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THE IMPACT OF COVID-19 ON AIRBNB PRICES

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The Impact of COVID-19 on Airbnb Prices

by

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ABSTRACT

Nowadays, the main part of the population around the world uses online sites to find local homes for vacations or even more long-term stays.

One of the most popular sites of short-term rental market is Airbnb. These rental markets have grown rapidly over the last decade which leads to the fast-growth of Airbnb (E. Holm, 2020).

“How COVID-19 impacted Airbnb prices in Lisbon?” is the main question of this work. Throughout the study it will be possible to understand the effects of pricing strategies, price positioning and dynamic pricing, more precisely if COVID-19 affected Airbnb in a way that leads to changes in the trends of the prices per night in the various accommodation that Airbnb has in the chosen cities.

To answer this question, was constructed a database with data extracted from the website InsideAirbnb. Our findings suggest that Berlin prices comparing to Lisbon have decreased 2.66% during this pandemic.

KEYWORDS

Airbnb; Accommodation; COVID-19; Price; Local Homes; Difference-in-Differences; Causal Inference.

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LIST OF ABBREVIATIONS AND ACRONYMS

CNN	Cable News Network
DiD	Difference-in-Differences
GDP	Gross Domestic Product
IMF	International Monetary Fund
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
SARS	Severe Acute Respiratory Syndrome
TWFE	Two Way Fixed Effects
UNWTO	United Nations World Tourism Organization
YoY	Year-on-Year
WHO	World Health Organization
WTTC	World Travel & Tourism Council

1. INTRODUCTION

1.1. RESEARCH QUESTION

COVID-19 had started a pandemic situation around the world who has had a massive impact on short-term rental markets.

This new disease, which began in Wuhan, China was reported to the WHO on December 31st, 2019 but this was only confirmed on January 12th, 2020 by the World Health Organization (WHO). It was a very alarming situation due to the facility that the virus spreads and one of the biggest reasons for this velocity is because people only feel the side effects of the virus after a few days of having already contracted it, normally up to fifteen days. Some of those symptoms are fever, cough, fatigue, breathing difficulties and loss of smell and taste.

In March 2nd, 2020, was confirmed that Portugal had already cases of coronavirus.

At the beginning of COVID-19 in Portugal, the demand for local homes has decreased due to the restrictions imposed by the Government. One of the biggest reasons for this demand decreased was due to the fact that Portugal went into a lockdown and no one could leave their home. However, in June, this demand had increased. This fact could be explained by the facility that Portugal, among all other countries, have been fighting against the virus becoming one of the countries with the largest number of solutions to combat this pandemic (OECD, 2020).¹

“How COVID-19 impacted Airbnb prices in Lisbon?” is the biggest question of this work.

“COVID-19 has impacted travel and tourism like no other event before in history. Governments have put public health first and introduced full or partial restrictions on travel. With tourism suspended, the benefits the sector brings are under threat: millions of jobs could be lost, and progress made in the fields of equality and sustainable economic growth could be rolled back. UNWTO therefore calls on governments to continuously review travel restrictions

¹ Jornal Económico, “OECD: Portugal is the country with the most innovative projects to combat Covid-19”, August 3, 2020, <https://jornaleconomico.sapo.pt/en/news/ocde-portugal-and-the-country-with-more-innovative-projects-to-combat-covid-19-578610>

and ease or lift them as soon as it is safe to do so.” (UNWTO Secretary-General Zurab Pololikashvili, 2020).²

In this study is going to be analysed the effect of the trends of Airbnb prices, will be compared two European cities to have a better perception of how this pandemic spread and to understand in which cities there was a bigger oscillation of the prices caused by COVID-19.

1.2. STUDY RELEVANCE

In 2019, tourism represented 10% of global GDP and was worth almost \$9 trillion³, making this sector almost three times larger than agriculture.

The tourism sector has a characteristic of extreme sensitivity to various situations, such as seasonal fluctuations in demand, meteorological and geological risks, political instability and epidemic and pandemic outbreaks. One of the biggest pandemics in the world is the actual COVID-19 and for that reason it becomes necessary to analyse this crisis.

With the actual world pandemic, it is important analysing how Airbnb prices behaved with these global changes. This is a very actual topic, that’s why this theme is very interesting because it is going to be analysed something that actually is happening. Furthermore, this is a global scale problem that is affecting everybody in the world, so no one is indifferent to the situation.

The World Travel & Tourism Council (WTTC) has estimated that the global economic impact on tourism due to COVID-19 would be more than five times greater than the impact of the global financial crisis in 2008 (WTTC, 2020).

The tourism industry had no plan B, once the Spring lockdown obliged them to stop their activities and teleworking was not possible for this sector.

² World Tourism Organization, “Covid-19 Response: 96% of Global Destinations impose Travel Restrictions, UNWTO REPORTS”, April 17, 2020, <https://www.unwto.org/news/covid-19-response-travel-restrictions>

³ World Travel & Tourism Council (WTTC), “Economic Impact Reports,” 2020, <https://wtcc.org/Research/Economic-Impact>

Internal tourism has a huge impact on society and it can interfere with the social and economic well-being of residents in tourist destinations (Jordan, Moran, & Godwyll, 2019).

Between April and May 2020, all worldwide destinations introduced travel restrictions in order to combat the pandemic, through the closure of borders for tourists and suspension of international flights (UNWTO, 2020).

The UNWTO previsions reveal that international arrivals could decline by 60% to 80% relative to 2019 and it is likely that by 2024 everything won't be normalized yet.⁴

Some critics are speculating about "What will travel be like after the Coronavirus", with some unrealistically optimistic perspectives that already having proved that are wrong (Forbes, 2020).

With the help of the tourism sector, the fight against the virus will be easier. However, tourists have a responsibility to inform themselves before they travel and they should follow the recommendations of the WHO.

People believe that tourism will recover, has it already done in previous crisis (CNN, 2020). Nevertheless, it is evident that COVID-19 will be different and will bring a lot of transformations for the tourism sector. However, it is too early to estimate all the impacts that this pandemic will have.

1.3. METHODOLOGIES USED AND SUMMARY OF THE RESULTS

COVID-19 came and changed a lot of things on society, brought a lot of losses for the economy and tourism has been the worst affected of all main economic sectors.

The hospitality sector had a huge drop in sales at the beginning of the pandemic because they had to close the hotel units. All this happened in one of the highest seasons for Algarve, in Easter. At this time, a lot of Portuguese as well as Spanish and English people usually spend a few days in this destination and probably this also happened in the other countries. For that

⁴ World Tourism Organization, "International tourist numbers could fall 60-80% in 2020, UNWTO reports," May 7, 2020, unwto.org.

reason, in this project, it will be analysed the variation of prices in two European countries – Lisbon and Berlin.

The tool of impact evaluation method to analyse the effect of the trends of Airbnb prices chosen was Difference-in-Differences. This method is used to estimate the effect of a treatment by comparing the changes in outcomes over time between the experimental group and the control group.

The data was analysed on R and the main results are that in Lisbon the prices have risen and in Berlin have dropped. The lifting of measures imposed by governments had a mean impact of -2.66% on Berlin's Airbnb Prices.

2. LITERATURE REVIEW

2.1. AIRBNB AS A COMPANY

Airbnb is a platform for renting local homes. It was founded by Brian Chesky, Joe Gebbia, and Nathan Blecharczyk in San Francisco during the year of 2008.

This project arises when, on a business trip, they realized they had no money to pay the accommodation during their stay, so two of the founders decided to rent out their apartments in order to help pay the travel expenses. They wanted to build a business that would not only change the way people think about travelling, but also become a revolutionary company. This idea revolutionises online accommodation.

Over the years the company has continued to innovate and improve their price recommendation tool. By using dynamic prices who provides a more effective price recommendation tool to Airbnb hosts.

Airbnb is one of the largest marketplaces for places to stay and with activities to do in the whole world. Is the largest short-term rental platform and actually it's present on more than 30,000 cities across 191 countries, with income over \$2B and a total valuation of \$38 billion (Gallagher, 2018).

Before being known as Airbnb, the website that they launched was called *Airbedandbreakfast.com*. In a few years, this small experiment led to the extraordinary success of Airbnb.

The platform operates through a total of 4 million Airbnb lists and more than 2 million individuals use Airbnb to gain access to the renting.

In addition to renting houses, the Airbnb also offers:

- Airbnb Experiences: The renters can do activities like cooking classes, tours and adventures.⁵

⁵ Airbnb, "Airbnb Experiences", <https://www.airbnb.com/s/experiences>

- Airbnb Collections: Is served to find properties that can be used for special trips or other occasions.⁶
- Airbnb Plus: This section features homes that are highly rated and come with standard facilities.⁷

The success of Airbnb is dependent on the millions of empty spaces that are not being used but more relevant, this success is about ordinary people trusting your homes to other people that they don't know. Building a business on an unconventional idea means that Airbnb sometimes has had to counter traditional business knowledge.

One of the biggest focuses of Airbnb is "making what people want" by involving its community through story sharing on the Airbnb website. Another form of interaction is through the local community, where partnerships are established with municipal authorities in San Francisco and Portland to help identify hosts to help displaced people in case of emergency.

Defines itself as "a social website that connects people who have space to spare with those who are looking for a place to stay".

Airbnb has created a culture supported not only by its commitment to its mission and values, but also by its constant belief in honest and two-way communication.

It's success and fast growth have made it the focus of concern for policy makers. Acts as an intermediary operating that connects hosts and travellers allowing transactions without owning any of the accommodations (Choudary, 2013).

This platform creates trust in the user community and lowers transaction costs by providing protection insurance for the host, as well as a rating and review system.

Normally, is less expensive booking a room with Airbnb than at a hotel (D. Guttentag, 2015; Wang & Nicolau, 2017).

⁶ Airbnb, "Airbnb Experiences", <https://www.airbnb.com/new>

⁷ Airbnb, "Airbnb Experiences", <https://www.airbnb.com/plus>

Airbnb is a good platform for people that have more than one home and want to monetize them. Therefore, listing a guest bedroom in a house, a suite, the entire property, or other type of accommodation are other options that costumers have while renting a place.

Also, booking through Airbnb provides guests the opportunity to communicate with their hosts and have a more authentic experience enjoying 'everyday life' while they are travelling (Brochado & Shah, et al., 2017; Guttentag & Smith, 2017; Maitland, 2010).

In order to make the process of reservations easier, more than 40% of Airbnb listings are now available via Instant Book. Another function that Airbnb has is a check-in tool that automatically gives to the travellers, arrival instructions through the online application. They also expanded into Business Travel Ready listings, which offer travellers a work space, Wi-Fi...

2.1.1. Airbnb Business Model

The term business model has become more and more important and very popular within management, strategy and information systems (Hedmang & Kalling, 2003).

Business models are useful tools for both managers and entrepreneurs. Allow them to maintain a global view of their business, ensuring that operational decisions are in line with their overall strategy.

Huge part of the literature on business models defines it as "the ways of creating value for customers, and the way in which a business turns market opportunities into profits through set of actors, activities and collaboration" (Rajala & Westerlund, 2007).

In practice, the concept of a business model offers an additional advantage: while each company has a business model because each company creates value, not all companies have a defined strategy (Casadesus-Masanell and Ricart, 2010).

Airbnb is a community-based, two-sided online platform, on the one side it enables owners to list their space and earn money through the house rental. Conversely, on the opposite side it provides travellers easy access to renting private homes.

A two-sided market enables interactions between multiple interdependent customer groups. The value of the platform increases as more groups or as more individual members of each group use it.

This company has become very known for the fact of the facility of process of booking private living spaces for travellers.

Hotels and commercial groups can now list their rooms on Airbnb. For that reason, Airbnb is competing directly with other hotel booking sites.

The main source of revenue of Airbnb is the received commissions from two sources on each reservation, such as hosts and guests. For each reservation, Airbnb levies the guests 6-12% of the booking reservation. Depending on the size of the reservation, guests are required to pay a non-refundable service fee based on the type of listing, normally less than 14.2%.

Also, Airbnb charges the host 3% for each successful transaction to cover the processing of guest payments. This fee may be higher for Airbnb Plus listings and for hosts that use super rigid cancellation policies. Is calculated from the subtotal of the booking and is automatically deducted from the payment to the host.

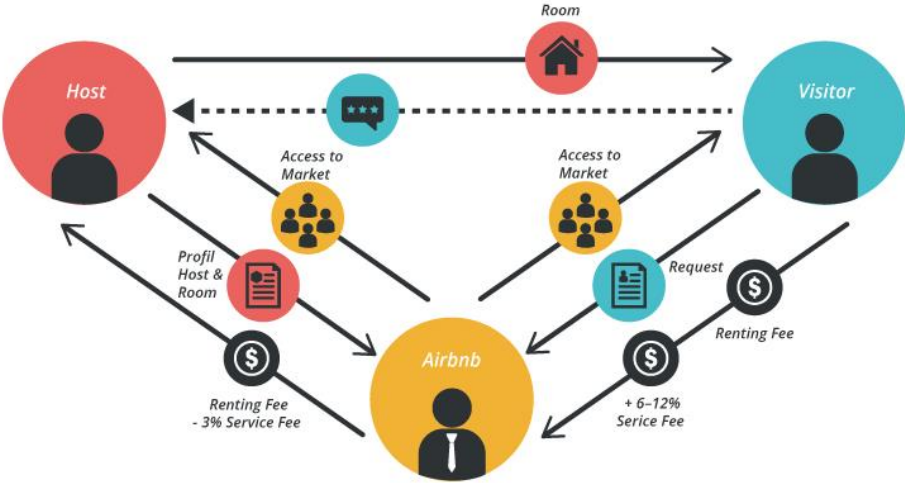


Figure 1 - Airbnb Business Model

2.2. ECONOMIC IMPACT OF COVID-19

Tourism is one of the economic sectors that grows faster and is a key driver of economic growth and development.

The coronavirus has frozen the entire world. It has started in Wuhan, China in December 31st, 2019 but immediately propagated to the rest of the world. Actually, are being conducted a lot of researches and tests to find a cure. Although, six months after there was not yet a vaccine and the capacity to treat the disease is limited.

In June 11th, 2020 the disease had a total of 7.350.698 confirmed cases in more than 187 countries, included cruises. It had a total of 3.447.918 recovered cases and 415.277 deaths.⁸

The confinement caused an unprecedented crisis in the country. The IMF released the economic forecast in April, according to which GDP will contract 8% and the unemployment rate will rise to 13.9%.

International restrictions immediately affected national economies, including tourism. Boundaries have been closed, tourism had been suspended, hotels and accommodations have closed for indefinite period, social activities were disallowed and people have been told to stay in their homes.

Although experts had advised about the possibility of a pandemic given the increasing frequency of outbreaks in this century (Sands, 2017), the truth is that COVID-19 caught the world mainly unprepared.

Pandemics are responsible for devastating losses of human life, they have been responsible for more deaths than armed conflicts (Adda, 2016).

The COVID-19 outbreak will have severe consequences for international tourism, with concomitant effects on the economic growth and prosperity of several nations (Gössling, Scott, and Hall, 2020).

⁸ Google News, Coronavírus (Covid-19), June 11, 2020, <https://news.google.com/covid19/map?hl=pt-PT&mid=/m/02j71&gl=PT&ceid=PT:pt-150>

In the developed and developing countries, the tourism sector is a huge source of employment, budget revenue and foreign exchange income. Without this, many countries could suffer a dramatic contraction in GDP and an increase in unemployment.

The World Tourism Organization⁹ claimed “ours has been the sector hardest hit by the crisis”.

The term ‘crisis’ refers to unexpected events that cause huge unrest in a country and cause a feeling of threat and fear. A public health crisis is a difficult situation that affect individuals in one or more geographical areas.

The impact of COVID-19 on global economy and tourism industry was quickly apparent. For that reason, to stop the disease spread and dissemination, EU countries adopted extreme measures in Spring 2020, such as lockdown and travel restrictions.

Travel had to be adapted to the impact of COVID particularly in terms of travel restrictions. Trips within the own country had increased. The most affected were the developing countries because they are dependent on international travel.

The learning from the distressing events in Italy and Spain led the government to act very early and for that reason the schools were closed before the first (known) death caused by the SARS-CoV-2. The management of the crisis in Portugal attracted substantial interest from international media in the early days of the confinement.

These policy actions have affected both demand and supply in the value chain, leading to economic contraction, job losses and income reduction. The public health crisis has become an economic crisis. The massive reduction on demand for goods and services due to the closure of shops, hotels, restaurants and other services is leading to a significant increase in unemployment and business failure, affecting all European regions.

Huge part of travel destinations were entirely closed in April and May 2020 and have just slowly open back in some regions for the summer. According to the UNWTO there is uncertainty in relation to the duration of the pandemic and this frightens everyone working in this area.

⁹ UNWTO. (2020a, April 1). Message from Madrid: Tourism and Covid-19”. <https://www.unwto.org/news/madrid-tourism-covid-19>.

The United Nations World Tourism Organization (UNWTO) estimates a loss of \$850 million to \$1.1 billion international tourist arrivals. Relatively to the export revenue, it was estimated a total of damages of \$910 million to \$1.1 trillion.

They said that tourism experts do not expect that tourism returns to pre-COVID arrival levels until 2023 or later. In fact, nearly half of the experts interviewed see a return to 2019 levels in 2024 or later (UNWTO, 2021). The biggest obstacles are travel restrictions, slow containment of the virus, low traveller confidence and a poor economic environment.

UNWTO said that the impact of COVID-19 on tourism will be much higher than the recession after the Great Financial Crisis of 2008, when international tourist arrivals dropped by 4%, and the SARS crisis (Severe Acute Respiratory Syndrome), which affected the industry only by 0.4% internationally (UNWTO, 2020).

In spite of their commonalities (Gössling et al., 2020), the two crises have had different effects, the SARS epidemic affected only 29 countries, whereas the COVID-19 is now a global pandemic, with cases in more than 188 countries (WHO, 2020).

Also, the current crisis can stimulate the already tense situation between China and the United States of America, which can lead to further negative effects.

Actually, researchers are examining the effects of the COVID-19 pandemic using the preliminary data available. Wen et al. (2020) present their suggestions on possible multi-disciplinary research ways on the pandemic and discuss possible challenges. Gössling et al. (2020) compare the COVID-19 crisis with the previous crises in the tourism industry and show the initial data predicts damaging results for the sector. At last, Hoque et al. (2020) study the effects of the crisis on Chinese tourism and claim that as the crisis worsen, the persistence of the negative effects also aggravates.

Airbnb has come closer to turning a profit than Uber (American company that offers vehicles for hire, food delivery, package delivery, couriers, freight transportation) or WeWork (American commercial real estate company that provides flexible shared spaces for technology start-ups and services for other enterprises), until the appearance of the COVID-19 when more than \$1 billion of reserves were lost almost overnight. In the spring, Airbnb expected its revenue for 2020 would drop to half of the \$4.8 billion it originated in last year.

They had to cut costs quickly, raise emergency funds, lay off almost 2,000 employees and file their plans to go public.

3. BACKGROUND

3.1. IMPACTS ON AIRBNB PRICES

3.1.1. Airbnb Price Determinants

Airbnb hosts can set their price based in what they think the market will pay. In other way, they have a tool for price recommendation, the Smart Pricing tool where the hosts can set a minimum and a maximum price and will automatically update the prices according to the fluctuations of demand in the pretended area.

The price suggestions are given by a machine learning algorithm and these are updated every day according to current market dynamics. The main objective is to determine a dynamic pricing strategy that helps hosts set the optimal price.

Setting the right price at the right time is a very important management technique for service companies to maximize incomes (Gallego and Hu, 2014).

Pricing system of Airbnb consists in three mechanisms. In first place, the booking probability of listing the house will be predicted by a binary classification model. After that, a regression model predicts the optimal price for each night. Finally, it's going to be applied additional personalization on top of the output from the second model to provide the final price suggestions (F. Yang, J. Qian, et al., 2018).

Recent research indicates that majority hosts fail to maximize their potential income due to poorly pricing their listings. It was estimated that Airbnb lost 46% of incomes due to inefficient pricing (Gibbs et al., 2018).

3.1.2. Oscillation of Airbnb Prices

Horn and Merante (2017) analysed the rental cost of long-term in Boston and conclude that prices increased in areas with more Airbnb.

Exists two main factors that cause the oscillation of prices: (1) Seasonality and events: the demand is not constant over the year and in this market exists high and low season. Over the summer, high season, more people search "Airbnb" on Google. This is due to more people

planning to travel during this season. Furthermore, special events also cause an increase in demand for a short period of time in the region where is the event. (2) Lead time: is the time distance between the current day and the day that we want to estimate the demand. “As lead time reduces, there are less opportunities for this night to be booked, which leads to the change in the demand function”. (Chen, J., & Zhang, L., et al., 2018).

Tourism already has experienced numerous crisis before COVID-19 pandemic which also leads to fluctuations of prices, including the tsunami in the Indian Ocean region in 2005, the impacts of the September 11th, 2001 terrorist attacks on the USA and previous pandemics such as the 2009 swine flu crisis.

Even though, COVID-19 has had a higher magnitude than crisis above mentioned and no one has perspectives of when it ends. This fact is explained by this pandemic appears in global scale.

3.2. SHARING ECONOMY

The sharing economy is an economic or commercial model often referred to as a peer-to-peer economy. Allows buyers and sellers to conduct their business more easily by sharing human and physical resources.

There are several definitions of sharing economy. The authors disagree on the specific meaning of ‘sharing’ (Habibi et al., 2017), but agree on a common concept: sharing economy refers to a specific context of exchange (Muñoz and Cohen, 2017) which does not have to align with classical industry definitions (Kathan et al., 2016)

Peer-to-peer markets or, more known as sharing economy, had grown up in recent years (Sundararajan, 2017) enhanced by new platforms, like Airbnb.

“The two most prominent sharing platforms—Airbnb and Uber—are very commercial and have very little to do with actual sharing in the sense of solidarity and community,” say Christoph Lutz, associate professor of communication and culture at BI Norwegian Business School.

Sharing economy is an economy based on the idea that people share their underutilized resources with other consumers in the market (Botsman and Rogers, 2011) and additional value will be added to these resources (Koopman et al., 2015).

One of the most successful companies of sharing economy is Airbnb. (Quattrone, G., et al., 2016). Offers a wide range of accommodations, through peer-to-peer interaction between hosts and clients.

More and more, people are renting out some extra space on platforms, like Airbnb, in a way to get more income. Micro-transactions and peer-to-peer reviewing have facilitated and allowed more trust in online sharing.

The growth of the technological world has been the main driver behind the increase in sharing economy.

“Through digitalization, corporations have been able to tap into the informal economy and capture some of its value,” Attila explains.

Tourists say that sharing economy, in this case, rental accommodation, has a lot of benefits and the main benefit is the cost reduction. Other benefit is the opportunity for cultural exchange and social interaction with their hosts (Balck & Cracau, 2015, Guttentag, 2015, Quinby & Gasdia, 2014).

Sharing platforms, like Airbnb, are also threat to local economies. This platform of renting has been accused of contributing to increase rent and gentrification.

“It profits from growth, while risks and losses are externalised to its environment,” Attila Marton, professor of digitalization at Copenhagen Business School, explains.

4. DATA

The data was extracted from the website Inside Airbnb. It was scraped from information that is available on the Airbnb website because the official data is not provided by the platform. This website utilizes public data collected from the Airbnb site including the availability calendar for 365 days.

Nowadays, Airbnb represents a huge percentage of the tourism sector among peer-to-peer markets. According to AirDNA, one of the largest databases on short-term rental analytics.

In this project will be analysed if Airbnb demand has had biggest fluctuations or not, will be compared two European cities to have a better perception of how this pandemic spread and it's going to be able to understand in which city had a bigger oscillation of the prices caused by COVID-19.

The aim of the project is to have a macro analysis, to perceive what happened in these last months that the pandemic has spread.

It was chosen two European cities – Lisbon and Berlin - and will be compared the trends of these two cities throughout this world pandemic, more known as COVID-19.

The time imposed by the government for the lockdown was similar in these cities. However, for the second lockdown they had different time periods. For this reason, these are the two cities chosen for the analysis, to be able to compare them.

The data collected has a time period from 2018 until 2021, but the analysis is only for 2020 and 2021. There is no seasonality in the data because we cannot observe periodic patterns that occur in a systematic way throughout the year (Figure 2). What concerns to trends as we can see below in Figure 2 there is no trend along the time series.

We can also observe in Figure 2 that the trends in prices are parallel between the two cities. They maintain a similar trend through the time.

	Minimum	1 st Quartile	Median	Mean	3 rd Quartile	Maximum
Typology	0	1	2	2.247	3	24
Price	5.95	38.25	59.50	94.28	97.58	11 900
Ln(price)	1.783	3.644	4.086	4.156	4.581	9.384

Table 1 - Descriptive Statistics

After extracted, the data was cleaned and just kept only the variables that are important for the analysis. The extraction had 106 variables but was only maintained 5 of them.

From these 5 variables, it was necessary to remove duplicates, eliminate all rows with blank cells and finally, delete potential outliers.

The data was extracted per month and after all months been extracted it was all put together in a single excel, to after import to R and analyse the data.

The sample includes Airbnb prices per night in two European cities – Lisbon and Berlin– and 28 neighbourhoods, between 2018 and 2021.

Furthermore, the variables chosen for the analysis were the types of accommodation, neighbourhood, type of property, typology and the price. The frequency of the data is monthly.

The types of accommodations are:

- Entire home
- Private room

And in some cities, from a certain year, they have other types of accommodations, like:

- Shared room
- Hotel room

Variable name	Description
city	Berlin or Lisbon
neighbourhood	Name of the neighbourhood
property_type	Type of property of the Airbnb listing
room_type	Type of the room
typology	Number of bedrooms
price	Price of the Airbnb listings
ln(price)	Logarithm of the Airbnb listings prices
month	January, February..., December
year	2018, 2019, 2020, 2021
period	Quarters of a year
treated	1 if Berlin (treatment); 0 if Lisbon (control)
post	1 if December 16 th , 2020 until January 15 th , 2021; 0 if June 1 st , 2020 until December 15 th , 2020
treatedpost	Difference-in-differences estimator

Table 2 - Variables Description

5. EMPIRICAL STRATEGY

In the methodology is going to be applied a tool of impact evaluation method to evaluate the effect of the trends of Airbnb prices.

Card and Krueger (1992) investigate the important question of how minimum wage affects employment. This work will take the same approach, but instead of wages and employment we will have Airbnb prices and two European cities.

It is not possible to draw causal conclusions by observing simple before and after differences in outcomes. Other factors besides the treatment can influence the outcome over time. Furthermore, we cannot only compare enrolled and unenrolled groups due to selection bias and differences in unobservable characteristics between the groups. Difference-in-differences combines these two methods to compare the before and after changes in outcomes for treatment and control groups and estimate the overall impact of the program.

The estimator that will be used in this study is Difference-in-Differences (DiD), more known as Diff-in-Diff. This method is used to estimate the effect of a treatment by comparing the changes in outcomes over time between the experimental group and the control group.

This is an evaluation method used in non-experimental environments, as opposed to random experiments that allow a simple comparison of treatment and control groups.

The aim of these methods is to estimate the causal effects of a programme when the allocation of treatment is not random.

To use this model is necessary to verify the “Parallel Trends Assumption”. It requires that in the absence of treatment, the difference between the treatment and control group is constant over time.

To use the DiD method is necessary to collect data before and after the intervention, such as cohort (set of people that have in common an event that happened at the same time).

The centre of the analysis is perceiving the effect of lockdown in Airbnb prices in Lisbon and Berlin. COVID-19 brought uncertainty to the world, which means that this pandemic was not

expected to the researchers as well as to the households. In this way, the last ones had to adapted their business to this new reality.

Berlin imposed lockdown much earlier than Portugal. On December 16th, 2020, Berlin goes into hard lockdown. Lisbon, only later, on January 15th, 2021, also had to close everything and go back into confinement – this is “the source of identification”.

For this analysis, the treatment group is the group that receives the treatment that we are testing. In this case the treatment group is the Airbnb prices in Berlin.

The control group is a group separated from the rest of the experiment and does not receive the tested treatment, so will not influence the results. Provides a baseline that allows see if the treatment has an effect or not. In this study the control group are going to be the Airbnb prices in Lisbon.

The counterfactual is the Airbnb prices after the pandemic if this had not existed.

As pre-treatment period we have June 1st, 2020 until December 15th, 2020 and as the post-treatment period we have December 16th, 2020 until January 15th, 2021.

To estimate the model, it's used a classic multivariate linear regression:

$$\ln(y_{it}) = \alpha + \beta_1 \text{treated} + \beta_2 \text{post} + \beta_3 \text{treated} * \text{post} + \varepsilon_{it} \quad i=1,2,\dots,n; t=1,2,\dots, T$$

Where y_{it} is the outcome of the prices in Berlin.

β_3 is the difference-in-differences estimator which is the parameter of interest. Represents how much the average outcome of the treatment group has changed in the post-treatment period, compared to what it would happened to the same group if the intervention did not occurred.

In this model, it's going to be observed the outcomes before and after the intervention.

	BEFORE	AFTER	DIFFERENCES
TREATMENT GROUP	A	B	B - A
CONTROL GROUP	C	D	D - C
DIFFERENCES	A - C	B - D	(B - A) - (D - C)

Table 3 - Difference-in-Differences Estimator

C is the base group average.

B-A and D-C, represents the time trend in the treatment group and the time trend in the control group respectively, between the period before and after the event which is being examined.

The difference-in-differences method calculates the estimated impact:

1. Calculate the difference in the outcome between the before and after for the treatment group – first difference (B-A).
2. Calculate the difference in the outcome between the before and after situations for the control group – second difference (D-C).
3. After this it is necessary calculate the difference between the difference in outcomes for the experimental group and the difference for the control group, or difference-in-differences (DiD). This difference-in-differences is our impact estimate (B-A) - (D-C).

This variation is the (B - A) – (D - C) in the Difference-in-Differences table and can be shown by:

$$\hat{\beta}_{Berlin} = (\bar{y}_{Berlin}^{POST} - \bar{y}_{Berlin}^{PRE}) - (\bar{y}_{Lisbon}^{POST} - \bar{y}_{Lisbon}^{PRE})$$

Looking at this coefficient we can measure the impact on Airbnb prices due to lockdowns and analyse the trend impact of COVID-19 on the prices.

6. RESULTS

The purpose of the current study is to estimate the impact of lockdowns on prices. To analyse this, DiD model differences in trends.

For that reason, like it was said above, the methodology used is the Difference-in-Differences. It will be analysed two time periods and two European cities.

In this project it will be estimated a simple diff-in-diff model. The obtained coefficients are:

	Coefficient	Std.Error	T-value	P(> t)
Intercept (α)	4.050307	0.002790	1451.527	<2e-16***
Treated (β_1)	-0.243470	0.003910	-62.266	< 2e-16***
Post (β_2)	0.164417	0.003740	43.959	< 2e-16***
Treatedpost (β_3)	-0.026023	0.005145	-5.058	4.24e-07***

Table 4 – Difference-in-Differences Coefficients Summary with Logarithms

The diff-in-diff estimate ($\hat{\beta}_3$) is statistically significant (p-value is lower than 0.05).

Through β_3 coefficient it is possible to conclude that the Airbnb prices in Berlin decreased 2.66% comparing with prices in Lisbon between December 16th, 2020 and January 15th, 2021. These are the analysed months (post-treatment) because are the only two periods that the two cities overlap.

This coefficient also represents the difference between the counterfactual and the average outcome for Berlin at time = 2. Berlin may have tried to decrease prices to attract more tourists.

The most common alternative when is assumed independence across i is to analyse cluster standard error estimator, clustering at the group level.

Clustered standard errors happen when some observations in a dataset are related to each other. We should cluster when clusters of units, rather than individual units, are assigned to a treatment.

Clustering by city, the coefficients are:

	Std.Error	Clustered Std. Error
Intercept (α)	0.002790	1.2565e-13
Treated (β_1)	0.003910	1.4167e-13
Post (β_2)	0.003740	1.8558e-13
Treatedpost (β_3)	0.005145	2.0146e-13

Table 5 - Clustering of the Standard Errors

After analysing in R, the standard deviation becomes smaller when clustered. They can be smaller than OLS standard errors for two reasons: a small sample bias and higher sampling variance of the standard errors.

The two-way linear fixed effects regression (TWFE) has become a default method to estimating causal effects from panel data.

Fixed effects are variables that do not change over time, which means that any change they cause to an individual is always the same.

To estimate the fixed effects model, the regression is:

$$\ln(y_{it}) = \alpha + \beta_1 \text{treated} + \beta_2 \text{post} + \beta_3 \text{treated} * \text{post} + \delta_i + \varepsilon_{it} \quad i=1,2,\dots,n; t=1,2,\dots, T$$

Here, it was included a city fixed effect - δ_i – dummy for city.

	Coefficient	Std.Error	T-value	P(> t)
Treated (β_1)	3.806838	0.002739	1389.779	< 2e-16***
Post (β_2)	0.164417	0.003740	43.959	< 2e-16***
Treatedpost (β_3)	-0.026023	0.005145	-5.058	4.24e-07***
Factor(city) Lisbon	4.050307	0.002790	1451.527	< 2e-16***

Table 6 - Two-Way Linear Fixed Effects Regression (TWFE)

The p-value of the F-statistic is < 0.05, for that reason the model is correct. The F-test is used to see whether all the coefficients in the model are different than zero.

The coefficient on city is positive and statistically significant. The interpretation is that Airbnb prices in Lisbon increase more 4.05% than Berlin, on average.

This model assumes that in absence of the treatment, the treatment and control group need to have a similar trend over time, so as we can calculate the counterfactual based on the changes in the control group. This is called the parallel trend assumption.

We can see in the graphic below that this assumption is verified, because the lines that represents the prices of Lisbon and Berlin remains constant over time.

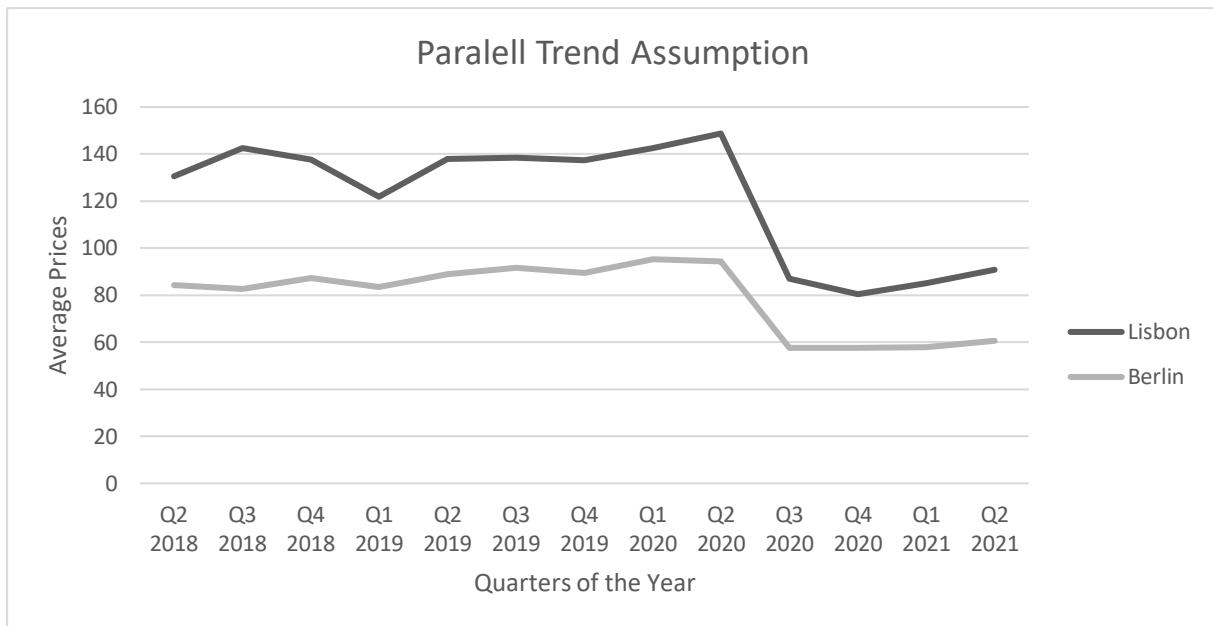


Figure 2 - Verification of Parallel Trend Assumption between Lisbon and Berlin

Note: the frequency of the data is quarterly.

Plotting the data, it is possible to see that there are not trends as can be seen in Figure 2. In the second quarter of 2020 there was a fall in Airbnb prices, both in Lisbon and Berlin. This price drop is due to the appearance of COVID-19, in March 2020.

Looking through the two cities, is perceptible that exists a trend between them over the months.

7. DISCUSSION

The objective of this analysis is understanding the trends of the Airbnb prices between Lisbon and Berlin during the pandemic that we are all going through. It's obvious that COVID-19 changes a lot of things in society and tourism is not an exception.

The data used is from 2018 to 2021 but the analysis only falls on the months of June 2020 until January 2021. Between June 1st, 2020 and December 15th, 2020 (pre-treatment) are the months that both cities were open without restrictions. From December 16th, 2020 to January 15th, 2021 is the post-treatment because is the month when Berlin is open and Lisbon is closed.

Looking at the results it is possible to assume that the Airbnb prices in Lisbon have remained higher than in Berlin.

A possible reason for this price increase in Lisbon in relation to Berlin is because Portugal was considered a successful case in the control of COVID-19, during the March 2020 outbreak in Europe due to timely confinement measures. For this reason, hosts may have taken advantage of this to increase prices.

The analysed months are basically the summer months, normally in these months Portugal receive a lot of tourists and probably this is another reason for the higher prices in Lisbon.

Last year, Portugal received a lot of international tourists that possibly if other countries were open, they would go there and this should be the most advantage for Portugal in this period.

"The cities that used to live from tourism were the first to suffer an unparalleled crisis, while the streets became deserted and the economy was paralysed due to a lack of visitors" Expresso (2020).

8. CONCLUSION

Concluding, the main objective of this project is understanding how Airbnb prices behaved during the pandemic crisis we all facing, more known as COVID-19. The analysis was made through the Difference-in-Differences method and the obtained results are that in Lisbon the Airbnb prices remained higher than in Berlin during the time of December 16th, 2020 until January 15th, 2021.

The empirical results suggests that despite the pandemic, Lisbon managed to keep prices higher than Berlin, but still prices fell. That being said, with a solid platform, a good reputation and a growing community, Airbnb finds itself in a strong position to sustain its competitive advantage.

While making this work, the main limitation was found in what concerns to the data extraction because Airbnb does not provide online data, which makes the creation of the database more complicated, as we want the most reliable data possible. To get over it, it was found a website that utilizes public data collected from the Airbnb.

In relation to policy implications, the two countries had to deal with some necessary measures that no one was expecting in a way to face the virus, like lockdowns, close borders and mandatory quarantines when arrived in other countries.

Regarding further research, could be interesting analysing if the vaccines are having an impact on the Airbnb prices. With the appearing of the vaccines, many restrictions were lifted and people began to return to normal life gradually.

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