cannot be expanded mainly in the city centers where there is no more space to create a new ones. It is clear that the loss of supply of long-term rents would cause increase in prices but the question is whether this effect is noticeable and whether the increase of rents and prices of housing has its origins really in Airbnb or if this platform actually helps to allocate otherwise unused spaces to sector where it can be useful. Other big problem is that hosts of short-term rentals can influence lives of their neighbors as well. Mainly the apartments that are located in the city center or apartments that are located near the night life zones might be accommodated by guests who can cause troubles not only to the owners of the apartment who is paid for his services but also to the neighbors who are not given any compensation for their troubles (Filippas *et al.* 2019). R.Lieber (2015) studies this problem in Austin where many complaints arrived to the local authorities. City council tried to solve this problem by limiting the maximum number of guests to 6 however complaints about noise, trash, sometimes even racism or offensive language have not diminished. Real estate professional was asked about this problem and its connection to the price of the real estate and he answered that it might drag down the price and that the potential buyer of the property should check for number of the close short-term listings. Rising costs of housing and rents and unfair competition of Airbnb with hotels leads to another problem – lower taxes. Low transparency of peer-to-peer platform and transfer from hotels that have very small possibility of tax cuts to Airbnb where there are many ways of not declaring the income leads to decrease in tax payments which might hurt the cities and countries who's budget is heavily dependent on tourism and lodging taxes (Bivens, 2019).

Chapter 4

Impact of COVID-19 on Czech Housing Market

Communicable diseases have existed as long as the humankind itself. As our ancestors started to live in communities that at first had only a few members like tribes and later expanded to whole cities that these days count tens of millions of inhabitants the spreading of such a disease became much faster and easier. Epidemics of leprosy, tuberculosis and many other diseases were nothing uncommon mainly in Middle Ages, but they had one thing in common — they were spread only across one location. However, in some cases the disease got spread so widely that the new term — pandemic, had to be used. First recorded pandemic happened 430 B.C. during the Peloponnese War and since than humankind survived more than 20 of pandemics that cost lives of hundred million of people all around the world. For some of the viruses the vaccine was made, others were more complex that no cure has been invented yet and the quarantine was the only way to banish the virus.

It is hard to compare these pandemics throughout the time because its impact on the world and in our case on the global economy varies a lot. However, we can compare its fatality ratio to get an idea how dangerous COVID-19 is. More than 2.5 Million people have died while being infected by COVID-19 so far in the time of writing of this work and there are around 7.5 billion people in the world, so it makes approximately 0,03% of global population dying either directly because of the virus or because of the complications connected with it. To put it in some context, worst pandemic the humankind has ever faced “ Black Death, that occurred in 14th century, had more than 50 million vic-

tims which was almost 10% of total population at that time. Luckily for us, the medicine did huge progress and every of this pandemic contributed to its improvement. Even though this virus might not be that deadly, mainly these with weaker immunity or older ones had to be very careful and certain steps had to be taken because no matter how dangerous the virus is it is still able to kill. Most of the countries closed their borders for most of the foreigners and the traveling almost disappeared. In Czech Republic, the situation got critical more than once and currently we are the worst country when it comes to number of total and active cases per 1 million population if we do not count Andora and Montenegro which are countries with very low population (approximately 80 000 and 630 000).

It all began at the end of 2019 when first cases of infection appeared in Wuhan, China which is considered the origin country of the virus. For more than three months it did not look like any threat and almost not attention was paid to it. Being ignored, the virus got spread to other countries including Czech Republic and new cases started popping up all around the world. When it was unclear what the result of the spread of virus will be and how big of a treat it can ever be, Czech government at first believed that the situation might solve itself by natural spread of the virus followed by building of an immunity, but the virus got so aggressive that it was necessary to intervene. First steps to suppress the virus were taken on March 2020 when the World Health Organization also declared COVID-19 a pandemic. Since then apart from a few months in summer 2020 a state of emergency is declared in Czech Republic in order for government to be able to handle this situation easier and faster. At first international flights from countries that were hit most critically by COVID-19 were prohibited, operation of shops and restaurants was banned as well together operation of elementary and high schools and most of the universities. Later, national borders were completely closed, and movement of residents was limited to the immediate vicinity of their home or necessary trips. Except for short break in the summer, similar measures continue up until now. These measures do not apply to Czech Republic only, on the contrary most of the countries applied at least some of these measures where most of these measures included closing down the borders and at least some kind of lockdown causing tourist flows decrease dramatically all around the world.

According to United Nations World Tourism organization (UNTWO), tourism

is the third-largest export category (Only fuels and chemicals are bigger) and in 2019 it represented around 7% of global trade. According to Czech Statistical Office, tourism made almost 3% of GDP of Czech Republic and there were 240 thousand people employed in tourism sector in 2019. During this year, Czech Republic was visited by 37 million tourists from abroad of whom 40% stayed for at least one night and Czech citizens made 13 million trips abroad of whom almost 3/4 stayed abroad for at least one night. In countries like Maldives or Aruba, tourism can represent up to 30% of its GDP (in Macau its even 50%). These countries are however hardly comparable to other countries of the world since they are either part or a region of larger constituent state or kingdom and most often, they are either island or archipelagos (excluding Macau which the economy is strongly based on casino and gaming).

Tourism sector is quite obviously one of the most affected by COVID-19 and UNTWO predictions at the beginning of crisis were that the international tourism could decline by 60-80% and these predictions proved to be very close to the reality of a loss of -74% in tourist arrivals all around the world. In the Figure 4.1, we can see that Asia and the Pacific was the most affected in the terms of percentage change however, Europe was hit the hardest in the terms of overall decline and the predictions of UNTWO are that the world could reach the pre-pandemic numbers somewhere between 2023 and 2024.

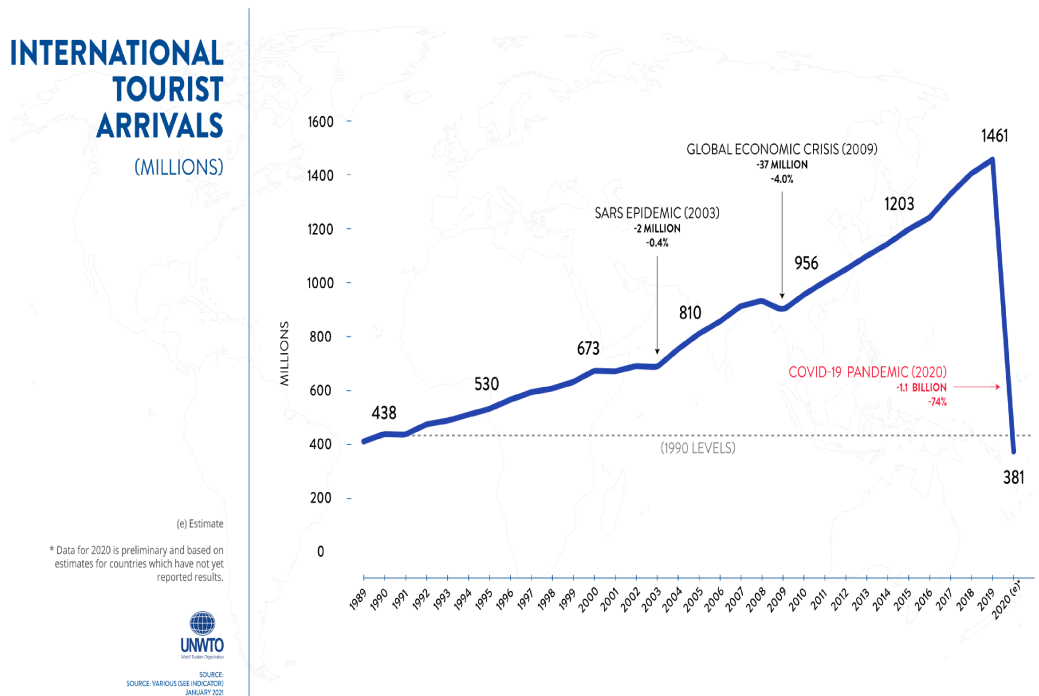
Figure 4.1: International Tourist Arrivals by Years



Source: World Tourism Organization

In the Figure 4.2 we can see that in total tourist arrivals decreased from 1461 million in 2019 to 381 million in which Europe participates by approximately half of the total tourism arrivals. This huge decline puts the tourism rates to the situation 30 years ago and is expected to impose a loss of over 2 trillion dollars in global GDP. In Czech Republic according to preliminary estimate GDP fell by 5,6% in 2020 mainly because of household's consumption and tourism which could be classified as non-existent during this pandemic.

Figure 4.2: International Tourist Arrivals by Continents



Source: World Tourism Organization

Loss of tourism was apart from other tourism-based sectors huge damage for short-term sharing. Without any guests, landlords in many cases offered their houses or apartments for long-term sharing overflowing the long-term sector pushing the long-term rents down drastically proving that at least in short-term the effect of Airbnb fluctuation has impact on housing sector, mainly on the rents. House prices were not affected as much as the rents, in many districts the prices even went up by tens of percent as we can see in Table 4.1. Apart from Troja, rents dropped in most cases by tens of percent while prices per square meter went up. This does not apply the very city center districts like Josefov, Hradčany or Nové Město where prices dropped quite dramatically. These districts are also one of these where the rental prices went down the most. Dejvice could not be included in this table due to lack of data.

Table 4.1: Number of rented nights needed to pay for 1 square meter

District	Price per M2			Rent		
	2020/02	2020/12	Difference	2020/02	2020/12	Difference
Břevnov	96984	100754	3.9%	316	274	-13.3%
Bubeneč	109102	103770	-4.9%	303	274	-9.6%
Holešovice	102499	102807	0.3%	313	295	-5.9%
Hradčany	178177	155458	-12.8%	356	293	-17.8%
Josefov	212325	170607	-19.6%	423	351	-16.9%
Karlín	91875	95162	3.6%	331	310	-6.2%
Malá Strana	183861	183485	-0.2%	460	320	-30.5%
Nové Město	161601	138687	-14.2%	371	314	-15.4%
Nusle	73826	80167	8.6%	301	272	-9.7%
Smíchov	99495	108254	8.8%	332	287	-13.6%
Staré Město	134239	137321	2.3%	357	324	-9.4%
Strašnice	82102	101246	23.3%	304	266	-12.6%
Střešovice	102490	104249	1.7%	321	292	-9.0%
Troja	84006	118086	40.6%	285	291	1.9%
Vinohrady	113525	127337	12.2%	383	309	-19.2%
Vyšehrad	97252	131313	14.5%	324	315	-2.9%
Žižkov	97631	101022	3.5%	351	297	-15.5%

Chapter 5

Data

Collection of data and their future editing was the hardest part of this work. Our three main datasets used for this analysis - Airbnb data, rent price data and property price data, are not publicly available and once we obtained these enormous datasets we had to spend hours editing them in order to get the best possible samples. In addition to this data, population, average income, unemployment and data about what share of population has bachelor's degree or higher will be used in our model. These data are collected from Český Statistický Úřad (ČSU) and Ministerstvo Práce a Sociálních Věcí (MPSV). Unlike other studies, we will focus on Prague as a single city unlike most of other studies that use datasets containing multiple cities. Because Airbnb activity is getting stronger as we move closer to the city center, we will not be studying and using data about all the Prague districts only about districts: Břevnov, Bubeneč, Dejvice, Holešovice, Hradčany, Josefov, Karlín, Malá Strana, Nové Město, Nusle, Smíchov, Staré Město, Strašnice, Střešovice, Troja, Vinohrady, Vyšehrad and Žižkov. These are the districts with highest Airbnb activity and these districts are the closest to the city center and therefore are the most important for us.

5.1 Airbnb Data

Main source of data is provided by Adam Nedvěd from Blahobyty.cz and these data are collected directly from Airbnb.com website. They were scrapped on regular daily basis between years 2016 and 2021 and contain all the important information about all the listings that were available in this period. Couple listings that were located at the very edge of Prague might have been skipped

by the scrapping algorithm, but these listings are negligible part of our sample since the most important data for this work are based on the very city center of Prague and its closest periphery and therefore would have been skipped anyway. This dataset contains information about the price, number of bedrooms, GPS location, minimal number of nights that must be spent in the accommodation, type of property and room and information about the rating of the listing and number of reviews where namely the last one of these are used mainly for the purpose of distinguishing between active and inactive listings in one of the methods that are introduced later. For easier interaction with this data, I will be using monthly average of Airbnb prices per night and for occupancy I will be using the ratio of number of days in month the apartment is booked during the month. For the profitability part of this work we are going to use prices of Airbnb and I am aware of prices being higher during occasions like New Year's Eve but this increase of prices is projected in monthly average in a way that it has no influence on the results.

In total, there were 1 045 169 listings in Prague since 2016 from 34 757 hosts offering their property for short-term rent. These data were very raw and for this thesis it was very important to get number of listings and active accommodations as close as possible to the actual number so a lot of work and filtering had to be done in order to get meaningful sample containing only active listings since the original dataset is very likely to overestimate this number. First step was to remove hosts with no location assigned together with the hosts who's listings were never occupied. After we had location for all the listings, next step was to assign Prague district to each listing according to their GPS location. After closer look we found out that this dataset included small number of apartments from other cities than Prague, sometimes even other countries. Last step was to remove these listings that are useless for us, keeping only these listings that are from Prague districts we are interested in. Once we had listing from only these districts we were interested in we could proceed to four methods we are using in this work.

Like Baron *et al.* (2020) and Bao & Shah (2020) I will be using similar methods of determining the supply of Airbnb differing in the entry and exit date of a listing adding one additional method neither of them was using that considers listing active in specific month only if it meets certain criteria. First and the simplest method assumes listing active once it is available on Airbnb

and inactive when it is taken down from Airbnb site. This method might overestimate the number of Airbnb supply because the listings might still be available even though they are not accepting any new reservations and the usage of such an accommodation for short term renting is probably zero. Second method avoids this problem by considering listing inactive if its occupancy is equal to 0 for couple months before or after it accommodated guests. Third method will avoid the problem of overestimation in little bit different way, it will consider listing active once its occupancy rate is higher than 0. With this method one has to be cautious because of the issue I encountered during my research and should be addressed which is that hosts can book their own listing for whatever reason for example using the apartment for themselves or in some cases hosts are accommodating their guests outside of the Airbnb platform to avoid fees and taxes and therefore must lock the date on Airbnb as well so nobody can reserve the same days and it is impossible to say what was the actual reason of apartment being booked. For this purpose, the number of review every host receives will be important for us as well. Obviously not every guest leaves a review of an accommodation but when the apartment is booked every single day of a month for couple months in a row and no guest leaves a review it is most likely because the owner booked his own room for any other reason than for short-term booking via Airbnb and I should not use this booked listing as a part of my dataset of active listings. Same rule goes for the listings with low number of days being occupied in a month which has also very low or even no reviews. Because of that, we have to expand this method so it uses only these listings that meet both occupancy and review count condition every month. Notably the problem of high occupancy with no new reviews and removal of these listings from the dataset is supported by the situation after April 2020 when there was no tourism and traveling but some listings were reporting full occupancy even multiple months in a row.

5.1.1 Methods of Determining of Airbnb Activity

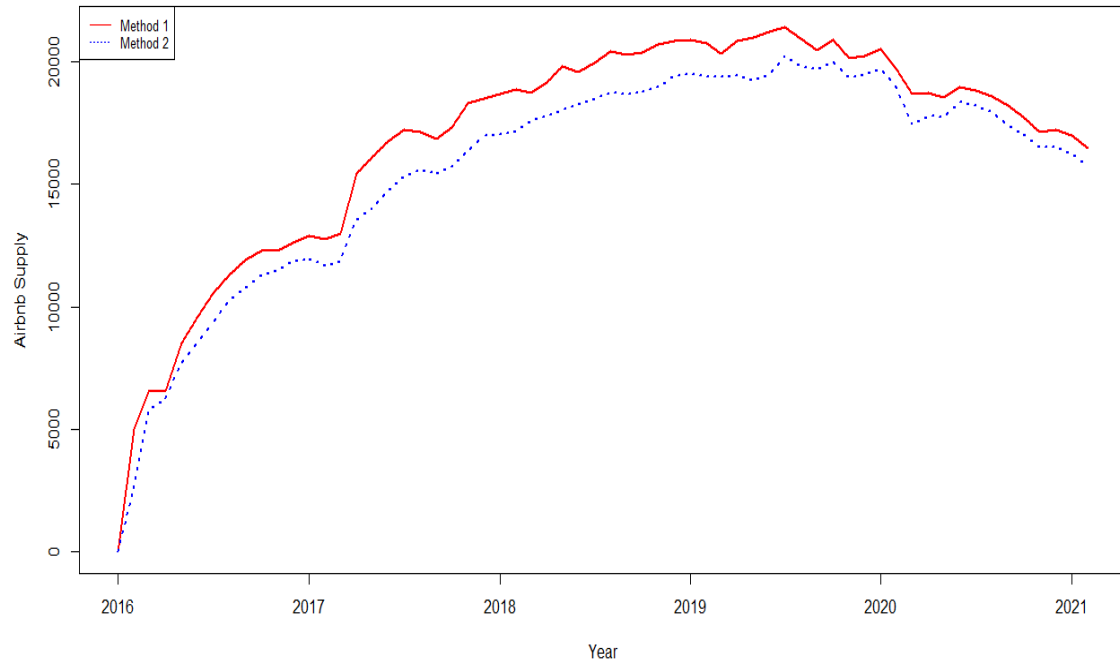
Calculation of Airbnb activity as close as possible to the reality is crucial part of this work. Without any doubts there are multiple ways of how to determine the number of active listings. Bao & Shah (2020) use little different approach among this kind of literature where instead of using absolute number of listings, their first method uses the share of Airbnb listings on total housing units and second method substitutes total housing supply with vacant units in the

market. Baron *et al.* (2020) are using three methods where first one considers listing active since the day it became active on the Airbnb platform and second and third method consider listing active three and six months after host join date and after every review. Approach of first mentioned work makes sense but since we are working mostly with city center and its nearest neighbours, total housing supply is very inelastic, close to being constant. Similar assumption goes for vacant housing units since there is huge demand for such a spaces and they are very rarely vacant.

First method that we are using is considering Airbnb listing active anytime it is available on Airbnb site because it is creating kind of supply of short-term accommodation and therefore influences the whole market. On the other side there might be scenarios where for example even though the booking is listen on the websites the host is not accepting any new reservations and therefore the apartment is empty even for couple months which might cause this sample to be overestimated. Because we are able to see the occupancy of every host every month we are able to avoid using these listings that are obviously not being used at all or that were used for some time but for any reason they are still visible on Airbnb site while no new bookings are being made.

Second method will filter out these listings and will consider them active only once they reach occupancy rate higher than 0 and they become inactive after the occupancy rate is 0 for three consecutive months - these listings may become active again if new guests arrive after these inactive months. With second method one might still argue that the condition of being uninhabited is too much and these three months should not be counted among active listings and that is where the third method arises. This method looks only at a occupancy rate of every listing and considers it active only when it is above 0 and in the case it is equal to 0 it does not give it an opportunity to be considered active even though it really had for example very bad month and no guests arrived. Difference between Method 1 and Method 2 is relatively negligible and in the Figure 5.1 it can be seen that the gap between this these two methods is very small.

Figure 5.1: Method 1 Compared to Method 2

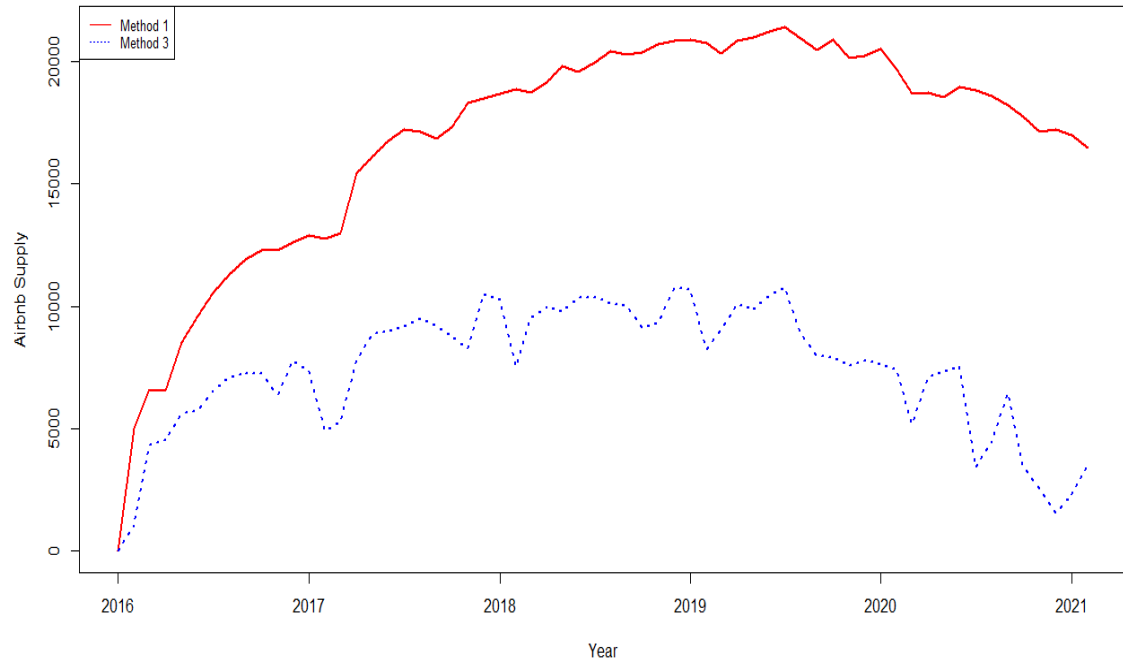


Note: Method 1 and Method 2 can be found Table 5.1

In our opinion third method can be further improved by implementing guest reviews as an indicator of activity. Especially during the recent COVID-19 pandemic data collected after April 2020 when the lock downs came into force and tourism of most countries of the world stopped including Czech Republic proved that many hosts are booking their own listings for other reason than for Airbnb guest being accommodated because according to the data from Airbnb site more than 75% were occupied for more than 25 days a month which is very suspicious and for most of the hosts not possible under these conditions and these listings had to be removed from the dataset for last method. To find such a cases we used number of guest reviews together with occupancy and we filtered our these listing that had occupancy higher than 0.9 but had 0 reviews. Implementation of this step makes sense since if there were multiple guests during the months that was supposedly occupied almost every day in a month in average from personal experience at least one of them should leave a review of his stay. The difference between method 1 and method 3 depicted in Figure 5.2 is much bigger than the difference in Figure 5.1 and also proves

that hosts during the lockdown made their listings look fully occupied based on the all time biggest gap between number of listing of method 1 and 3.

Figure 5.2: Method 1 Compared to Method 3



Note: Method 1 and Method 3 can be found Table 5.1

We will be using all three methods and however our preferred method will be the method 3 because we believe its results are the closest to the real numbers of active Airbnb listings. Brief description can be found in Table 5.1.

Table 5.1: Methods of determining the Airbnb listing active

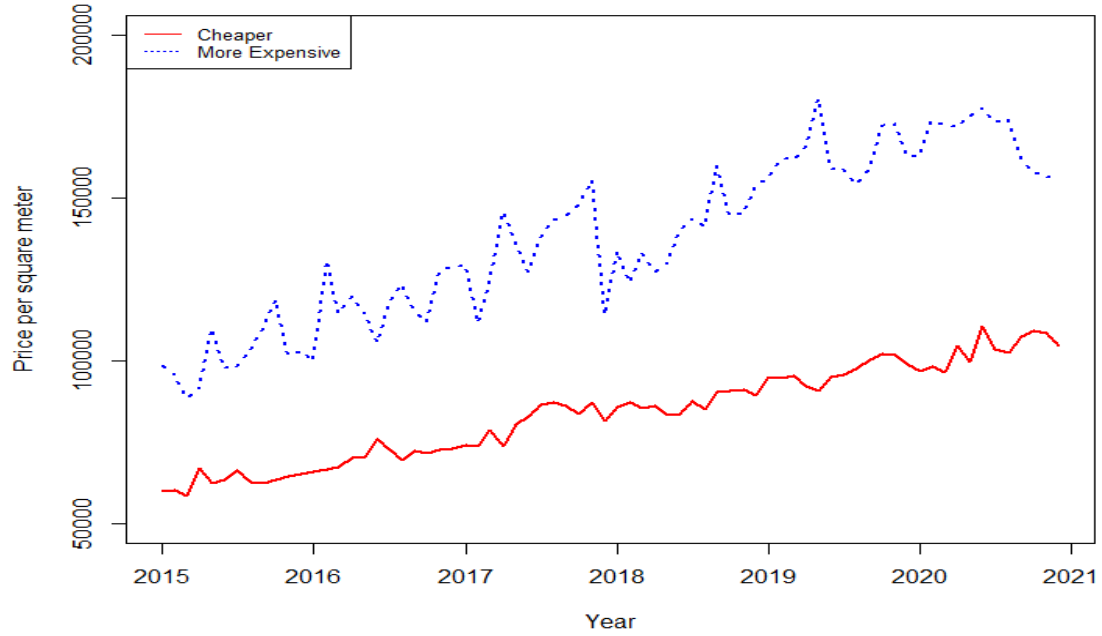
Which listing we consider active:	
Method 1	Every available listing
Method 2	Occupancy higher than 0 and we discard it after three months of 0 occupancy
Method 3	Occupancy higher than 0 and more than 0 review if occupancy higher than 0.9

5.2 Housing Price and Rent Index

Data set containing information about more than 21 000 transactions from the beginning of 2015 until the end of 2020 were provided by Společnost pro Cenové mapy ČR s.r.o. as well as more than 165 000 offered rentals from the same time period. Transaction dataset is very detailed and includes all the transactions made during period we are researching. It contains data regarding price, apartment area, date of transaction and a specific location - Prague district, street, building identification number, even number of the flat, but for purpose of this work, Prague district will be sufficient. Apart from condition of the building, renting data include similar information as transaction data. These data are very well prepared however a lot of work had to be done. At first we had to choose and eliminate outliers that were in this case enormously large apartments or on the first sight overpriced flats and then we had to eliminate duplicates which we encountered. From this data we are able to calculate index prices for both house prices and rent datasets for each Prague district which can be furthermore used to calculate price-to-rent ratio by simply dividing the house prices index by rent index. In some cases there were very small samples causing the rents and prices fluctuate a lot during some months so we had to adjust these data by making them smoother and thus a greater reflection of reality.

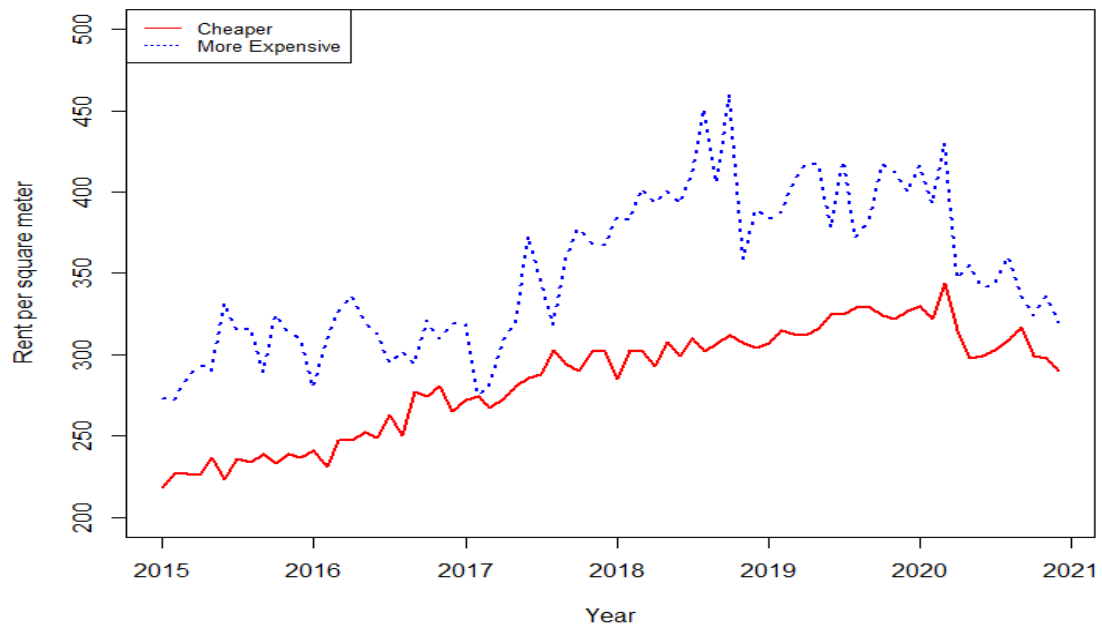
In order to have an idea of what the development of price and rent index looked like we will have generalize our datasets since each of our districts have different change in time of both rents and prices and not a single districts has same price or rent history as any other. We can however create two groups of districts with similar development and characteristics in which we can calculate average of prices and rents for every month in order to generate house price index development in Figure 5.3 and rent price index development in Figure 5.4. First group will be composed of these districts that are more expensive which are Hradčany, Josefov, Malá Strana, Nové Město and Staré Město. The other group will include districts Břevnov, Bubeneč, Dejvice, Holešovice, Karlín, Nusle, Smíchov, Strašnice, Střešovice, Troja, Vinohrady, Vyšehrad and Žižkov. This plot is mainly illustrative so the reader gets the idea about the prices and the development of prices in general. In future research we are using data for every district separately.

Figure 5.3: House price index development



Note: Comparison of development of prices of cheaper and more expensive districts.

Figure 5.4: Rent index development



Note: Comparison of development of rents of cheaper and more expensive districts.

5.3 Other Independent Variables

Airbnb activity and housing price and rent index data were very complex datasets that had to be managed, filtered and edited in order to get numbers meaningful for this work. Rest of our variables that supplement these datasets are population, average income, unemployment and portion of population with university title could be used in a raw form in which they were obtained from ČSU and MPSV which are collecting or calculating these data either on yearly or monthly basis and can be considered trustfull and up to date. Most of these data are collected quarterly or even yearly so we had to artificially fill the months between reported values in order to get monthly data. Since neither of these variables is very sensitive to outside shock and there is only little movement during the year we simply distributed the whole year difference among individual months.

Chapter 6

Profitability

Housing market is very lucrative sector for investment but on the other hand big amount of capital is required to obtain such an asset. There are plenty of investment opportunities like stocks, bonds, startup investments or even art. These kind of investment do not require any capital assumptions and anyone with spare money can use them for such a purpose. Especially stocks, bonds and options can be invested in quite safely if the approach is done correctly and if we consider common market situation without any crisis effects being present and influencing the market behavior. Returns of such an investments are not any spectacular most of the times it at least covers inflation and your money do not lose their value. You can always choose the amount of risk you are willing to put in your portfolio and make it possible for higher returns but that is not important for this thesis. With enough capital, one can decide to go for bigger investment in the form of any kind of real estate. We do not need to distinguish between case where the buyer is able to pay full amount of price immediately or where he needs to take out the mortgage to cover the expenses.

The principle in housing market is similar to stock markets. In the case of real estate market you buy a house or an apartment with belief that its future value is gonna grow while you can also rent it for regular monthly income. With stocks it is similar but instead of monthly payments from subtenant investor is being paid dividends periodically. Rents you can choose based on the supply and demand and optimize them to be as large as possible while still having a taker while dividends are decided directly by companies and its board of directors and when the company is in losses or when the board decides to reinvest its revenues investor might end up with zero dividend. In general

these two types of investment have a lot in common and their price change are almost identical as we can see in Figure 6.1. In this figure it is depicted only the revenue from price change, which means that dividends and rents are not included in it and that makes it one of the biggest difference in these two kind of investments. That is one of the premiums for ability to collect enough money to buy a property. On the other hand real estate market is not so liquid and fees are much higher than in stock market so it depends on every single one which way he decides to go.

Figure 6.1: SPDR S&P 500 ETF (SPY) and the Vanguard Real Estate ETF Total Return (VNQ)



Source: Investopedia

6.1 Airbnb Profitability

Finding optimal property to buy in order to achieve the biggest profit is very difficult process since multiple factors influence the price of it. Size and location are the biggest determinants of price but factors like public transport, parks and restaurants in the surrounding area play their role. Better these parameters are, easier it is to find tenant both for short-term and long-term lease but obviously also the purchase price of such a property is higher. The question is, whether it is always better and more profitable to buy a more expensive property. Studied area of this thesis is Prague, which is the most expensive city in Czech Republic in the terms of price per square meter and rental prices, however the return of investment to an apartment in Prague that is calculated by number of months needed for property to be repaid by its long-term rent is the longest among all the other cities in whole country. On the other hand Prague is the city with the highest number of tourists and Airbnb listings widening the pool of possible usage of apartment. In this section I will show which Prague district is the most profitable and what is the difference in income from short-term and long-term lease.

Prague is very touristic city which was visited by more than 7 million foreigners in 2019. In the past, most of the tourists in big cities were using hotels as a place to spent night but nowadays hotels are receding into the background and they are being replaced by Airbnb services. The largest influx of tourists to Prague is around July, August and December and these months will be the most interesting for this part of work. Apartment owners basically got two options how to generate. First one, long-term rentals, is simple and apart from initial contracting and paper work once the subtenant gets accommodated the job can be considered finished and this source of passive income comes without any other effort. The second option is much more demanding but comes with higher profit. Host have to, in most cases personally, accommodate every single guest, clean after him and prepare room for another guest and this process might be repeated every couple days which might be time consuming. Both short-term and long-term rentals fall under the same percentage taxation of 15%. As we can see in Table 6.1 where the difference between shot-term and long-term rentals in August and December of 2019 is captured the profitability of short-term rentals is more than two times higher than long-term in most districts of Prague, closest to the city center like in Josefov or Staré Město it

is even over three times higher during the summer months. This results apply only in the case when the apartment used for the short-term renting is fully occupied for the whole month. This scenario is very common during months with high arrival of tourists but in general there is occupancy rate of about 60% to 70%. It is up to everyone if they want to put some extra effort for some extra profit or they are fine with lower income with no additional effort needed. There is also a middle way these days when the company for portion of profits manages the apartment for short term renting all on its own.

Table 6.1: Profitability of Airbnb compared to long-term rent

Rent to Airbnb Price Ratio		
District	2019/08	2019/12
Břevnov	2.44	2.31
Bubeneč	2.30	2.70
Holešovice	2.16	2.35
Hradčany	2.86	2.67
Josefov	3.04	2.97
Karlín	2.35	2.27
Malá Strana	2.77	2.93
Nové Město	2.80	2.92
Nusle	1.97	2.43
Smíchov	2.48	2.54
Staré Město	3.15	2.94
Strašnice	1.75	1.89
Střešovice	1.92	1.93
Troja	2.31	1.90
Vinohrady	2.32	2.38
Vyšehrad	2.04	2.93
Žižkov	2.18	2.31

Note: This table shows how much more of in income on can generate by using the property for short-term rentals instead of long-term in a case of 100% occupancy.

To put these numbers about rents into perspective with actual prices of apartment we can have a look at table Table 6.2 which shows the number of nights needed to be occupied in August and December of 2019 in order to cover the costs for one square meter of an apartment in different districts of Prague. In average it takes about 80 days to completely repay one square meter just by the profit from the Airbnb. This means that for an apartment with size of around 50 square meters it would take around 11 years to completely cover apartment costs by short-term renting revenue. This scenario would apply if the

prices for one night would be constant for the whole year and the occupancy would be 100% which is very hard to achieve, especially in Czech Republic, which is very cyclical country in terms of its tourists and therefore both prices and occupancy differs a lot depending on the part of the year.

Table 6.2: Number of rented nights needed to pay for 1 square meter

District	2019/08	2019/12
Břevnov	82.76	76.71
Bubeneč	83.34	81.26
Dejvice	85.07	86.76
Holešovice	76.71	71.86
Hradčany	74.06	83.53
Josefov	94.29	80.32
Karlín	77.92	63.89
Malá Strana	85.00	78.86
Nové Město	78.45	78.11
Nusle	80.88	68.43
Smíchov	75.24	68.93
Staré Město	66.17	77.37
Střešovice	90.78	89.19
Troja	66.75	84.67
Vinohrady	77.83	79.76
Vyšehrad	61.40	72.54
Žižkov	72.55	71.13

Note: This table shows the number of rented nights needed to repay the price of 1 square meter of property in different Prague districts.

Apart from rental revenues, the property's price is also changing over time which is also quite important aspect. Josefov is a district, where the short-term rent is almost three times higher than the long-term rent and yet it would take the longest to repay 1 square meter among all the other districts. It is one of the most city center districts, so one would say, that it should be one of the most profitable districts, but the true is the opposite and additionally even its value as it is shown in Table 6.3 is the slowest rising. In general, real estate prices have risen in most of the districts by more than 50%, sometimes even 100%.

Table 6.3: Development of real estate prices

District	Difference of prices between 2015 and 2020	Difference of prices before and during COVID-19
Břevnov	33.8%	3.9%
Bubeneč	49.9%	-4.9%
Dejvice	66.9%	-6.9%
Holešovice	62.1%	0.3%
Hradčany	130.4%	-12.8%
Josefov	29.5%	-19.6%
Karlín	73.8%	3.6%
Malá Strana	73.1%	-0.2%
Nové Město	100.5%	-14.2%
Nusle	48.0%	8.6%
Smíchov	67.4%	8.8%
Staré Město	53.8%	2.3%
Střešovice	82.7%	1.7%
Troja	67.5%	40.6%
Vinohrady	95.8%	12.2%
Vyšehrad	43.6%	14.5%
Žižkov	59.7%	3.5%

Note: Difference of prices between 2015 and 2020 is based on data from January 2015 and January 2020 while difference of prices before and during COVID-19 is based on data from January 2020 and December 2020.

6.2 Real Estate Profitability

Real estate investments are a very good investment for those who have enough money to afford it but in general city center districts like Josefov or Malá Strana might not be the best choice for investment for multiple reasons and these districts can be considered quite overpriced and decrease of prices can be expected which was so far proved by COVID-19 situation when Josefov prices drooped by almost 20%. First reason is that the monthly income from both short-term and long-term are the lowest compared to the total price of property and therefore it might be wiser to buy multiple cheaper apartments in order to achieve the highest profit. Secondly, the property value is not increasing over time as much as it does in other locations and in the third place its high cost makes it much less affordable, harder to possibly sell it and higher fees and taxes. Based on our results, best location to buy a property for the purpose of Airbnb is Troja with one of the fastest return of initial investment and one of the biggest price increase if we include the growth during the COVID-19 pandemic which was the largest over other districts. Other interesting locations to invest in are Hradčany, Nové Město and Vinohrady because of its price increase and

also these locations are still very well performing in the duration it requires to repay its initial investment by rents. Smíchov, Karlín and Vyšehrad have to be mentioned as well as they maintain the balance between price compared to rents together with solid increase of both rents which can be seen in Table 6.4 and price over time.

Table 6.4: Development of Rents – January 2015 to December 2020

District	Difference of rents between 2015 and 2020
Břevnov	29.6%
Bubeneč	45.1%
Holešovice	43.1%
Hradčany	46.7%
Josefov	-1.9%
Karlín	26.1%
Malá Strana	25.4%
Nové Město	25.3%
Nusle	30.3%
Smíchov	25.7%
Staré Město	7.6%
Straš	19.9%
Střešovice	69.8%
Troja	35.4%
Vinohrady	28.9%
Vyšehrad	25.9%
Žižkov	32.5%

Note: Difference of rents between 2015 and 2020 is based on data from January 2015 and December 2020 and therefore the influence of COVID-19 is noted in these results.

Chapter 7

Empirical Analysis

7.1 Methodology

We study the impact of change of Airbnb supply caused by possible transfer from long-term to short-term market on price index, rent index and price-to-rent in Airbnb most active Prague districts over the time period from 2015 to 2020. For the price index model, we had to omit data about Střešovice district and for the rent index model we had to omit data about Dejvice district since these datasets were very small and variables for multiple years were missing. Both these districts were obviously removed from the price-to-rent index model as well. We at first perform Hausman test to decide whether fixed or random effect model should be used and in order to explain the relationship between Airbnb supply and price, rent and price-to-rent ratio indexes in year and month t and Prague district i which are represented by Y_{it} we introduce following model:

$$\ln Y_{it} = \alpha + \beta \text{AirbnbSupply}_{it} + \gamma X_{it} + \lambda_i + \varepsilon_{it} \quad (7.1)$$

where X_{it} is the vector of characteristics of district i in year and month t described above, λ_i contains time-invariant unobserved district factors and ε_{it} contains other unobserved factors that could possibly influence our dependent variable Y_{it} . We could use OLS to estimate the above relationship but because of the possible presence of heterogeneity presence results of this method could be biased. We used all three methods we introduced before and for each of these methods we used firstly dataset containing data since January 2015 to

December 2020 and secondly data ending at the time when the COVID-19 began to have impact on tourism and short-term accommodation in particular to see the difference in results. Our preferred model is the one using the method 3 data which we believe are the nearest to the real number of active listings at a time. This statement is proved by multiple studies which estimate similar numbers of active Airbnb listings as the third method does however our results will look at all the models and methods used and the optimal solution based on all these results will be chosen.

7.2 The Effect of Airbnb on House Prices

Firstly, we study the effect of Airbnb on house prices by using three different methods described in 5.1. First method was considering all the listings available on the Airbnb site active and Table 7.1 reports multiple regressions results. Column 1 shows results from simple OLS regression of log of price index on log of Airbnb supply and it says that 1% increase of airbnb supply causes a 0.064% increase of house prices. Using fixed effects model we get results in column 2. These results are similar to OLS except for little decrease of Airbnb effect to 0.056%. By adding variables Income, Unemployment, Population and Education we got to results in column 3. At the first sight it is clear that the effect of Airbnb on house prices dropped a lot and in this model it is not significant at any level. On the other hand income is very significant and its effect is quite noticeable - 1% increase of income is associated with 1.285% increase of house prices. This method however was not our preferred one because the possibility of overestimation of Airbnb listings and therefore results of second and third method are much more valuable for us. Method 2 with results in Table A.1 comes with similar results as method 1 from simple regression and fixed effect model with no additional variables. However column 3 with additional variables becomes interesting since the supply of Airbnb is significant in this case bearing the effect of 0.01% increase of house price when the Airbnb supply increases by 1% while education becomes non significant.

Table 7.1: The Effect of Airbnb on House Prices Using Method 1

	<i>Dependent variable:</i>		
	log(PricePerM2)		<i>panel linear</i>
	<i>OLS</i>		
	(1)	(2)	(3)
log(Airbnb)	0.064*** (0.004)	0.056*** (0.005)	0.002 (0.004)
log(Income)			1.285*** (0.102)
Unemployment			0.003 (0.016)
log(Population)			-0.239 (0.309)
Education			0.108*** (0.022)
Constant	11.092*** (0.021)		
Observations	1,223	1,223	1,223
R ²	0.141	0.132	0.583
Adjusted R ²	0.140	0.119	0.575
Residual Std. Error	0.308 (df = 1221)		
F Statistic	200.225*** (df = 1; 1221)	182.591*** (df = 1; 1205)	335.519*** (df = 5; 1201)

Note:

Results of linear regression models studying the effect of Airbnb on house prices using method 1 described in Table 5.1

*p<0.1; **p<0.05; ***p<0.01

Finally method 3 with results in Table 7.2 is the most important and interesting for us. It is very similar to results in method 2 apart from the influence of Airbnb on price being little lower but the effect is still around 0.01% for 1% of increase in Airbnb price and education becoming significant again in column 3 which is using fixed effect method with multiple added variables. If we compare this method to method 1 the significance of Airbnb variable is the most important difference for us. In general the results prove that there is an effect on house prices driven by the change of supply of Airbnb which is probably caused mostly by the increased demand for houses and apartments used for this short-term rents that brings an opportunity for both regular income but also increase in price of housing as well which is also connected with increasing demand for houses that are being used for Airbnb or other short-term platforms. Income has also huge effect on house prices which is quite obvious for multiple reasons - inflation, higher income is connected with higher affordability and therefore higher supply which together with very inflexible prices causes prices to shift up.

Table 7.2: The Effect of Airbnb on House Prices Using Method 3

	<i>Dependent variable:</i>		
	log(PricePerM2)		<i>panel linear</i>
	<i>OLS</i>		
	(1)	(2)	(3)
log(Airbnb)	0.057*** (0.003)	0.058*** (0.002)	0.009** (0.005)
log(Income)			1.395*** (0.122)
Unemployment			0.008 (0.014)
log(Population)			-0.230 (0.304)
Education			0.071** (0.036)
Constant	11.209*** (0.016)		
Observations	1,223	1,223	1,223
R ²	0.160	0.285	0.584
Adjusted R ²	0.159	0.275	0.577
Residual Std. Error	0.305 (df = 1221)		
F Statistic	231.794*** (df = 1; 1221)	480.092*** (df = 1; 1205)	337.256*** (df = 5; 1201)

Note:

Results of linear regression models studying the effect of Airbnb on house prices using method 3 described in Table 5.1

*p<0.1; **p<0.05; ***p<0.01

Previous regression results are based on data between January 2015 and December 2020. It is very unclear what was the effect of COVID-19 between February and December on economy in general as well as what was the effect on individual sectors like house prices and rent prices. What is clear is that the tourism was pushed to numbers close to zero but the effect of this drop on house and rent prices is still very hard to predict and because of the short time horizon it might be wise to discard this time period from dataset and see the different results. For this datasets we will use same three methods of how to determine Airbnb listing active as before. Table 7.3 reports results from regressions, specifically results of fixed effects with Income, Unemployment, Population and Education variables included. There is a big difference in relationship between all the variables and house prices. The effect of population is still insignificant but unemployment became significant with the effect of 0.075% decrease of house prices with 1% increase of population share with bachelor's degree or higher for all the methods. The effect of 1% of income dropped to 0.9% increase of house prices in our preferred method. Effect of education became insignificant and finally effect of Airbnb stays significant and 1% increase of Airbnb supply in method 3 is associated with 0.012% increase of house prices. Excluding the data that were influenced by COVID-19 noticeably shifts the relationship between our dependent variable and independent variables including the effect of Airbnb which is now little greater than in three

previous models.

Table 7.3: The Effect of Airbnb on House Prices Using Only Pre COVID-19 Data

	<i>Dependent variable:</i>		
	log(PricePerM2)		
	(1)	(2)	(3)
log(Airbnb)	0.004 (0.004)	0.014*** (0.005)	0.012** (0.005)
log(Income)	0.817*** (0.141)	0.916*** (0.159)	0.921*** (0.161)
Unemployment	-0.077*** (0.026)	-0.077*** (0.027)	-0.075*** (0.027)
log(Population)	-0.580 (0.413)	-0.570 (0.386)	-0.541 (0.387)
Education	0.033 (0.029)	-0.033 (0.045)	-0.015 (0.046)
Observations	1,053	1,053	1,053
R ²	0.548	0.551	0.550
Adjusted R ²	0.538	0.542	0.541
F Statistic (df = 5; 1031)	249.604***	253.210***	251.730***

Note: *p<0.1; **p<0.05; ***p<0.01

Results of fixed effect models studying the effect of Airbnb on prices using 3 different methods of determining the number of Airbnb listings as described in Table 5.1

7.3 The Effect of Airbnb on Rents

We use similar approach as with the house prices apart from switching our dependent variable to rent. Using our preferred method 3 we get results in Table 7.4. As we can see the 1% in Airbnb listing leads to a decrease of 0.001% which is a result that goes against our predictions. Income has much lower effect than on house prices since when it increases by 1% the rents increase by 0.3% which is almost 4 times lower than in model with house prices as dependent variable. Last interesting output of this model is that population

has positive significant effect unlike in previous models which makes sense since with higher population we can expect to be the vacancy and therefore also supply of apartments lower pushing the rents up. We will again apply only data collected in pre-COVID era to see the difference.

Table 7.4: The Effect of Airbnb on Rents

	<i>Dependent variable:</i>		
	log(Rent)		
	<i>OLS</i>		<i>panel linear</i>
	(1)	(2)	(3)
log(Airbnb)	0.043*** (0.002)	0.042*** (0.004)	-0.001 (0.006)
log(Income)			0.306** (0.125)
Unemployment			-0.079*** (0.015)
log(Population)			0.515* (0.311)
Education			0.028 (0.030)
Constant	5.517*** (0.010)		
Observations	1,224	1,224	1,224
R ²	0.283	0.326	0.577
Adjusted R ²	0.283	0.316	0.570
Residual Std. Error	0.162 (df = 1222)		
F Statistic	483.294*** (df = 1; 1222)	583.259*** (df = 1; 1206)	328.534*** (df = 5; 1202)

Note:

Results of linear regression models studying the effect of Airbnb on rents using method 3 described in Table 5.1

*p<0.1; **p<0.05; ***p<0.01

As the negative effect of Airbnb on rents in the results from regression with data including COVID-19 suggest we should use data excluding pandemic data again to see the difference. Table 7.5 reports results of fixed effect model including other variables using all three methods again. Only method 3 shows positive effect of Airbnb on rents but all three methods effect are very close to zero but neither of these methods shows airbnb effect on rents as significant. Only income and unemployment effect on rents are significant based on this model.

We found out that neither of our three methods does not find Airbnb effect on rents any noticeable or significant and this stays even for data excluding COVID-19 effect on economy. The effect of income and unemployment are the only significant effects on rents with Income having positive impact of 1% increase causing 0.5% increase of rents and 1% increase of unemployment causing the rents to decrease by 0.05%

Table 7.5: The Effect of Airbnb on Rents Using Only Pre COVID-19 Data

	<i>Dependent variable:</i>		
	(1)	log(Rent) (2)	(3)
log(Airbnb)	-0.004 (0.003)	-0.001 (0.005)	0.001 (0.006)
log(Income)	0.485*** (0.141)	0.488*** (0.144)	0.499*** (0.158)
Unemployment	-0.057** (0.027)	-0.057** (0.026)	-0.057** (0.027)
log(Population)	0.338 (0.329)	0.297 (0.337)	0.296 (0.340)
Education	0.047 (0.037)	0.044 (0.038)	0.038 (0.039)
Observations	1,054	1,054	1,054
R ²	0.592	0.591	0.591
Adjusted R ²	0.584	0.583	0.583
F Statistic (df = 5; 1032)	299.400***	298.281***	298.279***

Note: *p<0.1; **p<0.05; ***p<0.01

Results of fixed effect models studying the effect of Airbnb on rents using 3 different methods of determining the number of Airbnb listings as described in Table 5.1

7.4 The Effect of Airbnb on Price-to-Rent Ratio

We use same approach as with the rents and house prices and as in the models studying relationship between Airbnb activity and house price, results of interaction between Airbnb and Price-to-rent ratio suggest that with Airbnb supply increase of 1% there is an increase of Price-to-rent ratio of about 0.01% to 0.02% based on the method we choose. However, our preferred method shows no significance of Airbnb variable and R squared of all the methods are very low. Other significant variables are income with positive effect on Price-to-rent ratio and population with negative effect of almost 0.9% decrease for every 1% increase of population. All these results can be seen in Table A.4. At least the effect of Airbnb could be expected from previous models where we found out that there is zero effect on rents from Airbnb.

Table 7.6: The Effect of Airbnb on Price-To-Rent Ratio Using Only Pre COVID-19 Data

	<i>Dependent variable:</i>		
	log(PriceToRentRatio)		
	(1)	(2)	(3)
log(Airbnb)	0.007** (0.003)	0.017** (0.008)	0.013 (0.009)
log(Income)	0.306* (0.165)	0.416** (0.173)	0.400* (0.207)
Unemployment	-0.015 (0.028)	-0.016 (0.025)	-0.017 (0.026)
log(Population)	-0.888** (0.372)	-0.856** (0.341)	-0.829** (0.347)
Education	0.001 (0.045)	-0.072 (0.058)	-0.049 (0.059)
Observations	992	992	992
R ²	0.051	0.057	0.054
Adjusted R ²	0.032	0.038	0.034
F Statistic (df = 5; 971)	10.535***	11.788***	11.062***

Note: *p<0.1; **p<0.05; ***p<0.01
 Results of fixed effect models studying the effect of Airbnb on Price-To-Rent Ratio using 3 different methods of determining the number of Airbnb listings as described in Table 5.1

Chapter 8

Conclusion

The relationship between home sharing and housing market is an interesting topic studied in many researches all around the world and this work should contribute to them by studying the effect of Airbnb activity on house prices, rents and price-to-rent ratio in Prague. Apart from these dependent variables and independent variable Airbnb supply we used time series data about average income, percentual proportion of unemployed population and proportion of people with bachelor's degree or higher and total population for districts Břevnov, Bubeneč, Dejvice, Holešovice, Hradčany, Josefov, Karlín, Malá Strana, Nové Město, Nusle, Smíchov, Staré Město, Strašnice, Střešovice, Troja, Vinohrady, Vyšehrad and Žižkov. We find out these districts to be the nearest to the city center and therefore they are the main touristic destinations and places for short-term accommodation. Using three different methods of obtaining the Airbnb supply we were able to calculate its impact on our dependent variables. Our predictions were that there will be certain positive push on all our dependent variables from the side of Airbnb because of multiple reasons including the possibility of landlords transferring their long-term rentals to short-term which is as we showed in profitability section two times higher, sometimes even three times higher in the district that are the nearest to the center. This might cause lower supply in long-term rentals market and so the rents are being pushed up. Since the rents are being higher than before and short-term prices are already quite high, both old landlords who have already experience in this sector and want to expand their portfolio but also new ones who are looking for interesting and lucrative investment to either try something new, diversify their portfolio or simply see the potential of this sector, are attracted and encouraged to buy a property causing the increase of the supply which cannot be followed

by increased demand since at least in the city center there is no possibility of building new buildings or apartments and therefore the demand cannot be expanded.

The inhabitants of Prague are dissatisfied with this increase in prices and rents and they are calling for tougher regulations like in other big cities where there are fees and taxes or where the allowed days occupied in one year is restricted to for example 90. But there are these who claim that there is no effect on housing market from Airbnb and that the prices would go up anyways (this increase was in rare cases by more than 100%) and therefore the free market should be kept without any regulations. Our results show that Airbnb activity is pushing property prices up and with increase of number of listings by 1% the prices go up by 0.01%. At the very beginning of Airbnb activity in Prague between years 2016 and 2018 this effect could translate up to annual increase of 5 000 CZK per square meter which is quite alarming but on the other hand since 2018 the number of active Airbnb listings can be considered constant and therefore the effect on price in recent years would not be that significant as few years ago when it was building its activity and finding out the optimal number of sustainable active listings. House prices are pushed mainly by average income which was proven by both general dataset and pre COVID-19 data where 1% increase in income caused the house prices to increase by 1.4% and 0.9% respectively.

The effect on rents is however very close to 0 which is something we were not expecting but this might be caused by multiple reasons like short period of data collection caused by the fact that Airbnb is still something relatively new globally but especially in Czech Republic so future researches might come up with different results. Income has still significant effect on rents but this effect is much lower than on the prices. The effect of Airbnb on Price-to-Rent ratio is similar as on prices which makes sense since the effect on rents is around zero. Population has significant effect of decrease of Price-to-rent ratio by 0.8% for 1% increase of population. This might be caused by the fact that the amount of apartments in studied districts is fixed and therefore even maximal possible population is set. There is proportion of flats that are vacant at the moment and some are being used for short-term rents. If we consider the number of short-term rentals constant, which means that there would not be landlords moving from short-term to long-term and therefore increasing the supply of it,

increase of population means that some of these vacant apartments are now being occupied by new inhabitants and therefore the supply would be lower. Lower supply with same or even higher demand for long-term rent would cause the rents go up without prices to go up in short-term. In long-term the demand for apartments would increase because of the increased profit from rents and the price-to-rent ratio would stabilize. It is worth mentioning that the presence of time lag is possible. When the number of Airbnb listings increases it might take couple months or even years before the prices and rents react to that.

Whole world has recently been damaged by COVID-19 pandemics – deadly virus that has most probably its origins in China and which significantly influenced everyday lives of most of the worldwide population. This crisis hit most of economy sectors and many entrepreneurs went bankrupt since they were not able to last through this bad times. Tourism sector is one of those that were affected the most and people could not travel at all for multiple months which naturally caused short-term rentals change to long-term rentals in order to get at least some demand for their apartments. There are undoubtedly multiple factors influencing housing market during such a crisis but together with increased supply of long-term rentals rents in our studied districts went down by 10% to 20% during past year. On the other hand apartment prices went in most of these districts up by, in some cases, more than 10% so the impact is very unclear and yet to be clarified and therefore there is a lot of space for future research.

We showed that there is a relationship between Airbnb activity and house prices and therefore some regulations could take place in order to keep long term living in Prague relatively affordable. On the other hand question about positive impact of Airbnb on Prague rises since it is naturally connected to tourism from which at least city center profits a lot and therefore multiple sectors might suffer losses because of the possible regulations. On the other hand there are other negative externalities apart from price increase like noise or population that might influence not only the house owner but also neighbors or whole neighborhoods in the case of multiple Airbnb accommodations close to each other. We also conducted research on which districts of Prague are the most profitable which might be useful in predictions of future development of short-term rentals market in Prague but this might also help to interested investors with deciding of where to buy a property. Our results show that the

value of real estate in city center grew up by around 50% to 100% in last 5 years. This growth was little suppressed by the recent pandemic in few of our studied districts but the performance is still very good. The results also show that the city center can be considered overpriced and there are other locations like Troja that might be worth investing in which might in the future cause a certain change in prices of real estate in studied districts, mainly in the city center.

Finally, it is good to mention that Airbnb has certain effect at least on house prices but this effect is rather diminishing since the Airbnb activity is not increasing and it is more likely becoming constant throughout the recent years. There is a lot of space to improve studies like this since there are very few people working on this topic and so far we know very little about the impact of home sharing on housing market but in general about the impact of sharing economies on global and local markets. That is why we chose this topic and we hope this work will encourage others to conduct similar research in the future since we find it necessary to study these relationships more in order to see its actual potential or threats. This kind of research can be complicated mainly in the terms of data which are relatively difficult to obtain at least here in Czech Republic and Prague in particular and afterwards their editing is a process very time consuming. For example our main datasets are not public at all and we are very glad to Adam Nedvěd and Společnost pro Cenové mapy ČR s.r.o. for providing of such a data without which it would not be possible to conduct study like this and generate such results as we did. Lots of different approaches to choosing and working with so many kinds of different data as well as different approach to choosing the model itself can be made and I am very interested what future studies will arise and what will be their results but hopefully this work will clarify some questions and situation about Airbnb itself.

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Appendix A

Title of Appendix A

Table A.1: The Effect of Airbnb on House Prices Using Method 1

	<i>Dependent variable:</i>		
	log(PricePerM2)		
	<i>OLS</i>		<i>panel linear</i>
	(1)	(2)	(3)
log(Airbnb)	0.055*** (0.003)	0.059*** (0.002)	0.012** (0.005)
log(Income)			1.387*** (0.114)
Unemployment			0.005 (0.015)
log(Population)			-0.251 (0.304)
Education			0.053 (0.037)
Constant	11.181*** (0.017)		
Observations	1,223	1,223	1,223
R ²	0.176	0.365	0.585
Adjusted R ²	0.175	0.356	0.578
Residual Std. Error	0.302 (df = 1221)		
F Statistic	260.501*** (df = 1; 1221)	693.862*** (df = 1; 1205)	338.419*** (df = 5; 1201)

Note:

Results of linear regression models studying the effect of Airbnb on house prices using method 1 described in Table 5.1

*p<0.1; **p<0.05; ***p<0.01

Table A.2: The Effect of Airbnb on Rents Using Method 1

	<i>Dependent variable:</i>		
	<i>log(Rent)</i>		<i>panel linear</i>
	<i>OLS</i>		
	(1)	(2)	(3)
log(Airbnb)	0.040*** (0.002)	0.035*** (0.006)	-0.005* (0.003)
log(Income)			0.299*** (0.088)
Unemployment			-0.081*** (0.012)
log(Population)			0.533* (0.310)
Education			0.029 (0.026)
Constant	5.478*** (0.013)		
Observations	1,224	1,224	1,224
R ²	0.168	0.116	0.579
Adjusted R ²	0.167	0.104	0.572
Residual Std. Error	0.174 (df = 1222)		
F Statistic	246.722*** (df = 1; 1222)	158.399*** (df = 1; 1206)	330.866*** (df = 5; 1202)

Note:

Results of linear regression models studying the effect of Airbnb on rents using method 1 described in Table 5.1

*p<0.1; **p<0.05; ***p<0.01

Table A.3: The Effect of Airbnb on Rents Using Method 2

	<i>Dependent variable:</i>		
	<i>log(Rent)</i>		<i>panel linear</i>
	<i>OLS</i>		
	(1)	(2)	(3)
log(Airbnb)	0.040*** (0.002)	0.040*** (0.003)	-0.002 (0.005)
log(Income)			0.301*** (0.106)
Unemployment			-0.079*** (0.013)
log(Population)			0.519* (0.309)
Education			0.034 (0.029)
Constant	5.504*** (0.010)		
Observations	1,224	1,224	1,224
R ²	0.287	0.366	0.578
Adjusted R ²	0.287	0.357	0.570
Residual Std. Error	0.161 (df = 1222)		
F Statistic	492.262*** (df = 1; 1222)	695.423*** (df = 1; 1206)	328.712*** (df = 5; 1202)

Note:

Results of linear regression models studying the effect of Airbnb on rents using method 2 described in Table 5.1

*p<0.1; **p<0.05; ***p<0.01

Table A.4: Fixed Effect Models Results of Effect of Airbnb on Price-To-Rent Ratio for All 3 Methods

	<i>Dependent variable:</i>		
	log(PriceToRentRatio)		
	(1)	(2)	(3)
log(Airbnb)	0.005 (0.005)	0.016** (0.008)	0.012 (0.009)
log(Income)	0.955*** (0.158)	1.078*** (0.184)	1.116*** (0.190)
Unemployment	0.086*** (0.018)	0.089*** (0.017)	0.090*** (0.019)
log(Population)	-0.698** (0.354)	-0.712** (0.325)	-0.703** (0.332)
Education	0.093** (0.037)	0.024 (0.054)	0.041 (0.049)
Observations	1,152	1,152	1,152
R ²	0.172	0.176	0.170
Adjusted R ²	0.157	0.161	0.156
F Statistic (df = 5; 1131)	46.888***	48.336***	46.454***

Note: *p<0.1; **p<0.05; ***p<0.01
 Results of fixed effect models studying the effect of Airbnb on Price-To-Rent Ratio using 3 different methods of determining the number of Airbnb listings as described in Table 5.1