T.C.
ISTANBUL COMMERCE UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
BUSINESS ADMINISTRATION PROGRAMME

IMPACT OF COVID-19 PANDEMIC ON AIRBNB BUSINESS IN ISTANBUL

MBA Thesis

Abdaljabbar RAMDOUN

200010731

Istanbul, 2021

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ABSTRACT

The recent COVID-19 pandemic had a major effect on all life aspects. Tourism is amongst the most impacted sectors by the pandemic, as people tend to avoid traveling, and governments took measures to restrict flights. Accommodation facilities that benefit from tourism were consequently affected, such as Airbnb, which has been showing high growth in the past few years in Istanbul, proving a solid business model. The aim of this study is to investigate the impact of COVID-19 pandemic on Airbnb business in Istanbul as a major touristic city. It's hypothesized here that the pandemic had a negative effect on Airbnb that it caused a significant decline in the number of reservations in Istanbul. Daily number of Airbnb reservations in Istanbul were collected between January 2017 and February 2021 from a dedicated open-source database. In addition, the daily numbers of COVID-19 patients from its emergence in March 2020 to February 2021 were collected. After processing the data, four sets of results were obtained, namely the monthly and yearly Airbnb number of reservations from 2017 to 2020, month-to-month Airbnb number of reservations, and the monthly number of COVID-19 patients compared to the month-by-month decline in Airbnb reservations, which were calculated after applying non-linear regression using an exponential function to predict the number of reservations in 2020 if they were to continue growing, and compare those to the actual ones. It was found that in 2017, 2018 and 2019, a constant pattern was followed seasonally in terms of Airbnb reservations, which was broken in the first half of 2020 with the emergence of the pandemic. Additionally, the yearly number of reservations dropped in 2020 to rates close to 2018 rates after exponential growth in 2019, which can be also explained by COVID-19 pandemic. Comparing COVID-19 number patients and Airbnb reservations monthly showed that reservations rate decrease as the number of patients increase with a response delay of about a month. This study can help understanding the impact of pandemics on tourism in major touristic cities, and can urge other researchers conducting more studies in the field, in addition to assisting similar businesses to benefit from the Airbnb experience during the pandemic to avoid large losses and adapt flexibly in similar situations.

Keywords: Airbnb, COVID-19, pandemics, tourism.

ÖZET

COVID-19, hayatı her yönden büyük ölçüde etkiledi. Özellikle seyahatten kaçınmada yaşanan artış ve devletler tarafından alınan uçuş önlemleri sebebi ile turizm; pandemi sürecinden en çok etkilenen sektörlerden biri arasında yer alıyor. Sonuç olarak, sağlam bir iş modeli olduğu kanıtlanan ve son birkaç yıldır yüksek oranda büyüme gösteren Airbnb gibi turizmden beslenen iş alanları da bu süreçten olumsuz olarak etkilenmiştir. Bu çalışma ile COVID-19'un büyük bir turizm şehri olan İstanbul'daki Airbnb işletmesi üzerindeki etkilerinin araştırılması amaçlanmıştır. Pandeminin Airbnb üzerinde olumsuz bir etkisi olduğunu ve dolayısıyla İstanbul'daki Airbnb rezervasyonlarının sayısında önemli bir düşüşe neden olduğunu varsayıyoruz. Mart 2020'de COVID-19 ' un ortaya çıkmasından Şubat 2021'e kadar olan sürede günlük COVID-19 hasta sayısını ve Ocak 2017 - Şubat 2021 tarihleri arasında İstanbul'daki günlük Airbnb rezervasyon sayısını özel açık kaynaklı veri tabanından topladık. üstel bir işlev kullanarak doğrusal olmayan regresyon, veri işlenmesinden sonra, sonuçları 4 set halinde derleyerek 2017'den 2020 yılına kadar aylık ve yıllık olarak Airbnb rezervasyon sayısını elde ettik, aylık Airbnb rezervasyon sayısı ve aylık COVID-19 hasta sayısı, Airbnb rezervasyonlarındaki aylık düşüşe kıyasla, 2020'deki rezervasyon sayısının artmaya devam edip etmeyeceğini öngördükten ve bunları gerçek olanlarla karşılaştırdıktan sonra hesaplandı. 2017, 2018 ve 2019 yıllarında, 2020'nin ilk yarısında iptal edilen Airbnb rezervasyonları açısından mevsimsel olarak sabit bir örüntü izlendiğini ve pandeminin ortaya çıkmasıyla başlayan bir değişiklik olduğunu saptadık. Ek olarak, yıllık rezervasyon sayısı 2020'de, 2019 yılındaki üstel büyümenin ardından 2018 yılı oranlarına yakın oranlarda seyretmiştir ve bu da COVID-19 pandemisi ile açıklanabilir. Ayrıca, aylık bazda COVID-19 hasta sayısı ve Airbnb rezervasyonlarının incelendiğinde ve kıyaslandığında hasta sayısı arttıkça rezervasyon oranının azaldığını gözlemlenmiştir. Çalışmamız önemli turistik kentlerde pandeminin turizme etkisini anlamaya yardımcı olacaktır, ayrıca daha fazla alanda çalışmalar yürüten diğer araştırmacıları teşvik edebilir. Buna ek olarak; benzer işletmelerin büyük kayıplardan kaçınması ve benzer durumlarda esnek bir şekilde uyum sağlaması için pandemi sırasında Airbnb iş modelinden ve deneyiminden yararlanmalarını dileriz.

Anahtar kelimeler: Airbnb, COVID-19, pandemiler, turizm.

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LIST OF ABBREVIATIONS

AD : Anno Domini

CDC : Centers for Disease Control and Prevention

COVID-19 : Coronavirus Disease 2019

FAO : Food and Agriculture Organization

FMCG : Fast Moving Customer Goods

GDP : Gross Domestic Product

H1N1 : Hemagglutinin Type 1 and Neuraminidase Type 1

NRF : National Retail Federation

OECD : The Organization for Economic Co-operation and Development

P2P : Peer-to-peer

SARS-COV-2 : Severe Acute Respiratory Syndrome Coronavirus 2

TV : Television

UK : United Kingdom

UNAIDS : Joint United Nations Programme on HIV/AIDS

UNCTAD : United Nations Conference on Trade and Development

UNWTO : United Nations World Tourism Organization

US : United States

USA : United States of America

WFP : World Food Programme

WHO : World Health Organization

WWI : World War I

1. INTRODUCTION

1.1 Motivation

Pandemics are amongst the highest recognized events in history, as their consequences take place on a global scale. In some cases, those consequences last beyond the event itself. COVID-19 is the latest and an on-going pandemic during the preparation time of this study, emerged in December of 2019, and spread all over the world. The effects of it have touched people's life in multiple aspects, significantly changing the norm lifestyle. Naturally: businesses were affected by the pandemic; certain sectors have suffered more than others have. Many studies were recently conducted in the light of COVID-19 pandemic, and showed that aviation; food industry, restaurants, fast-moving consumer goods (FMCG), and entertainment are among the sectors that were affected by the pandemic, either positively or negatively.

In addition, tourism and hospitality are amongst the sectors that took a greater hit, since the pandemic's primarily protective precautions included movement restrictions, domestically and internationally. That effect was demonstrated in a number of studies. Moreover, with the rise of the platforms of the shared economy, that touched many sectors, accommodation for instance, we can recognize Airbnb as one of the main players. It became obvious for researchers the importance of such business models. Studies were conducted to investigate the effects of COVID-19 on different aspects of Airbnb business, such as the change in demand caused by the pandemic in certain cities.

Yet, no study in the literature has addressed the effect of COVID-19 pandemic on Airbnb in Istanbul, which is a major touristic city that showed an exponential increase in the reservations of Airbnb before the pandemic.

1.2 Aim of the Study

In this study, the aim is to fill a gap in the literature, where the effects of COVID-19 on the state of Airbnb reservations are not addressed in the city of Istanbul. The importance of this work stems from the fact that the pandemic had major effects on almost all business sectors; and Airbnb is considered a rising and unique business model that proved its efficiency in the tourism market. On the other hand, Istanbul is one of most desired destinations for local and international tourists in Turkey. Therefore, we believe it is of impotence to get a closer look at the changes that occurred during the pandemic to Airbnb's reservations in Istanbul. The study focuses on the monthly and yearly numbers of Airbnb's reservations from the years of 2017 to 2020, and how the reservations number changes in response to the change of COVID-19 status in Turkey, represented by the number of patients, which can safely be considered an indicator to the degree of the pandemic's severity. Elaborating more, as the pandemic state exacerbates, the protective measures towards it become stricter, and the most related precaution to the study is travel restrictions. In addition, pandemic's state in a given country also affects the willingness of tourists to visit that country; standardly tourists book properties in different accommodation facilities because of visiting, using multiple platforms, including Airbnb. The study dive more in details in the previously stated phenomena and clarifies them.

1.3 Outline of the Study

In order to accomplish the aim of this study, it was broken down to 5 chapters. In chapter 2, the latest literature that studied the effects of COVID-19 pandemic on different business sectors was reviewed. Next, the methods of collecting the data of Airbnb's reservations and COVID-19 patients were explained, the data pre-processing and handling that we performed, and the analysis of data in the form of 2D plots was presented. In chapter 4, the obtained results were shown, including the monthly, yearly, and month-to-month change of Airbnb reservations. In addition to the response to the emergence of the pandemic and its dynamics. Finally, the results and the relationships that we observed were discussed, and we projected our interpretations on functions of the business model of Airbnb, and suggested the

conduction of further studies to provide a deeper understanding on the long-term effects of the pandemic on the business model of Airbnb in Istanbul.

2. LITERATURE REVIEW

2.1 Definition of Pandemics

Throughout history, humanity has encountered numerous events, which lead to change in living ways and conditions, and even more, reshaped them. Some of those events were occurring on a large scale: on vast areas of land, or affecting huge numbers of population. In those cases, one could argue that such events changed human civilizations. Out of those events, few had the severity in effect, as pandemics had.

An infection happens when an agent causing disease invades a host's tissues or organs, and then multiplies in it; the host reacts to the toxins produced by the agent, causing an infectious disease. The agent could be a virus, bacteria, fungus or other possible carriers, mainly and most commonly viruses and bacteria. The infectious agent can then be transmitted to another individual, causing its spread in a certain speed, which is called an infection rate (Sehgal et al., 2020).

When an infectious disease spreads rapidly to a high number of people in a given population, exceeding the normal rate, or the expected rate in the case of unknown disease, in a relatively short period regarding time, it is referred to as an *epidemic*. (Green et al, 2002). The word outbreak is also used to describe the previously mentioned phenomenon. The distinction between the two terms is not exactly clear amongst researchers, as both are used to report the rapid spread of a disease. They were also used in the case of 1918 influenza by different states (O'Neil and Naumova, 2007).

As for the definition of a pandemic, it is an epidemic that has spread to numerous regions, crossing the domestic borders of a population (Niknamian and Spencer, 2020). In other words, it is the spread of an epidemic or an infectious disease to different countries with a high rate of infection. The factors that distinguish a pandemic from other diseases is the speed in which it spreads and conditions contagiousness. A disease with high death rate is not necessarily a pandemic; it has

to be contagious. For instance, taking cancer as an example, although deadly, it is not even infectious, and therefore, not classified as a pandemic. Moreover, a flu that occurs at slow infection rate is not considered as a pandemic (Dumar, 2009).

2.2 Impact of Different Pandemics in Human History

To be able to understand the severity of a pandemic's consequences, observing the history of the pandemics that had a significant impact on humanity in the past is required. By doing that, we can have a deeper understanding of modern pandemics, or ones that are currently ongoing, and be equipped to predict the impact of future pandemics, which helps in improving the response towards it, in the purpose of minimizing their negative effects on different aspects, such as social, economic, educational, political aspects, and the health of individuals. In the following paragraphs, major pandemics that have taken place over history will be demonstrated and their impacts will be discussed.

2.2.1. Black Death

In 1346, the Black Death, commonly known as the Great Mortality or the Plague, started spreading in Europe and western Asia, causing the death of 75 to 200 million people over the course of 8 years. With such a high number of deaths, the Black Death is considered the most fatal infectious disease in history. In fact, the Black Death is the second plague, the first being the Plague of Justinian, which was spread in the same region of Eurasia long before that, particularly between 541 and 549 AD (Green, 2014).

In response to the great decline of population, the region suffered from a severe shortage of labor, causing wages to increase rapidly. In contrast, certain workers such as craftsmen and artisans had an income crisis, as their occupations became dangerous due to the accelerated inflation during the pandemic. Those who own lands and real estate started to accept labor services instead of cash money as rent, aiming to keep tenants. Environmentally speaking, the pandemic is thought to have

an impact on the climate, in such a way the temperature decreased as more land was unoccupied by people, forcing reforestation, and probably was one of the main causes of the Little Ice Age (Scheidel, 2017).

On the social side of the consequences, the influence of both the church and the state at that time was dulled, as workers in Europe were being run by the church in a form of a feudalist society. However, after the pandemic it was completely discarded as people started adapting diverse spirituality and beliefs (Garrett, 2005).

Furthermore, the pandemic itself was a factor in the emergence of the renaissance period in Italy according to (Brotton, 2006). Although it was not the direct reason nor the only one, it had a significant mark on that period, due to the big number of deaths as a result. It has been believed that the renaissance was the result of the interaction of many factors, one of them being the Black Death plague.

2.2.2. The Spanish Flu

As referred to in 1918. The Spanish flu was a pandemic caused by the H1N1 influenza virus. Started in February of 1918, lasting until April 1920. In those 2 years, the pandemic hit around 500 million of the world's population. Estimating between 20-50 million deaths, as a result of 4 waves of infections throughout the whole world. It is considered one of the deadliest pandemics in history. (WHO, 2013).

It was a common belief that influenza pandemics have their highest killing rate amongst the youngest and the oldest of a population, whilst ages in-between have a higher chance of surviving or a lower chance in death amongst the young. However, contrary to the common belief, the Spanish flu exceeded the expected death rate amongst the young (Gagnon et al., 2013).

Hence the breakout of the Spanish flu coincided with the late days of WWI, (Price-Smith, 2008) argues that the pandemic had favored the allied forces as far as the power balance goes. Since the mortality rate between the German and the Austrian

troops was higher than their opposing French and British troops. Also mentioned, the pandemic hit the central powers before it did with the allied forces as regards to time, of which we can conclude that the pandemic had more time to spread amongst the central powers.

As for the effect of the measures taken to prevent the spread of the pandemic, (Correia et al., 2020) study showed that the cities that exercised extensive and strict measures in the US, have faced lesser damage to its economy than those whom did not take any measures or implemented them late to their subjects.

Nonetheless, there were lasting effects to many economies. (Almond, 2006) discusses a relationship between adults' general health after exposure to the pandemic, and the economic situation. Using infant survival rate as an indicator to the next generation's strength and number, mentioning that the racial factor was favoring the black population over white in the studied sample, which was in the United States.
Finding that physical disability had increased, individual income became lower, and individuals attaining education decreased after the pandemic.

Eventually suggested further research to conduct policies that enables the full utilization of the population to refresh the economy. We can conceptualize the seriousness of the pandemic, as the effects were not confined to its victims, but had a lasting effect extending to a following generation of population.

2.2.3. HIV

Infecting more than 30 million people, HIV is considered by many researchers as a global pandemic (Cohen et al., 2008). However, (WHO, 2020) classified it as a global epidemic. Beginning in 1981 in Congo, the HIV virus that causes AIDS kept adding to its victims. Reported around 1.7 million cases in 2018. By that year, almost 40 million people were coexisting with the virus globally. More than half of them were undertaking medication to treat the virus. Estimated deaths in 2018 due to diseases related to AIDS were around 770 000 individuals. (CDC, 2021, a).

The areas most affected by the virus are in the Sub-Saharan region in Africa according to (CDC, 2021, b), it accounts for approximately 61% of the newly infected cases. The Pacific, Asia, Latin America, Eastern Europe, central Asia, and the Caribbean all had AIDS related disease caused by the HIV virus.

It was also stated that 69% of the new cases of HIV diagnosed in the US were in bisexual and gay men or other men who involved in male-to-male sexual intercourse. Heterosexual people accounted for 24% between men and women. UNAIDS suggested that higher risks of being a victim to HIV virus dwells in people who use drugs through injection, transgender individuals, sex workers and men who are involved in man-to-man intercourse (CDC, 2021, b).

2.2.4. COVID-19

Arriving in the ongoing novel COVID-19 pandemic, which started in December of the year 2019 in China, from a city called Wuhan located in Hubei province. An infectious disease caused by SARS-CoV-2 virus (Page et al., 2021). Viruses that belong to the same family were found in animals, particularly in bats. The infection spread through mainland China, exceeding borders to reach the Philippines, The United States and spread across the globe (WHO, 2021). The World Health Organization (WHO) announced it as a public health emergency of international concern on January 30 of 2020, and a global pandemic on March 11 of the same year. The number of infected individuals has exceeded 202 million worldwide by the time of preparing this research according to (worldmeters.info, 2021). Deaths reached over 4.29 million cases and recoveries over 182 million. Of which we can conclude, that it is still an active pandemic, reports say it is considered one of the deadliest pandemic humanity have ever witnessed.

As a result, certain preventive measures had to be taken, which came in the forms of recommending wearing facemasks, social distancing, hands and surfaces hygiene, and many others. In the hope of controlling the pandemic; containing it in the most optimistc scenario, slowing the spread at the least optimistc one, many governments took actions. Applying lockdowns, quarantines, and travel restrictions. Travel

restrictions were applicable on visitors from infected areas, citizens, or travelers all together (Schwartz, 2021). However, (Chinazzi et al., 2020) shows that those restrictions are effective as desired only when combined with the measures to prevent the infection.

2.2.4.1. COVID-19 Effect on Life Aspects

The effects of the pandemic have touched communities in many aspects, people had to adapt with the lockdowns and the obligation to stay home longer than what they would prefer. Education resumed online in secondary and high school, higher education as well.

Culture related events were in jeopardy as well, as it was associated with social gathering, it was profoundly affected by the curfews and movement restrictions. The impacts were on both organizational and individual levels, as performance venues, museums, cinemas, libraries, and multiple culture organizations were until further notice closed, their exhibitions and events were canceled, or postponed at best. (Mcgivern and Kenney, 2020). Some activities were continued digitally, either through platforms, social media live streaming, or web-based festivals. (Fadroski, 2020).

The celebration of the holy week in Rome, usually taking place at the end of the lent season of the Christian penitential, was canceled. Religious Christian figures recommended staying home during pandemic time as a preventive measure, especially for older people. Most activities shifted to digital channels, broadcasted through live streams, radio stations, or even TV. The catholic churches in Rome closed their doors and Christian pilgrims were evacuated from St. Peter's Square. (Burke, 2020).

In conjunction, Saudi Arabia has forbidden foreigners from entering the kingdom for the purpose of pilgrimage, also the residents were forbidden from visiting both holy cities, Mecca and Al Median. (Al Omran and Kerr, 2020).

As for politics, there were many effects on the political systems because of the pandemic.
Epidemiologists recommended preventive measures to address the spread of the pandemic, social distancing in specific. It had to be supported by legislation to be obligatory for the public, considering the nature of the event. This resulted in conflict between politicians, between supporters and those opposed the policy (The Economist, 2020).

Certain governments had to handle more heat than others did, in particular the Chinese government. Given that the pandemic started in China, the Chinese government was blamed for its poor policies in containing the spread of the virus; some parties even held it directly responsible (Proctor, 2020). The Chinese government rushed to dismiss multiple administrators on the provincial level; observers claim that it was an act for the purpose of exonerating the general secretary from any controversy (Bostock, 2020).

On the other hand, the United States had taken the same steps that similar wealthy countries have taken, making the health system accessible to all residents, including children as well, sick leaves were paid, and increased the funding of the health system (Miller, 2020). There was a belief that it was a factor in Donald Trump's losing in the presidential election of the year 2020 (Haberman and Martin, 2020).
In addition, it is worth mentioning that there were protests in numerous states against the government's decision regarding the coercion of business closure and movement restrictions. Moreover, workers in many associations organized protests in the form of a general strike, and Amazon workers in New York were the headline (Hilary, 2020).

The government of Iran was heavily affected by COVID-19, as the infection have reached more than couple dozens of their political and parliament figures (Cunningham and Bennett, 2020). In addition, the president pled for help from the worlds' leaders, as the struggle of the country continues because of the sanction by the United States government, and therefore, global markets were inaccessible for Iran (Reuters Staff, 2020).

Japan’s relationship with South Korea has witnessed disturbance, as South Korea criticized the actions taken by Japanese government towards the pandemic, as it described it "ambiguous" and "passive", also the decision of having people coming from South Korea quarantined in a governmental facilities (Farrer and McCurry, 2020). Moreover, some authoritarian governments' usage of the pandemic to strengthen their grip on power is a possibility, through emergency legislation, as response to the pandemic itself.

Hungary made the spread of false and misleading information, one with relation to the pandemic of COVID-19, a criminal offense. In addition, the prime minister was voted to rule by decree indefinitely. In Serbia, as a response to the emergency of the pandemic, soldiers were patrolling the streets as a routine (Walker, 2020).

2.2.4.2. COVID-19 Effects on Businesses

The most notable effect of the pandemic was on the economy. Businesses were affected in all sorts of ways. The supply chain faced multiple challenges because of the pandemic; travel bans prevented logistics from performing their customary role efficiently, distribution as well, due to the restriction on movement (Singh et al., 2020). A state of panic-buying was observed amongst the public in the United States, as shelves were cleared of food and water bottles (Tyko et al., 2020). As a result, retailers struggled to keep up with the increase in demand, taking into consideration the reduced work hours, and occasional closure which were in place as a precaution. Even in working hours, shopping malls witnessed a decrease in foot traffic (NRF, 2020). The head of World Food Program (WFP); David Beasley warned of multiple famines are ahead of us of a biblical proportion in the upcoming months (BBC News, 2020).

Energy sources and oil took a considerable hit after the pandemic, as the pandemic spread from China, the country's demand of oil was reduced, and therefore the prices were declined considerably, given China's demand rate in the market (Reed, 2020).

With numerous other businesses witnessing similar effects of the pandemic, it added up to the point of recession, a severe one, the last witnessed catastrophe of parallel level was in 1930, the great depression (IMf blog, 2020).

To be able to conceptualize the severity of the previously mentioned phenomena, and get better comprehension of the effect of COVID-19 on the economy, it is crucial to explore the effect of the pandemic on each industry separately with more details.
As mentioned earlier, amongst the earliest actions taken by governments as a response to the pandemic were lockdowns, and travel restriction (Aytekin, 2020).

Because of travel restrictions, the aviation industry was the first to suffer the pandemic's consequences. A study demonstrates how the pandemic affected 52 listed airline companies around the world (Maneenop & Sotcharin, 2020). Data was collected from nine countries in Asia, Europe, South Africa, Australia, North America, and Chile in addition. The stock price of the listed companies, and the market return for them were assessed in three different points temporally, all of which took place after the pandemic outbreak. The first of them was the announcement of the first case of corona virus by WHO. Second one being the outbreak of the pandemic in Italy, and the third one was the announcement of president Trump of the United States that his country bans traveling to 26 European countries. The point was to assess the expected stock return, with the stock market price and the market return as the parameters of measuring it, then finding the difference between the expected stock return and the actual value return of it, which they named abnormal return. The following graph shows its average values and the way it changed during the five days before the pandemic, and the five days after it happen.

The findings unfold a negative effect on stock price because of COVID-19 pandemic. Even so, there was a notable underreaction towards the pandemic's outbreak by the investors. Yet moving towards the second event, which is the pandemic's outbreak in Italy, fear and anxiety were building up amongst investors.

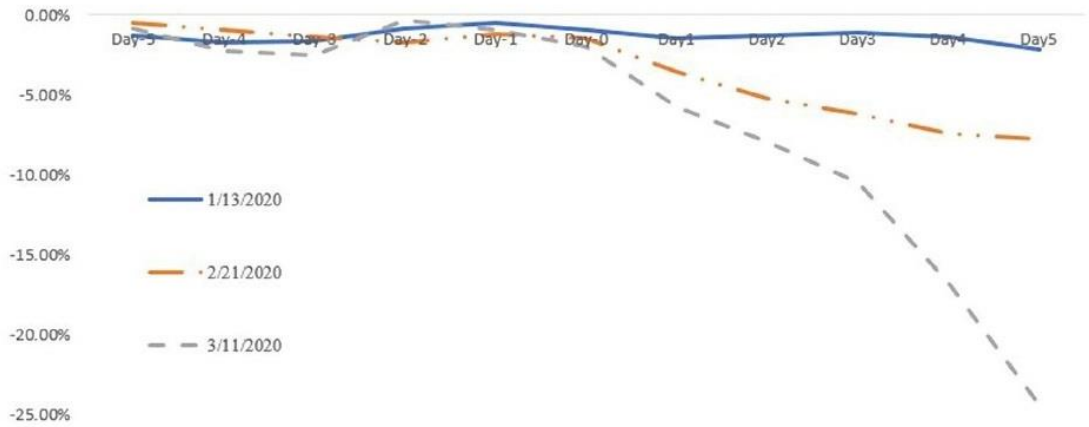


Figure 1. Average Cumulative Abnormal Returns for the Studied Sample Whole (Maneenop & Sotcharin, 2020)

By the time the announcement of travel ban by the United States president accrued, which is the third and last event as a temporal landmark in the study, overreaction was the word that described the state of the investors. Moreover, western countries' investors were noticed to have the quickest reaction toward the news of the pandemic and the information in relation to it.

As a response to the pandemic, the researchers suggested certain policies, in the hope of reducing the investors' panic towards the pandemic, and refreshing the sector ultimately. Finance-wise the recommendations were: the possibility of acquiring loans, reducing the interest rate of those loans, temporal relief of taxes for companies in the aviation sector, and recommended capital injection. As for employment, suggested policies were organizing unpaid leave programs instead of laying-off employees, and providing wage subsidies to employers.

Regarding the charges of using airplanes, offering discounts on ticket prices was a recommendation, and parking fees to be dismissed. In certain periods; even exempting air navigation charges were recommended, reduction in landing charges, and others. Administration wise: re-scheduling, re-routing, restructuring, and permitting changes to business plans were recommended. Otherwise, the authors argue the inevitability of bankruptcy in the aviation industry, and many businesses that have relation to it. They stress the necessity of governmental interventionism to support the industry, subsidies or change in the tax policies were the primary suggestions.

Following aviation, tourism was the subsequent industry to take losses because of travel bans and movement restrictions. Indeed, the industry's dependence on geographic location changes in most business models is a rational reason for it. In this regard, (Skare et al., 2021) studied the impact of the covid-19 pandemic on tourism and travel; they used a dynamic model to project the effect of the current COVID-19 pandemic, relying on previous events of pandemics. Their findings included that COVID-19 will have more severe negative effects than previous pandemics. In addition, those effects will remain for a longer period, in comparison to other events of pandemics. Since they were projecting, they conducted three scenarios representing the possibilities of lockdown permanence, stretching over nine months. First and most optimistic is scenario 1: The declared lockdown in March of 2020; to last until April of the same year. Second scenario is when the lockdown lasts until August of 2020, and third and least optimistic scenario is when it continues until the end of the year 2020. Only To find that in the most optimistic scenario, the global GDP will witness a loss of 4.45% of its value in 2019, naturally equaling a recession of 4.45 %.

That percentage will increase to 9.80% if the lockdown was to continue until August, which is the second scenario, and for the least optimistic scenario, the loss in GDP was estimated to be 12.72%. The study included the losses in employment globally also, which were assessed at 164.5, 354.7, 514 million jobs lost globally in scenario 1, 2, 3 respectively. The spending of foreign tourists also was included in the model, which projected a dip of 604.8 US$ bn, 1.3 US$ tn, 1.9 US$ tn in scenarios 1, 2, 3 respectively. The researchers identified the *real dollar*, a US dollar equivalent currency with inflation control. For the purpose of elucidation, the researchers say that the losses in scenario (3) will set the income back to the rates of the year 1980 as an estimation. The investment flow in the industry was also assessed; the losses were at 362.9 US% billion, 781.5 US% billion, and 1.1 US$ trillion in scenarios 1, 2, 3 respectively. The following graphs show the values in details for all the projected scenarios.

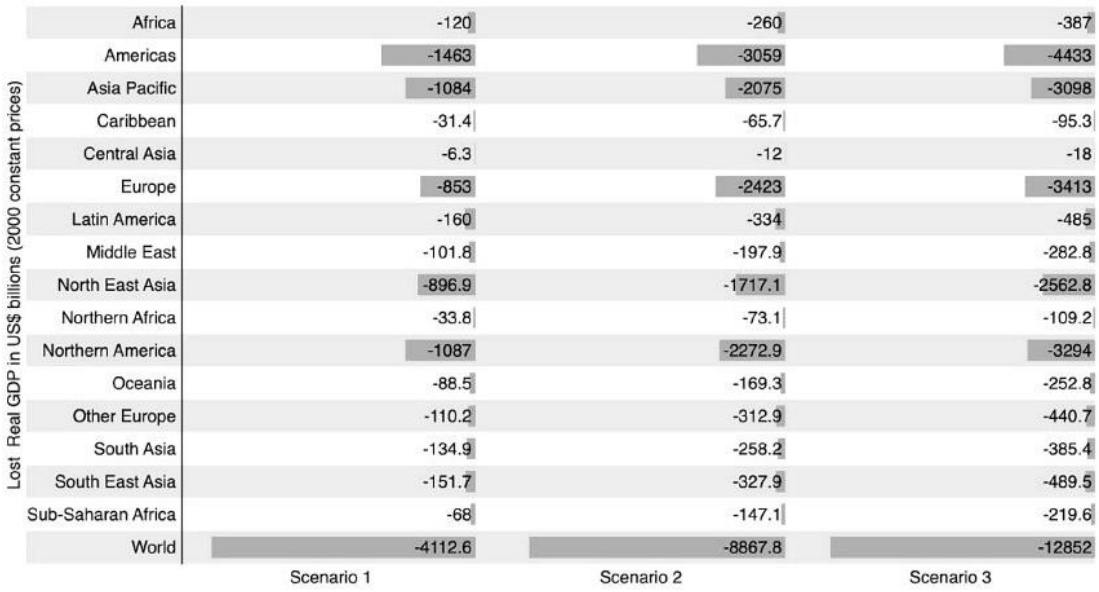


Figure 2. Estimated Potential (COVID-19) Impact on Output in the Travel and Tourism Industry by World Regions (Skare et al., 2021)

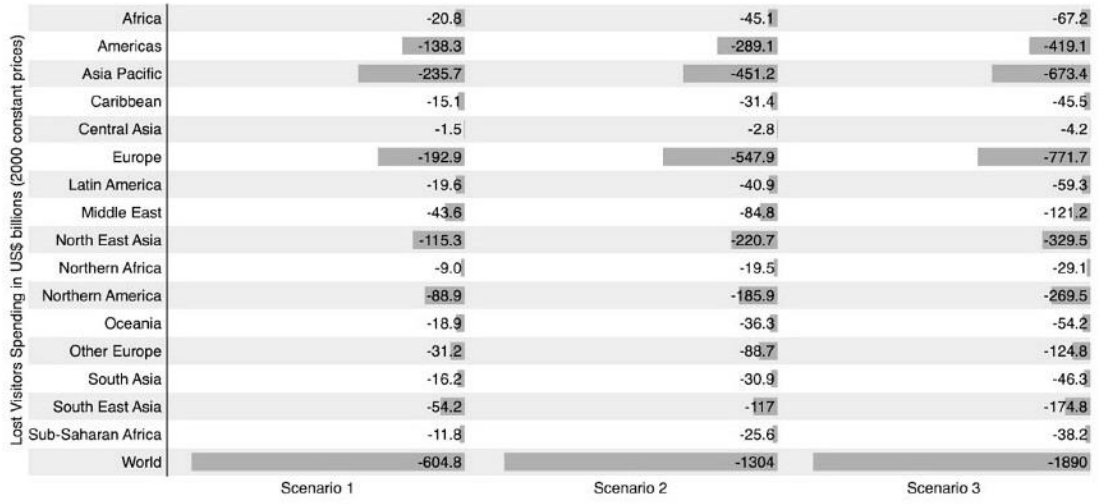


Figure 3. Estimated Potential (COVID-19) Impact on Tourists' Spending in Travel and Tourism Industry Worldwide (Skare et al., 2021)

It is only necessary to point out the fact that; those numbers have not been witnessed in modern history, which will only express the severity and seriousness of COVID-19. Governmental support policies were recommended. Moreover, the researchers labelled them as a necessity, as the recovery will be challenging at the lowest estimation. Even with the governments' support, the industry suffered what they called "common shock", as tourism in many countries had common struggles,

preventing the recovery of the industry in a given country, due to the lack of tourists from other countries. Those would be under a form of restriction; hence, COVID-19 restrictions are not lifted completely, on a global scale.



Figure 4. Estimated Potential (COVID-19) Impact on Employment in the Travel And Tourism Industry Worldwide (Skare et al., 2021)

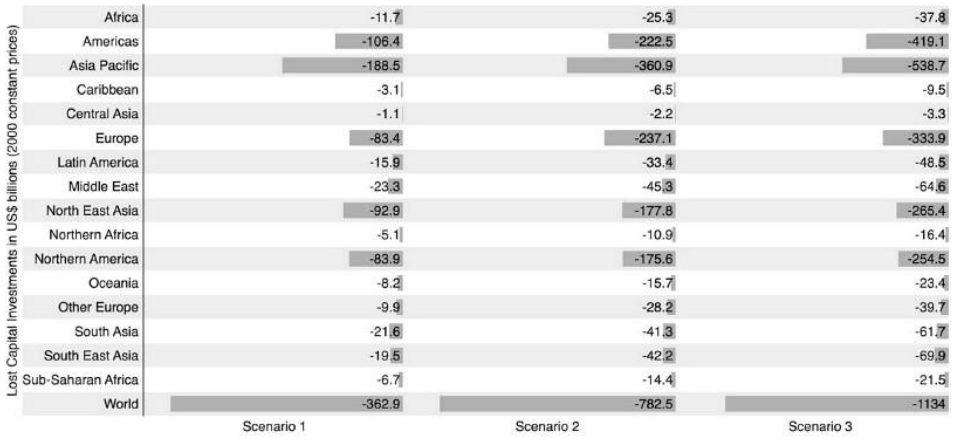


Figure 5. Estimated Potential (COVID-19) Impact on Capital Investment in the Travel and Tourism Industry Worldwide (Skare et al., 2021)

A report published in 2021 by the United Nation World Tourism Organization (UNWTO), says that the losses in tourism and related businesses in the year 2020, were estimated at 2.4 trillion as a result of indirect and direct drop in international tourists arrivals (UNCTAD, 2021). The same report predicted similar losses in the

year 2021, with regards to slight refresh in the second half of the year, the primary factor in tourism's rebound to health status was stated to be the vaccination, as it allows travelers to move without serving as agents to the virus.

Restaurants were in the same corner. (Dube et al., 2020), found that because of social distancing, and the policies of lockdown, the site-in guests disappeared. To conclude so, they utilized a reservation company's platform, one with reach in Mexico, Germany, UK, USA, Australia, and Ireland. Moreover, in comparison to the year 2019, restaurants were operating at between 10-20 % of its capacity, which reflects on the employees within, resulting in many layoffs. The following graphs shows the state of global restaurants during COVID-19 time.

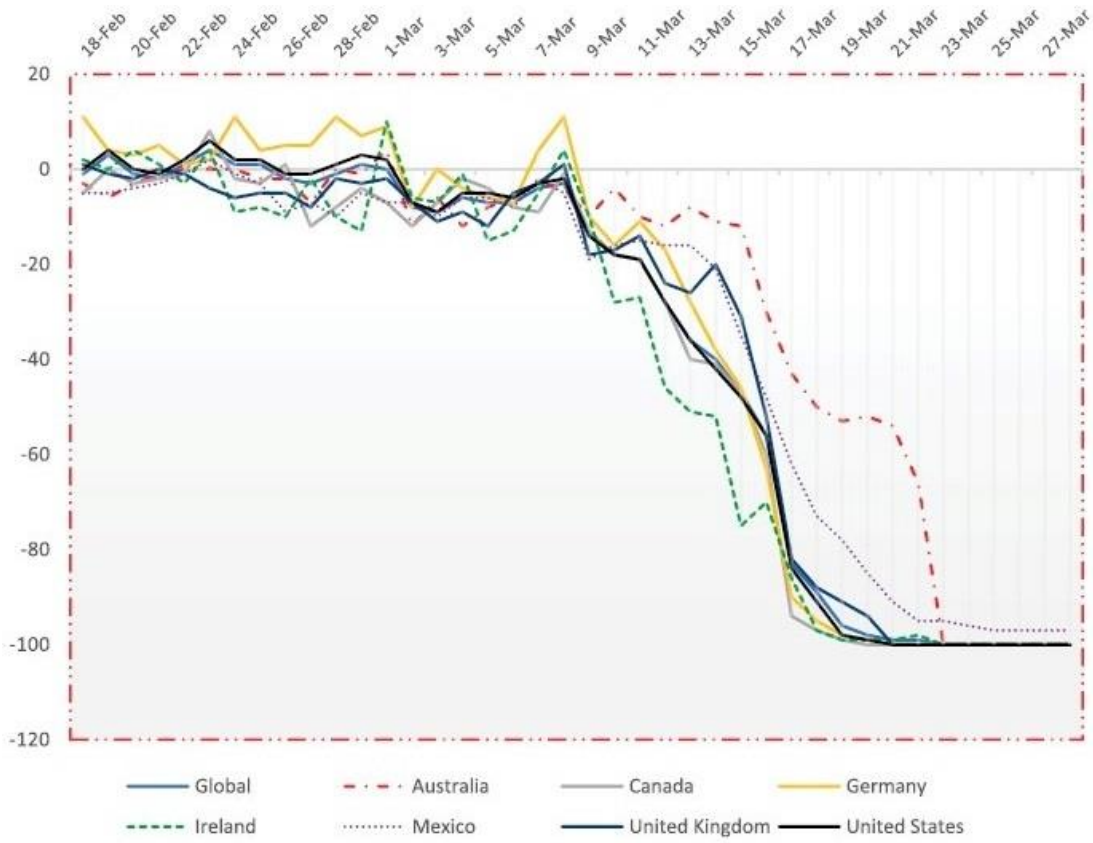


Figure 6. State of the Global Restaurant Industry in the Era of COVID-19 (Dube et al., 2020)

Similar to what has been suggested for the tourism industry as a recommendation, the researchers stress the necessity of governmental support to the industry.

Diving more into the food industry; as mentioned before, due to movement restrictions and travel bans, supply chain and distribution were all the same disrupted. the effects took place initially in agriculture, as the labor force witnessed shortage, and the food of livestock was hard to obtain, which suggests a problem in farming them (FAO, 2020). In addition to livestock, fishing was challenged as well; physical distancing resulted in the activities to regress. Difficulties in acquiring feeds and seeds emerged, as was the case in many industries, which prevented the ordinary process from being resumed as it would under ideal circumstances. The following graph shows how COVID-19 affected the logistic market.

Such an effect was inevitable to extend to retailing. (Singh et al., 2021) concluded four effects in the fast-moving consumer goods (FMCG). As goods' prices will not be affected whilst the demand and supply are in a state of inconsistency, he also predicts the local production to experience an increase in demand, payment will tend to be fulfilled relying on future installment and credits rather than cash. Finally, high-end brands will be at great risk, as their targeted customers have argent necessity to the basic needs instead of luxurious ones, making their place in the market in jeopardy.

In addition, figure 7 shows the change in logistics market before and after the pandemic breakout, as the market took the first hit because of the pandemic due to movement restrictions.

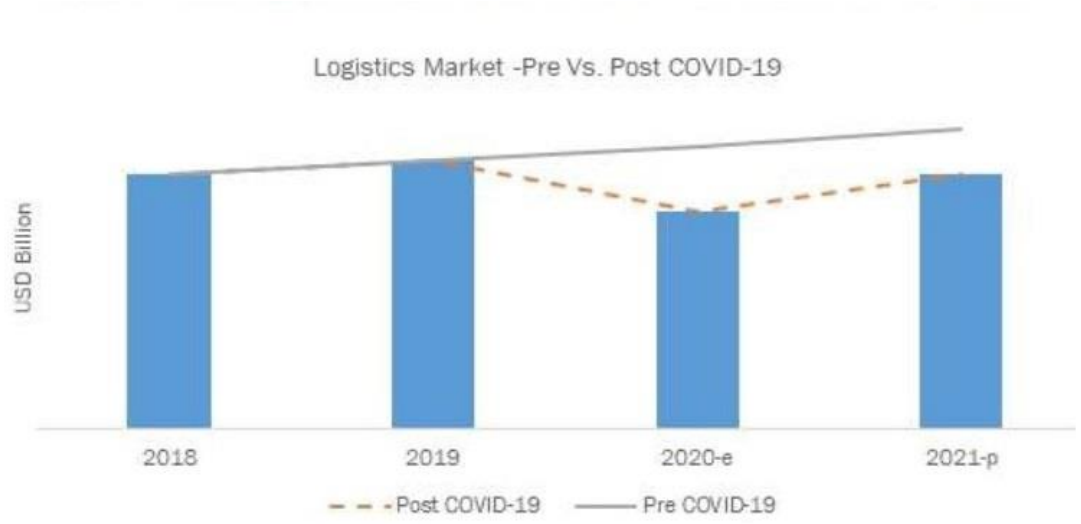


Figure 7. Logistics Market –Pre vs. Post COVID-19 (Singh et al., 2021)

2.3. The Effect Of COVID-19 on Turkey’s Economy

The pandemic entered the country on 11 March of the year 2020 as reported in official records, before that event occurred; the economy's growth was expected to witness a 2.7% increase, according to the Organization for Economic Co-operation and Development (OECD). Moreover, on the condition that the government takes well-focused measures, they expected the pandemic to have a positive effect on the economy (OECD, 2020).

The projected growth was to take place in numerous sectors of the economy, such as textile, furniture, food and steel. However, the pandemic prevented that growth from happening, and at least in the near future, it will remain as predictions, nothing more. The facts states: that after the occurrence of the pandemic, Turkey's exporting capacity has declined by 17.81% and import has increased by 3.13% in comparison to the previous year 2019. Another challenge facing Turkey's economy is the relatively high unemployment rate, which were documented at 13.7 % since the year 2018. This is unlikely to be improved in the year of 2020 due to multiple bankruptcies and closures in businesses because of the pandemic. In result, this will naturally affect the national GDP and workers' income in a negative way. (Açikgöz & Günay, 2020).

Reaching a more specific sector of the Turkish economy, with closer relation to our study subject; real estate, an exploratory study (Tanrıvermiş, 2020) was conducted on the possible effects of COVID-19 on the development and management processes of the real-estate market; the pandemic was described as unprecedented in effect, on the development of new projects, sales and return of the already existing ones. Using the volume of transactions, the use of credit in real estate value, he observed a decrease in sales as of March 2020 in comparison to the previous year 2019. The year 2020 was expected to be a recovery year for real estate, and for the sales to reach its peak around June. Yet, against expectation, losses of 42%, 33% in sales took place, in comparison to the rates of 2018, 2019 respectively. However, as of April a noticeable recovery in the sector happened, because of the reduction of interest rates and the allowance of mortgage loan, giving sales a huge boost. Moreover, the researcher

emphasized the need for more research, since he claims that the government is trying to revive the market of real estate solely by increasing the sales of current properties, and the long-term effects of such policy are not obvious.

In any case, the rise of the shared economies' platforms has affected many sectors of the economy, regards accommodation; Airbnb is the most famous one. A platform representing the P2P business model started in 2008, Airbnb thrives in central areas of places with touristic influence, including Istanbul as one of the main destinations for tourists in Turkey. Another study (Alrawadieh et al., 2020) measured to which degree hotel managers perceive Airbnb as a threat to their businesses. This was assumed to be an indicator to the degree of which Airbnb has a presence in the market, since it originally was promoted as an expansion to the accommodation market, and not a main competitor to hotels of different sizes. It was found that Airbnb presence in Istanbul has started to threaten midrange and budget hotels, already gaining some market share from hospitality businesses. However, there is still a gap in the literature as to how the pandemic has affected Airbnb demand in Istanbul.

Thackway & Pettit (2021) explored how the decline in Airbnb reservation rate due to COVID-19 pandemic affected the supply and demand of rental stocks in Sydney Australia. Starting the second quarter of 2019, Airbnb activity witnessed a notable decline because of COVID-19, in comparison to the rising trend of the previous year. Figure 8 shows the annual change in Airbnb density by decile. In addition, long-term rental stock increased in correlation with the decrease of activity in Airbnb, figure 9 shows the percentage of change in LTR between the second quarter of 2019 and the second quarter of 2020. The data collection was from Airbnb active neighborhoods, which can be interpreted as, people tend to rely more on long-term rental in the absence of tourism during COVID-19. However, with the price of a long-term rental stock property considered, they distinguished two areas; low and high activity of Airbnb. They found that where the activity of Airbnb was low, the price was stable, relatively speaking. Comparing it to the high activity areas, where the price decreased considerably. Which can be justified with the inverse relationship between the rental prices and rental supply.

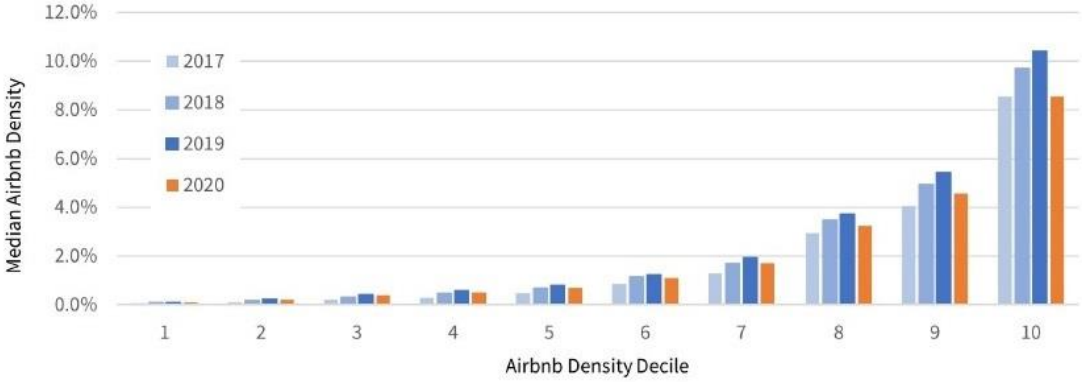


Figure 8. Annual Changes (2017 Q2 – 2020 Q2) in Airbnb Density by Airbnb Decile (Thackway & Pettit, 2021)

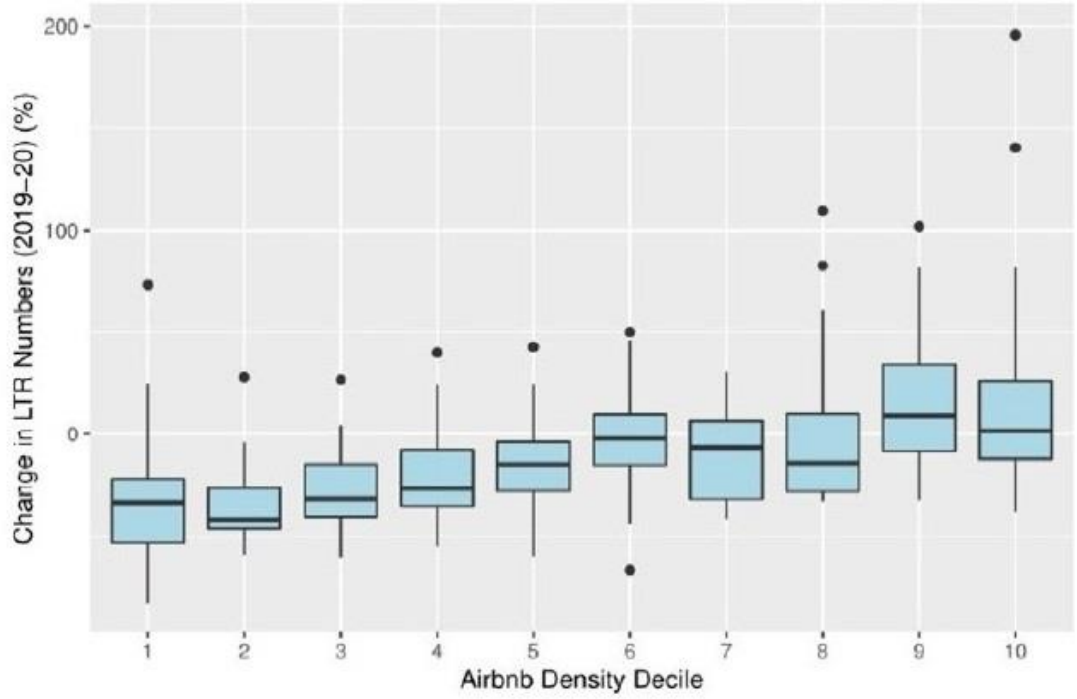


Figure 9. Boxplot Illustrating % Change (2019 Q2 – 2020 Q2) to Long Term Rental Stock Supply by Airbnb Decile (Thackway & Pettit, 2021)

3. METHODOLOGY

While the study subject was being conceptualized, and since COIVD-19 was hypothesized to have a negative effect of reservations number, the best course of action was to operate based on the basic functions of statistics, through a non-linear regression using an exponential function to predict the rate which Airbnb's reservations was growing based on had the pandemic not occurred. Then compared it with the actual rates during COVID-19 outbreak. Since the collected data was determined to be returned to a simple form, the regression, which represents a state of valid relationship of consistent change in a given variable, would serve the purpose. Based on it the assessment of the damage taken to Airbnb's business during the studied period of COVID-19 pandemic was possible.

The workflow can be recognized in 3 main steps: First, the data were collected from the specialized databases in both Airbnb reservations and COVID-19 cases. Second, the collected raw data were processed and refined to extract the desired data for our work, merging data that are similar, excluding unwanted data, and rearranging such data to facilitate working with it. Third, a Matlab code was written to extract useful statistics from the processed data, and to plot four different graphs that can be used to draw conclusions about the effect of COVID-19 pandemic in Istanbul on Airbnb reservations.

3.1. Data Collection

Since the main aim of this thesis is to study the relationship between COVID-19 pandemic and the change in Airbnb reservations in Istanbul, related quantitative data must be collected to observe any relationship between the two variables. For simplification purposes, each one of the two variables was represented with a single piece of data.

The number of Airbnb reservations can be thought of as the number of check-ins or checkout. However, direct channels or databases that provide such data were not found. On the other hand, the number of reviews can be considered as a solid

indicator of reservations number, since each review corresponds to a reservation, but not to the opposite, yet it is the closest available piece of data that can approximate the number of reservations. A website called insideairbnb.com is a third party specialized in collecting data and statistics about different parameters of Airbnb, providing the data for public fair use. The website provides its data as comma-separated values files, categorized based on the city in which the data was collected. For each city, the data files are arranged from newer to older, according to the time of data scraping. Usually, data is scraped every month, but sometimes at a different rate. Each time data is scraped, it's divided into four different files: a calendar file regarding listings, a file for listings, a file for the number of listings in each neighborhood, and a file that lists reviews found on the website on the collection day.

As we are interested in the number of reviews, all the reviews files in the years of 2017, 2018, 2019, and 2020, in addition to the first two months of 2021 were gathered.

For the independent variable that will represent the COVID-19 prevalence in Istanbul, the number of COVID-19 patients over time as an indicator was chosen. However, we did not consider the patients only in Istanbul, but in Turkey in general. The justification is the assumption that people usually make travel decisions based on the state of the pandemic in the country without paying specific attention to individual cities. Additionally, travel restrictions that affect tourism and Airbnb reservations are considered based on the state of the pandemic in the whole country, not a specific city. This type of data can be collected from different sources, eventually being acquired from the official channels represented by the Ministry of Health in Turkey. The official website provides a historical table of daily COVID-19 statistics in Turkey, including the total and daily number of tests, patients, deaths, recoveries, in addition to the number of patients with critical conditions and those who are in intensive care units. For our study, one of those parameters is needed, which is the daily number of patients, which was extracted from the website to be used as our independent variable.

3.2. Data Pre-Processing

Since the main aim of this thesis is to study the relationship between COVID-19 pandemic and the change in Airbnb reservations in Istanbul, related quantitative data must be collected and analyzed. As mentioned above, raw data was collected from different databases. However, such raw data is not exactly what is needed as a direct input for our analysis, and it needs some pre-processing before it can be used as input for the algorithm.

Starting with the data collected from insideairbnb.com, the only acquired files are called “review.csv”. Closer examination of one of these files shows that it contains two columns: the first shows the identification number of the listing, or the property, for which the review is written, and the second contains the date of the corresponding review in “dd/mm/yyyy” format. Each file is dated by the day the data was collected, and contains the dates of every single review and the number of its properties.
Since the collected data spans over 4 years, there are multiple files that were acquired. The problem with those files is that a single review can be found in more than one file, since data scraping is performed periodically regardless of the reputation of one review. On the other hand, some reviews were deleted from the website over time, which means that we cannot rely on the most recent file to gather all the data. To solve this problem, Matlab software was used to eliminate repetitions and keep only one instance of every review. This was done by reading all the files by Matlab, combining them in a single matrix of 2 columns, and sorting them by property name. After that, “unique” function in Matlab was applied on rows to keep only one instance of each review, and that was sufficient to clean the data from repetitions. After this step, the first column was deleted since individual properties are not of interest or use to us, while what matters is the reviews date only. Since later work is to be done on monthly and yearly number of reviews, an extra step of processing was needed, which is separating the new one-dimensional array into 3 columns; namely days, months, and years columns. We did that by treating each cell as a string of text, and that resulted in 10 characters in each cell: two for day, two for month, 4 for year, and two dashes that separate them. By separating these strings and discarding the dashed, the needed three columns matrix was structured. Next, a third

matrix was created, where months and years columns are combined with each other. The third column of the second matrix was kept to get the years only, and the second column of the third matrix was kept to get months only. By calculating the frequency of the second and third arrays and converting texts into integers, finally operable data was acquired and was ready to be used directly for the analysis. Resulting in two matrices each of 2 columns, the first matrix is for months, the second for years, where the first column of each matrix represents the month or year depending on the matrix, and the second column is for the frequencies of those months or years. The first matrix was called “monthly number of reservations”, and the second “yearly number of reservations”. In addition, data of the first 2 months of 2021 were included, but we discarded the data in the year's matrix, while including it in the month's matrix. For the data that represents COVID-19 patients, similar work was done, yet without getting an array of years, since we will only look at monthly change over 12-month period, namely from March 2020 to February 2021, and that will be used later to be compared to the data of the corresponding months from the monthly reservation matrix.

3.2. Data Processing

After pre-processing the data, the figures became ready to be plotted, and the analysis to be performed to extract results. A Matlab code was developed to process the data further and plot 4 figures, which will be explained in details below. First, the code starts by clearing the data, figures and commands to avoid any confusion when running the code. Next, the pre-processed data, kept in a separate file will be read, after that a matrix of strings was created, one contains the months' names and uses them as labels, the same was done for the years, and both were combined in a third step.

The first established figure, is supposed to show the monthly change of the reservations number over 4 years from 2017 to 2020. The years' matrix was separated into four matrices; each one contains the data for a single year, which means that each new matrix is a 12 by 2 matrix. Then, each of those matrices was plotted on a single figure; distinguishing each year visually by giving the curve of it a different color, the curves that represented 2017 and 2019 were in black, while those

of 2018 and 2020 were in purple. also the x-axis was given the proper labels, and made a grid of only x-axis values to facilitate visualization.
The second figure was the yearly change, here the years' matrix was dealt with directly without splitting, and directly plotted the 4 by 2 matrix, which was already produced from the pre-processing step, to show the yearly number of reservations. X-axis was given the proper labeling without a grid since we only have four values, and further visualization is not of a necessity.

We also wanted to explore how the number of reservations changes in each individual month. For instance, examine the numbers of reservations in March of each year independently and observe the way reservations change over time. This was done for all months from 2017 to 2020, except for January and February where it was done from 2018 to 2021, since COVID-19 pandemic emerged in Turkey in March 2020, which made sense to start by March. For that purpose, a third figure was established and divided into 12 subplots, each representing a single month, and then the number of reservations of each month for 4 years was plotted. Afterwards, we noticed that the change in reservations number for each month follows an exponential trend for the first 3 years, which led us to fit an exponential function to predict the number of reservations in the 4^{th} year, if the trend would continue as exponential, and compare that to the actual number of reservations in the 4^{th} year. Then the predicted value was plotted in a different color for better visualization.

Lastly, we wanted to examine the effect of COVID-19 pandemic on the change of reservation numbers each month. To do so a new array of strings was created, one containing the months from March 2020 to February 2021, and used them as labels for the new figure. In order to calculate the change in the reservations number every month, the actual value in the 4^{th} year was subtracted from the predicted value in the 4^{th} year, and considered our first number, and then the value in the 1^{st} year was subtracted from predicted value in the 4^{th} year, and considered our second number. The first number was divided on the second for each month to get a 1 by 12 array of percentage change for every individual month. The main plot was divided into 2 subplots, where the first one represented the monthly number of COVID-19 patients

from March 2020 to February 2021, and the second represented the percentage change of reservations for every individual month over the same period of time.

4. RESULTS

After collecting the data from insideairbnb.com and analyzing it using Matlab, four sets of results over a period of 4 years were acquired, namely the 2017, 2018, 2019, and 2020 in which COVID-19 has emerged. Monthly and yearly change in checkouts were considered, in addition to change in each individual month during the four years, finally we crossed the decrease in reservation number during 2020 with the change in COVID-19 patients number in Turkey to conduct a time relationship. The outcome was four plots that represent the aforementioned results, to be presented in the following paragraphs.

4.1. Monthly change in Airbnb Reservations

Starting at the beginning of January 2017 until the end of December 2020, the number of reservations that took place every month was observed, in order to detect any pattern, if it exists. The change in the number of monthly reservations was plotted as a function of time, where Y-axis shows the number of reservations represented as monthly checkouts. Every tick represents the total number of reservations that took place in each month. X-axis shows time progress, where every tick represents one month starting in January 2017. For visual purposes, each year's graph was plotted in a color-alternating fashion in order to demonstrate the pattern of monthly change in checkouts, hence reservations. After combining the four graphs shown in Figure 10, which represents the monthly change in Airbnb reservation between 2017- 2020, the following pattern in the years 2017, 2018, and 2019 was detected: During January, the monthly reservations number is relatively low, yet it further drops to its lowest level in February. After that, it proceeds to increase in March and April, and it continues to increase until the end of spring, of which the particular month varies slightly among each year. This increase is followed by a slight decrease at the beginning of summer season, only to increase again to reach its highest levels in the beginning of autumn. The peaks were in October in 2017 and 2018, and in August in 2019.

After reaching the peak every year, a strong decrease in the monthly reservations number in comparison to the peak was noted, which kept dropping until the end of December. The lowest number after that drop is similar to spring rates of the same year. The explained pattern took place in the years 2017, 2018, 2019 with slight differences in values, yet the pattern stayed valid. The lowest number of reservations were in February in all those years. This means that the highest number of reservations takes place between the end of summer and the beginning of autumn, and the lowest number of reservations is at the end of winter, taking into account that the winter season starts from the end of December until the end of March. It is also noted that the number of reservations in January of each new year is slightly higher than December of the previous year. Another important note is that while the pattern is repeating itself every year, it expands vertically to be exponentially higher each year, which will be clearer when the yearly number of reservations is analyzed.

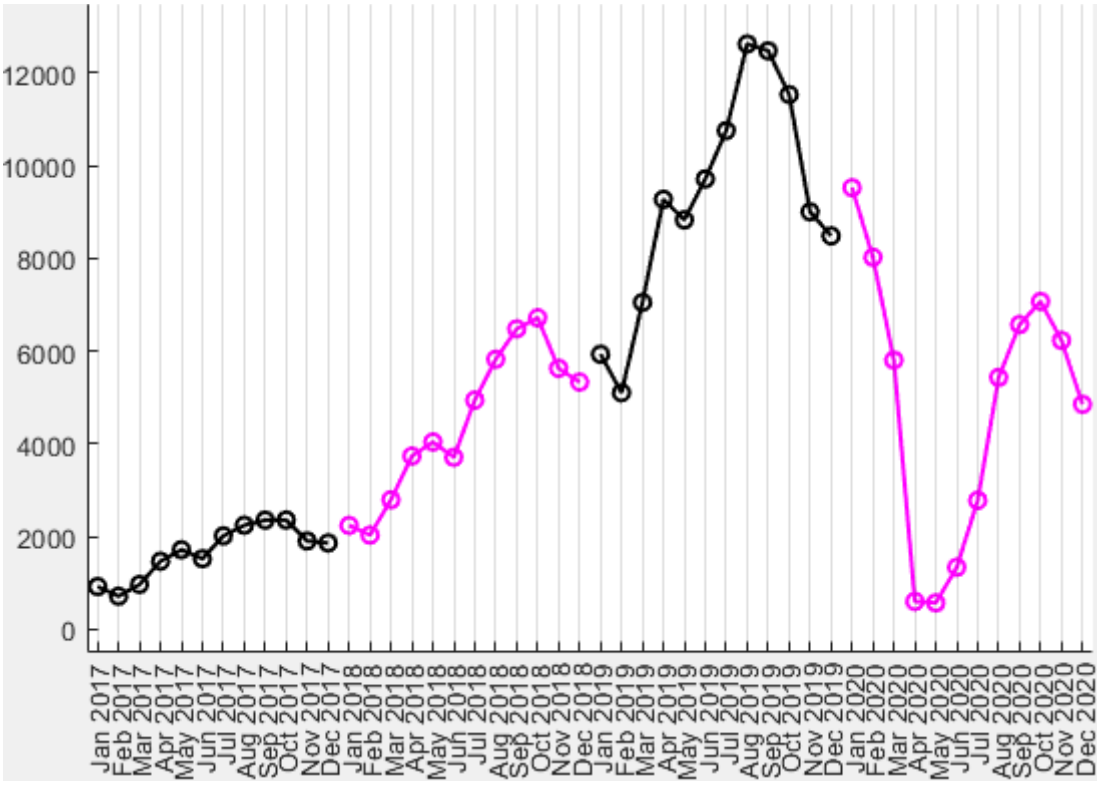


Figure 10. Monthly Reservations of Airbnb in Istanbul Between 2017- 2020

While attempting to apply the same logic on the change in the number of reservations in 2020, the year that witnessed the pandemic of COVID-19 in March, we notice that the previously mentioned pattern remains valid until March of that

year. The expected increase of reservation number in January in comparison to December of the previous year took place as well. The decrease in reservations number until February also took place. However, the expected increase from February did not take place. On the contrary, a drastic drop in reservation number took place in March, unlike the significant increase that was noticed in the same season of the previous 3 years. The number of reservations kept dropping until the end of April, and stayed relatively stable during May, which marked the lowest number of reservations in that year, one that was last witnessed in 2018. The number of reservations started increasing again from June until October, which matches the pattern conducted from analyzing the data of the previous 3 years in the second half of that year, where a usual increase is expected, reaching the peak in autumn season, just like the same pattern seen in the previous 3 years. However, the number of reservations was not higher than what it was in May, to decrease again until the end of the year, following the expected pattern too.

4.2. Yearly Change in Airbnb Reservations

Figure 11 shows the yearly change in Airbnb reservations, in which the number of reservations that took place each year was added, from 2017 until 2020, and the result was plotted on the X-axis as a function of time, Y-axis represents time in years, meaning each tick symbolizes one year. To find that in the year 2017, the reservation number was around 20 thousand reservation; in 2018, it increased to around 50 thousand reservation, to reach about 110 thousand reservation in the year of 2019, which is similar to the findings in figure 10 that demonstrates the monthly change regarding to the increase of reservation number over time. However, in 2020 the number dropped significantly to around 50 thousand, which is similar to the 2018 reservations number. We note that in 2020, the pandemic of COVID-19 will take place.

4.3. Airbnb Reservations for Each Individual Month Every Year

Each of the year's 12 months was considered individually, and monitored the change of reservation in that month over 4 years, namely from between 2017 to 2020. The change in each month was plotted separately on the X-Y coordinate system, where the X-axis represents the years 2017, 2018, 2019, and 2020. Y-axis represents the number of reservations in that month. In all 12 months, the number of reservations was increasing over time during the years 2017, 2018, and 2019. The increase was almost exponential, which can be noticed either from the previously explained plots in Figure 12, or from the yearly increase in reservation number in Figure 11.

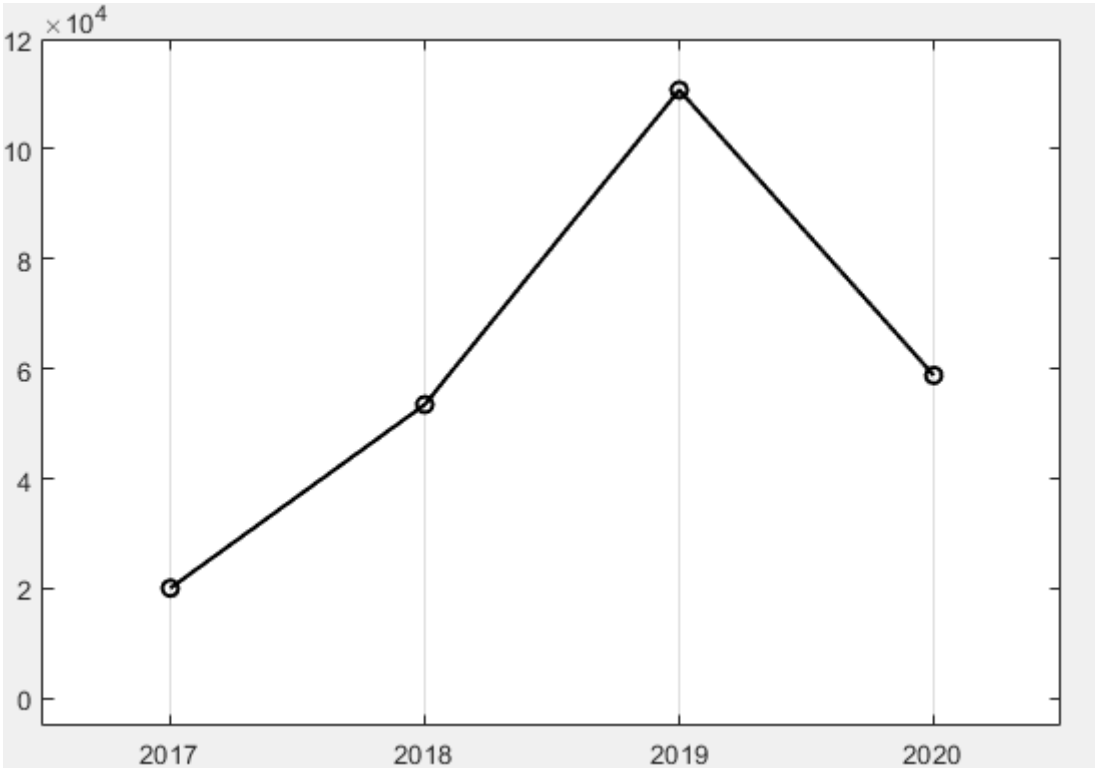


Figure 11. Yearly Reservations of Airbnb in Istanbul Between 2017- 2020

Since the increase in the first 3 years was almost exponential, we fitted an exponential curve, which was used to establish a prediction of the reservations number in each month of the year 2020, assuming that the exponential increase would continue. The fitted curve is shown in red in each of the 12 plotted monthly changes in reservations, all combined in figure 12. At the end of each red line, the

red data point represents the expected number of reservations in 2020 assuming that the increase proceeded exponentially as it was in 2017, 2018, and 2019.

On the other hand, the actual number of reservations that took place in 2020 was plotted in blue. A drastic decrease in reservation number was noticed, in comparison with the expectations. That decrease happened during the months of March to December of 2020, in addition to January and February of 2021, covering a whole year in total. The reservations number in each month of the year 2020 was lower than what it was in 2019. However, the severity of that decrease varied between the same year's months. In May, June, and July the decrease was most drastic, while in March and November, the decrease was not severe as it is in May, June and July. In all cases, a considerable decrease took place in 2020.

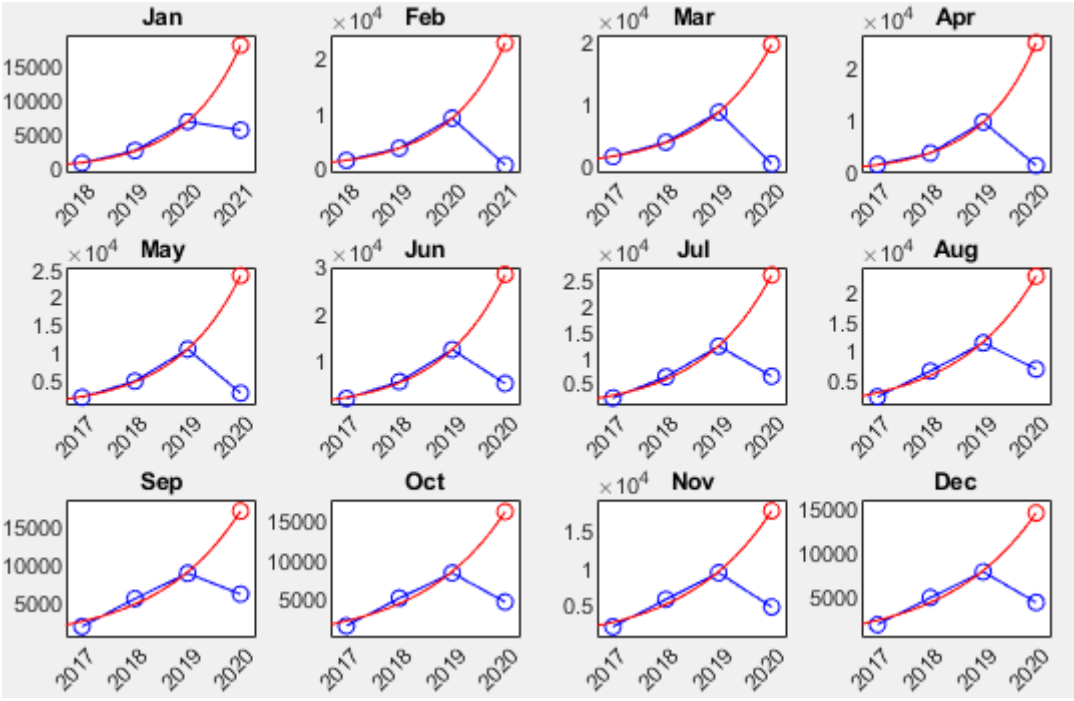


Figure 12. Actual (Blue) and Predicted (Red) Month-by-Month Reservations of Airbnb in Istanbul from March 2017 to February 2021

4.4. Relationship Between Rate of Reservations Number Change and The Number of COVID-19 Patients

In order to investigate the effect of COVID-19 on the number of reservations more closely over time, the extracted data while studying each month separately over 4 years was utilized. For each of the 12 months from March 2020 to February 2021, the actual number of reservations in 2020 was subtracted from the reservations number of reservations in 2017, and divided that on the difference between the predicted number of reservations in 2020 and the number of reservations in 2017. As a result, a percentage represents the decrease in reservations in 2020 was acquired. Next, those percentages were plotted in Figure 13 in purple where X-axis represents months and Y-axis represents the percentage of drop in reservations.

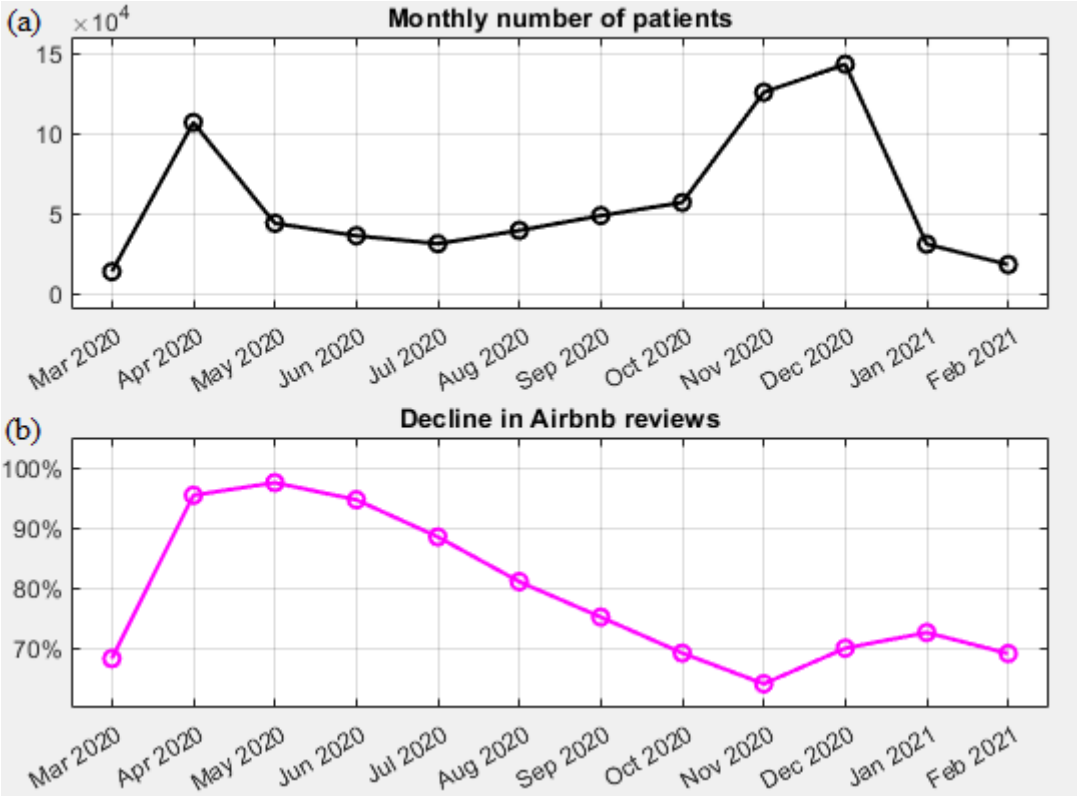


Figure 13. Comparison Between (a) Monthly Number of COVID-19 Patients (b) Decline in Airbnb Reviews in Istanbul from March 2020 to February 2021

In addition, using collected data of COVID-19 infected cases in turkey during the corresponding months, the change in the number of COVID-19 patients was plotted in Figure 13 in black. Both plotted graphs were analyzed in order to detect a common

pattern between them. A slight similarity in the patterns between the two graphs was noticed. During March and April, the number of COVID-19 patients has risen significantly. Similar increase appears in the rate of decrease in the number of reservations, which was also noticed in May. On the other hand, a sudden decrease in the number of patients was seen in May, and continued for 2 month, followed by a slight, yet insignificant increase until October. When this duration is analyzed for the decline in reservations number. A continuous, almost linear, decrease was noticed. However, this happened from June to November; unlike the case for the number of patients where a decrease or an insignificant increase was shown from May to October, which is one month before regarding the beginning and the end of the duration of interest.

From October afterwards, a strong increase in the number of patients was noticed, which continued until December. A 2-month long increase in the rate of reservations decline was also noticed, but also with a delay of 1 month too, namely from November 2020 to January 2021. This was followed by a decrease of both studied parameters, starting in December 2020 for the number of patients and January 2021 for the rate of reservations decline. Overall, a similar behavior between those two parameters is noticed, with a 1-month delay demonstrated by the rate of reservations decline.

5. DISCUSSION

Airbnb provides a variety of accommodation options, in reasonable conditions and affordable prices, which can be seen as a gap in the tourism market, as hotels address the high-end customers and provide them with luxurious amenities and features, and motels provide basic amenities with low prices. Indeed, the fact that hotel services and prices vary based on rates was not overlooked, which in return makes their targeted customers diverse. However, it does not contradict with the suggestion that Airbnb attracts a share of that market.

5.1. Monthly and Yearly change in Airbnb Reservations

The reservations number between January of 2017 and February of 2020 were observed (before COVID-19 outbreak). When comparing the reservations number in each month with the same month of the previous year, it was found to be higher over time. In other words, the number of reservations in January of 2020 is higher than January of 2019, January 2019 is higher than January 2018, and the same concept applies for the rest of the months, from which we can conclude that the total demand on Airbnb's services was increasing, and its market share was in a state of growth, until the occurrence of COVID-19.

Also In the light of the found results, we notice that the disparity in reservation numbers responses to the seasonal changes in the year, and since Airbnb thrives in touristic cities, and more actively in the touristic areas of those cities, all make that observation credible. Going more into details as to when the demand for Airbnb's properties is the highest during each year, that reservations number was found decreasing in February compared to January's reservations number, as February marks the end of winter season, where the temperature is low and tourism is at its lowest in Istanbul. However, entering March, the reservations number starts to increase, coinciding with the beginning of spring when the weather is more stable and the temperature is warmer. This increase continues until May, and then a slight decrease in the number of reservations happens. We can explain that slight decrease

by the departure of the residents who stayed during winter and spring, regardless of the reason for their stay. Yet as the summer season begins, a new segment of residents starts to flow; one with more consecrated tourism interests, which requires a form of preparation from both the host and the guest side.

As June starts, the reservations number climbs up again in a significant manner, to reach its peak around August. We interpret this event as a tendency towards summer vacation in Istanbul. Many factors influence this phenomenon, mainly that the weather of Istanbul in summer is more attractive than winter for tourists. Also during summer, vacations are more frequent than other times of the year, and students finishing their studies results in free time to travel. We also noted the peak of reservations taking place between the end of summer and the beginning of autumn, when the temperature is still warm, yet not as hot as it would be in June and July. A drawn conclusion is that the peak of tourism in Istanbul is not during the summer season, but at the end of it. From that point towards the end of the year, the reservations number starts to decrease, because of the summer season's ending, and residents going back to their countries. In addition, universities open their doors for the new semester. The previously explained pattern repeats itself in the following years, until COVID-19 outbreak.

The increase in reservations numbers was occurring almost exponentially, which can be interpreted as a stable increase in demand and market share for Airbnb in Istanbul, also a comfortable and inviting environment for hosts and new entries.
However, reaching the year 2020, we notice that the previously observed pattern occurs in the expected manner until March of that year, which synchronizes with the breakout of the COVID-19 pandemic. Here we observe how the pandemic affected reservation. From that point on, the pattern inverses. The reservations number decreased drastically instead of increasing in March, contradicting with the expectations.

The restriction that were in place as a precaution measures by the government, such as airport closure, travel banning, and curfews played a major and direct role in that drop in reservations. Multiple other factors all affected guests' travel decisions, such

as the state of fear, the ambiguousness of the pandemic of COVID-19, and the personal responsibility towards it.

The decrease reaches its lowest rate in April of 2020, where the reservations number gets to the lowest value in the studied 4 years, lower than 2017 number of reservations. We can only assume that Airbnb and the hosts on Airbnb in Istanbul suffered a significant loss as a result. However, we cannot assume that the revenue was set back to 2017 rates, as there is no significant data to refer to such a conclusion.

The number of reservations stayed the same during May of 2020, relatively speaking. Only to increase again in June, in a manner similar to the expectations, as the detected pattern from Figure 10. Multiple reasons partaken in that increase, one of them is the absence of panic and fear reactions from the pandemic, which possessed many individuals during the pandemics outbreaks. Another reason is the indulgence towards the pandemic restrictions, airports were open again and movement became more facilitated. Moreover, the beginning of June usually corresponds with the beginning of summer, where tourism becomes more tempting in Istanbul, as found in the previously studied data of 2017, 2018, 2019, and therefore the demand on Airbnb naturally increases.

From June of 2020 onwards, the reservations volatility proceeded as expected; however, the number of reservations was not higher than May's number of the same year, which is what the pattern predicts on a usual basis. In fact, the reservation number was set back to the rates of 2018. It is also demonstrated in Figure 11, the yearly change in reservations number. Although a considerable setback in reservations number was noticed, we do not believe that it will affect the market share of Airbnb in Istanbul, since the positioning of Airbnb was established over a long enough period of time. In addition, the causality of that setback has relevance to the pandemic of COIVD-19, not a shift of interest from the guests' side, nor inadequacy by Airbnb's side. Regarding the losses in revenue, due to the lack of sufficient data, calculating an accurate and reliable number was not possible. Yet we tried to assess the impact on revenue in an attempt of shedding light on the financial

part of the losses. An article published in Forbs (Barzilay, 2016) addressed the most profitable cities to rent out an Airbnb property. Amongst the list of 25 cities, Istanbul came 17th. The research was conducted in November of 2016. Out of the calculated variables, two are of a concern to us: The average revenue and the average 1-bed monthly rent. For simplicity, we will assume that the calculated 1-bed monthly rent was of a close value in the beginning of 2017 where our observation for the data started, and therefore the revenue was of a similar value. We will extend that concept to our reservation data, and start from January of 2017 with 513$ as the starting price point when the number or reservations was around a 1000 and the average revenue was 8218$. It would not totally accurate to conclude an exact value for the revenue, due to the complexity of the business model, as tenants could stay for a period less than a month, and there is a possibility of certain properties to be empty. In addition to the fact that the market of Airbnb was growing and as a natural result, the prices will increase. Nonetheless, at the highest number of reservations in August of 2019, the reservations number exceeded 12000, which will make the revenue equal to 98616$ if all variables were controlled. However, after March of 2020, the reservations number was set back to rates lower than January of 2017, which will hypothetically result in revenue losses estimated around 80% from the highest considered revenue, during the first 2 months of the pandemic. We suggest further research on the consequences of COVID-19 on Airbnb after the end of 2020, since it is not clear during the preparation of this research, as it requires complex modeling to consider all other variables.

5.2. Effect of the Number of COVID-19 Patients on Airbnb Reservations

As to the link between the pandemic and the decrease in reservations number, in Figure 12 the expected reservations number had the pandemic not happened was demonstrated. We acquired it by noticing a reservations' increase in each month over the period between 2017 and March of 2020. That increase was almost responding to an exponential line. However, since the breakout of COVID-19 pandemic in March of 2020, reservation numbers have been lower than expectations in every month separately. However, the severity of the decrease varied between months.

The highest drop in reservations numbers was in April and May of 2020, October and November witnessed the lowest drop compared to the rest of the months in the year 2020. It is of importance to highlight that the pattern in which the reservations number were changing in the years before March of 2020 was reversed since the breakout of the pandemic, only to bounce back in May of 2020 to normal state of increase, yet with reservation number similar to the rates of 2018.
By subtracting the actual number of reservations in 2020 from its opposites in 2017, then dividing it on the difference between the expectation number and the rates of 2017 reservations, performed on every month, we were able to perform a quantitative analysis on the previously mentioned phenomena. Represented as a percentage of a decrease from the expectation; finally, those percentages were plotted on the second graph in Figure 13.

A drop to around 70% from expectation in March 2020 was found, a percentage lower than the drop in following months, it varied between 100-110% between April and May. We believe the reason for the lower percentage in March to be that guests were already visiting during the first 10 days of the month, conditions were standard then, as the pandemic was officially reported on 10^{th} of March, both reservations before and after the pandemic were compiled, and presented as one month. However, the drop in reservations number was the lowest in the following months, April and May. As panic towards the pandemic spread, and flights were restricted as a result, also the natural state of low season may have had an effect, but we believe the pandemic had the bigger role in that severe decrease. Yet starting June of 2020, reservations number was refreshed, because of the indulgence towards the restrictions such as opening airports and allowing travel under conditions, and the absence of panic as people developed tolerance towards the pandemic and what comes with it as far as personal protective measures, and governmental restrictions. In addition, June marks the beginning of the summer season where the demand on tourism increases.

The recovery lasted until November of 2020, for many reasons. For instance, universities implemented distant education policy, where students are not required to attend lectures physically; cyber attendance took its place. In addition, as many

companies adopted a work-from-home policy, workers had liberty in terms of accommodation, as their tasks did not require physical attendance. Allowing more people to take advantage of the summer season. Yet by the end of November, the Turkish government placed new restrictions to prepare for the second wave of the pandemic. It included a general curfew during a specific time every day, restaurants were only allowed delivery service, gathering in houses for celebration and events was banned as well, and people older than 65 years and younger than 20 years were not allowed to use public transportation (Güler et.al, 2020). Synchronizing with the beginning of winter resulted in the reservation number dropping again, matching the pattern of change in reservation.

As for the number of Corona patients, after plotting it in response to time by month in Figure 13.a, three events are recognized. The first one in April, a drastic drop in patients' number, shown in the graph by a knee. The second event is in October, the patients' number increased drastically, although there was an increase in patients' number before October, yet it was slight and gradual. The third and last is in December, where the patients' number decreased severely. Three events correspond to the previously mentioned events in Figure 13.b, the decrease in reservations number.

First of them was in May, the decrease in reservations number climbed up, a second was in November, the decrease in reservations number dropped, and a third in January, decrease in reservations number climbed up again, meaning that when patients number increased, the decrease in reservations number increased with it. In other words, the number of reservations decreased, and vise-versa. However, the response happens with a one-month delay from the shift in patients' number. We emphasize an additional point, the severity in which the patients' number changes in increase or decrease, was not related to the amount of reservations that takes place. As people notice the corona situation in the country, and use the patients number as a marker, yet how big or small the number, does not affect the desire to visit as tourists, to which we used reservations number as an indicator.

5.3. Further Recommendations

We found the major effect of COVID-19 outbreak on Airbnb's accommodation in Istanbul took place in the first 2 month after the official announcement; the demand decreased drastically, and maintained low rates of reservation during that period. Nonetheless, by the end of the year, a form of recovery was accruing. In addition, a response to the change in the severity of the pandemic in Turkey by the tourists was noted; there was interval between the change in patients' number and the response of the market, which is an increase in demand. It is safe to assume that Airbnb has not lost share of its market in Istanbul, knowing that after the first two months, prospects were behaving in a similar manner to what they were behaving before the outbreak, with the drop in enthusiasm in consideration. We recommend implementing a reminder advertisement strategy in the upcoming campaign of Airbnb. Even though the reason of the decrease in reservations in the studied period has no direct relation with Airbnb practices to the extent of our comprehension, it presents an opportunity for the new entries to the market. Therefore, as we believe such strategy will be necessary for Airbnb to regain its place in the market, and it will contribute in the process of bouncing back to normal and healthy rates of reservations. We also recommend further studies on the effect of COVID-19 pandemic on Airbnb's demand after the year 2020. Explore in more details what are the long-term effects of COVID-19 pandemic, estimate the expected time for the market to bounce back to normal rates of reservations, the possibility of a shift in interest after the pandemic is over, all are subjects of further research.

APPENDICES

Appendix 1. Matlab Code

```
% Clearing the work space, the data, and the figures before running the code
clear
close all
clc

% Loading the reservations dataset that have been pre-processed
load('revs.mat')

% Extracting only dates of reservations in days
dates = T(:,'date');

dates1 = table2array(dates);

% Converting dates into frequency table to eliminate any repeated reviews resulting from overlapped data
F = tabulate(dates1);
Freqs = cell2mat(F(17:end,2));
dates2 = cell2mat(F(17:end,1));

% Converting the dates from texts to integer values for easier manipulation
D = dates1;
Ds = D.Year*100 + D.Month;
```

```
Ds = num2str(Ds);


% Getting the frequency table of the monthly reservations
FM = tabulate(Ds);
FMs = cell2mat(FM(:,2));
dMs = cell2mat(FM(:,1));
dMsN = str2num(dMs);


% Sorting monthly reservations from older to newer
FMN = sortrows([dMsN FMs]);


% Extracting final arrays that represent yearly and monthly reservations
yearsP = floor(FMN(:,1)/100);
monthsP = rem(FMN(:,1),100);


%% MONTHLY ----------------------------------------


monNames = [ 'Jan' ;
             'Feb' ;
             'Mar' ;
             'Apr' ;
             'May' ;
             'Jun' ;
```

```
        'Jul' ;
        'Aug' ;
        'Sep' ;
        'Oct' ;
        'Nov' ;
        'Dec' ];

% Associating month names with their corresponding reservations
for i=1:length(monthsP)
   Mlbls(i,:) = monNames(monthsP(i),:);
end

for i=1:length(yearsP)
   lbls(i,:) = [Mlbls(i,:) ' ' num2str(yearsP(i))];
end

% Plotting the monthly reservations
figure

myax = axes;

hold on

colors = [0.8 0.9 0.9;
```

```
0.9 0.9 0.5;
0.8 0.9 0.9;
0.9 0.9 0.5;
0.8 0.9 0.9;
0.9 0.9 0.5;
0.8 0.9 0.9;
0.9 0.9 0.5;
0.8 0.9 0.9;
0.9 0.9 0.5;
0.8 0.9 0.9;
0.9 0.9 0.5
];

Y17 = FMN(81:92,2);
Y18 = FMN(93:104,2);
Y19 = FMN(105:116,2);
Y20 = FMN(117:128,2);

plot(81:92,Y17,'k-o','LineWidth',1.5);
plot(93:104,Y18,'m-o','LineWidth',1.5);
plot(105:116,Y19,'k-o','LineWidth',1.5);
plot(117:128,Y20,'m-o','LineWidth',1.5);

hold off
```

```
xticks(1:length(lbls))

xticklabels(lbls)

set(gca, 'YGrid', 'off', 'XGrid', 'on')

axis([80.5 128.5 -500 13500])


myax.Layer = 'top';


%% YEARLY ----------------------------------------


% Extracting the yearly reservations from monthly ones

yearly = zeros(1,10);


idxY = 1;

for i = 9:12:117

    yearly(idxY) = sum(FMN(i:i+11,2));

    idxY = idxY + 1;

end


% Plotting yearly reservations

figure

plot(2017:2020,yearly(end-3:end),'k-o','LineWidth',1.5)


xticks(2011:2020)
```

```
xticklabels(2011:2020)

set(gca, 'YGrid', 'off', 'XGrid', 'on')


axis([2016.5 2020.5 -5000 120000])


%% Month by Month ---------------------------------


% Rearranging months to align similar month together

Mar17 = 83;


MbM = zeros(12,8);


X = 1:3;


% Creating an exponential regression model for each month

for i=0:11

    MbM(i+1,1:4) = FMN(Mar17+i:12:Mar17+i+36,2);

    Y = MbM(i+1,1:3);

    f = fit(X',Y','exp1');

    % Extracting coefficients of the trained model to predict future values

    MbM(i+1,5:6) = coeffvalues(f);

    MbM(i+1,7) = MbM(i+1,5)*exp(MbM(i+1,6)*4);

    % Calculating decline in monthly reservations

    MbM(i+1,8) = (MbM(i+1,7)-MbM(i+1,4)) / (MbM(i+1,7)-MbM(i+1,1));
```

```
end
% Plotting month-by-month figure as a grid
figure

for i=0:11
   subplot(3,4,i+1)
   plot(2017:2020,MbM(i+1,1:4),'b-o')
   hold on
   xx = 0:0.05:4;
   yy = MbM(i+1,5)*exp(MbM(i+1,6)*xx);
   plot(2016:0.05:2020,yy,'r')
   plot(2020,MbM(i+1,7),'ro')
   xticks(2017:2020)
   if i>9
     xticklabels(2018:2021)
   end
   title(monNames(i+1,:))
   axis([2016.7 2020.3 min(FMN(Mar17+i:12:Mar17+i+36,2))-1500
max(yy)+1500])

end

%% COVID ----------------------------------------
```

```
CovMon = [ 'Mar 2020' ;
        'Apr 2020' ;
        'May 2020' ;
        'Jun 2020' ;
        'Jul 2020' ;
        'Aug 2020' ;
        'Sep 2020' ;
        'Oct 2020' ;
        'Nov 2020' ;
        'Dec 2020' ;
        'Jan 2021' ;
        'Feb 2021'];

% Loading monthly patients count in 2020
CovidM =
[13531,106673,43738,35964,30967,39260,48530,56704,125498,142973,30707,1794
0];

% Plotting monthly patients count and monthly decline in reservations
figure
subplot(2,1,1)
plot(1:12, CovidM,'k-o','LineWidth',1.5)
xticks(1:12)
xticklabels(CovMon)
```

```
set(gca, 'YGrid', 'on', 'XGrid', 'on')

axis([0.5 12.5 -10000 160000])

title('Monthly number of patients')


subplot(2,1,2)

plot(1:12, MbM(:,8),'m-o','LineWidth',1.5)

xticks(1:12)

yticks(0.6:0.1:1.2)

yticklabels(['    '; ' 70%' ;' 80%' ;' 90%' ;'100%' ;'110%'])

xticklabels(CovMon)

set(gca, 'YGrid', 'on', 'XGrid', 'on')

axis([0.5 12.5 0.6 1.2])

title('Decline in Airbnb reviews')
```

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