Hotel transaction prices in key European cities during the COVID-19 pandemic

(A cross-city comparison for large cities in Western, Southern, and Northern Europe)

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Title	Hotel transaction prices in key European cities during the COVID-19 pandemic
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Abstract

The study investigates hotel transaction prices in some major cities in Europe from 2013 to 2022 including the COVID-19 pandemic period (which started almost at the beginning of 2020). The focus is on identifying differences in price trends between cities and how they changed during the COVID-19 pandemic. The observed differences in price trends are then further explained by specific hotel (branded and independent hotels) and city characteristics (the annual number of tourists). The empirical model is based on hedonic regression model and the sample data contain 333 transaction records during 2013 and 2022. At this rate, the results show insignificant price difference between hotel transaction prices before and during the COVID-19 pandemic. Moreover, there are some remarkable differences in hotel transaction prices between major European cities. Further investigations tried to unravel differences in hotel transaction prices by focusing on the differences between branded and independent hotels. Results do not suggest any evidence that the observed price trends in different cities or different city characteristics (the annual number of tourists) are associated with the type of hotel (independent or branded) during the research period.

Keywords: hotel industry, cross-city price differences, the COVID-19 pandemic, the annual number of tourists, branded and independent hotels.

1. INTRODUCTION

1.1. Motivation

Hospitality is one of the industries which was hit hard during the COVID-19 pandemic. The downturn is vivid in the hotel industry as it is one of the most important players in the hospitality sector. To get a better understanding of the hotel industry and the potential consequences of COVID-19, there are various performance indicators. The transaction price is an important measure for evaluating demand and supply in the hotel industry. The occupancy rate and average daily rate metrics are typically used to compare the performance of hotels (altexsoft, 2021).

Hotel transaction prices are likely to be affected by the COVID-19 pandemic. According the Boston Hospitality Review (2021), the number of hotel transactions decreased by approximately 83 percent during the second quarter of 2020 compared to the second quarter of 2019. At the same time the total transaction volume dropped by roughly 91 percent and the sales price per room declined with about 41 percent. Therefore, it seems crucial to have the relevant data before and during the COVID-19 pandemic in order to observe how hotel transaction prices changed before and during COVID-19. This could be lucrative for investors as well as developers by providing opportunities to buy relatively low-priced assets at the beginning of another major crisis other than the COVID-19 pandemic. In other words, despite uncertainty in the outlook for hotel performance, hotel investors are willing to opt for the risk of performance volatility and look for opportunities to purchase relatively low-priced assets, with the anticipation of strong price appreciation and high returns after a major crisis (HVS, 2020). Those opportunities could be strengthened by knowing how resilient a city is during the COVID-19 pandemic (resilient cities seem to be less risky for investments). In this manner, investors and developers, by knowing how the market behaves during any pandemic such as COVID-19, could optimize their investment portfolio by means of diversification. Likewise, economic pressures have created opportunities for investors to buy assets from sellers who ran out of cash due to the low vacancy rate at their hotels (hospitalitynet, 2021). By estimating future growth and taking into account that some sellers are in a weak position, they could acquire an asset at a relatively low price. This trend could also be applied when anticipating future pandemics.

As far as the issue above is concerned, there is yet no European study that studies hotel transaction prices before and during the COVID-19 pandemic, and no study that tries to unravel why there are such differences in hotel transaction prices between major cities. This information could be helpful for investors as well as researchers to better understand the hotel real estate market.

1.2 Literature review

The academic literature on exploring hotel transaction prices is scarce, and effect studies that investigate (exogenous) shocks on transaction prices in the hotel industry are even scarcer. The most relevant study that I was able to find is Roubi (2015). Roubi (2015) focuses on constructing a transaction-based hotel price index for Europe during 2004 to 2013 in which the grand financial crisis took place. Roubi (2015) argues that his estimated index reflects the hotel real estate performance. This helps investors make informative decisions. They can evaluate individual property performance, make an objective decision about where and which property type to invest in, and assess the relative performance of hotel assets to all other sectors to finally reach optimal allocation for an investment portfolio. Different characteristics of hotel properties are used to develop a model to estimate transaction prices. The findings from Roubi (2015) reveal that the hotel property price index (HPPI) represents a more realistic approach than the hotel valuation index to estimate hotel property prices. Roubi (2015) also concluded that HPPI does not suffer from sticky valuation issues as well as the fact that distressed properties show more volatility due to the distressed situation. Although Roubi (2015) encountered a vivid downturn (the grand financial crisis from 2007 onwards), it might be interesting to investigate whether the period in which the COVID-19 pandemic happened can also be identified as a vivid downturn in terms of hotel transaction prices.

Agmasiparn (2014) is relevant to this thesis as it provides a list of independent (control) variables that may explain hotel prices. Agmasiparn (2014) investigates hotel room rates in Bangkok during the year 2013 using a hedonic model. A total of 141 randomly selected hotels were included in the sample for this research. Their one-night room prices were compared for a one-night weekend stay. The room price data came from online hotel booking reservation website Agoda.com, which accounts for 30% of all bookings in much of the Asian market (Agmasiparn, 2014) although it missed some important variables. The variable service quality would be another factor that could signify hotel room price differences (Hung et al., 2020; Thrane, 2007). However, this was not included in the study as it is hard to evaluate with an objective measure. Hotel star ratings were also not included since Thailand does not adhere to an official star rating classification (Agmasiparn, 2014). The variables that showed up as significant were the hotel's age, room size, proximity to the city center, proximity to the BTS system and whether or not the hotel was part of a chain. Out of the dummy variables the presence of a plasma TV, the inclusion of breakfast and the presence of bars and restaurants came out as significant (Agmasiparn, 2014). Despite the research not addressing the value of the hotels or their properties, the independent variables that are found to be significant could potentially be used in the valuation a hotel. This is because they can affect the operational performance of a hotel (Camilleri, 2015).

Nemec Rudež (2022) studied the effects of the COVID-19 pandemic on investor sentiment by compiling data on the valuation of 12 major tourism-related companies. Part of these companies were hotel chains Hilton and Accor. The researcher analyzed the stock prices of these companies from January 1, 2020 to April 1, 2021. The expectations for the stock prices for the following year were also included. Dolnicar and Zare (2020) pointed out that the difference with previous crises is that the COVID-19 pandemic affects both supply and demand in the economy. Therefore, a comparison with previous crises would not yield valid results. Additionally, the magnitude of the traffic restrictions imposed was unique (Zenker and Kock, 2020). The 12 tourism-related companies were subdivided into the categories of accommodation sector (Hilton Worldwide Holdings Inc., Accor SA), restaurants and cafés (McDonald's Corporation, Starbucks, Domino's Pizza), the travel sector (Booking Holdings Inc., Expedia Group, TUI AG), the airline sector (EasyJet, Wizzair) and the cruise market (Carnival, Royal Caribbean). AirBnB was not included as it only went public in December 2020 (Nemec Rudež, 2022). The cruise market was hit the hardest by the pandemic outbreak. Most companies did not recover by April 2021. As the hope of an end to the pandemic increased, investor confidence also increased. Another effect on stocks were the suspension of dividends. These dividends were suspended as part of agreements on the receival of government support. The investor confidence differed among companies in the same industry. An example of this is the valuation of the two hotel groups. For the Hilton hotel group its valuation in February 2021 was actually higher than in February 2020. Yet Accor still traded slightly lower in February 2021 than it did in February 2020. Cruise lines and tour operators were the slowest to recover and did not yet recover by the end of the timeline for this study, which ended on the first of April 2021 (Nemec Rudež, 2022).

There seems quite some heterogeneity in investor sentiment during the COVID-19 pandemic which seem important for the current study to consider.

Singh's (2020) research lies on the hotel transaction prices for both financially distressed or foreclosure sales, and non-distressed hotel properties in the U.S. The research aimed to determine whether distress conditions influence distressed hotel transaction prices compared to non-distressed ones. The outcome helps investors to have a proper evaluation for distressed hotels as this study is the only one focusing on foreclosure discount studies in the hospitality industry. As far as the model is concerned, the hedonic pricing model was used to estimate the transaction prices for both distressed and non-distressed hotels across the U.S. The conclusion shows the significant negative effect of financial distress on transaction prices of distressed hotels including auction/trustee sale, short sale, foreclosure sale, and real estate owned (REO) sale properties. The data are from RCA (Real Capital Analytics) and CoStar, two of the largest sources in commercial real estate. Consequently, a hedonic model was constructed.

The sample data include variables in relation to property and hotel characteristics, distressed conditions, whether is in the foreclosure state, and location. The data encompass a great variety of features, but not necessarily comprehensive. In other words, there is no information regarding how the location is assessed by guests like location rating. Moreover, there is lack of distinction between hotels and hotel apartments in the research. Besides, including whether the property is close to sea or a beach could yield more accuracy as far as the model is concerned. Last but not least, the study focuses on U.S.

No other study could be found which addresses cross-city hotel price trends in a vivid downturn. The research gap is evident with regard to the studies discussed above: There is yet no European study that studies hotel transaction prices before and during the COVID-19 pandemic, and no study that tries to unravel why there are such differences in hotel transaction prices between major cities.

1.3. Research problem statement

The main objective of this study is to determine the price trend regarding hotel transaction prices during the COVID-19 pandemic. First, a specific model is used to find whether there is a significant difference in hotel transaction prices before and during the COVID-19 pandemic for key cities in Western, Southern, and Northern Europe. The answer is provided by determining the discount (or premium) on prices during the pandemic (first research question). The data are gathered on an international level for estimation of the model. At this rate, a large variety of data is used to ensure sufficiency, and possibly control for some elements which have great association with hotel asset values. The proposed model is based on a hedonic regression model with the inflation-adjusted transaction price as the dependent variable. Secondly, the study attempts to identify the price trend regarding hotel transaction prices during the COVID-19 pandemic for various cities in Europe by using interaction variables. The research also attempts to further discover the price trend regarding hotel transaction prices during the COVID-19 pandemic for various city characteristics in terms of annual number of tourists by using different interaction terms (thus using two different models with different interaction terms). Finally, the division in the data is enforced to explore if there is any heterogeneity in the relationship across branded and independent hotels. The potential heterogeneous effect in price could be explained by the premium that branded hotels are able to charge.

The remainder of this paper is organized as follows. Section 2 describes the theory behind the model, while section 3 depicts the empirical approach and data selection. Section 4 presents the results. Subsequently, section 5 brings an extensive discussion of the results and finally, section 6 concludes the analysis.

2. THEORY

2.1 Hotel transaction prices

The dependent variable for this research is inflation-adjusted hotel transaction price (The price is adjusted for inflation in order to make sure every price is on the base-year level). Based on Singh (2020), a hedonic regression model is used to estimate hotel transaction prices. The prices are determined by variables concerning property and hotel characteristics, distressed conditions, whether is in the foreclosure state, and location of the property.

Looking from the supply side, there are also factors affecting the value of a piece of land (Evans, 2004): 1) Residential attachment: is positively correlated with the price of land. If the land is occupied by the one who owns the property, especially when he or she lives there, there is a residential attachment to the site. The owner does not desire to sell the land, except for higher prices which can compensate the attachment. 2) Land ownership, politics, society, and economy: the social relationships among landlord, tenant, owner, occupier, and the rules imposed by the government have been an important issue in the real estate sector influencing the land prices. Politics and economy are also strong determinants when it comes to land prices as they represent the general condition of the land in which the property is located. For instance, the information asymmetry in property market is considerably higher when the market is inefficient due to political and economic factors leading to uncertainty and instability in land prices. In addition, the rules regarding the taxation of land have a great impact on land prices. 3) Land banking and land availability: local authorities evaluate the amount of land required for specific type of use and also determines the land which is available. The restrictive rules regarding land supply are especially common in locations which the amount of land is quite limited. On the other hand, land banking is conducted by construction companies, and central or local governments. Land banking is defined as acquisition of land before development takes place. 4) Problem of contiguity: This situation arises when the land which the buyer wants to acquire consists of multiple plots which are in proximity to each other. In this scenario, he or she has to negotiate with different owners and convince them to sell the property leading to purchase of some lands at higher prices than expected. This in general increases the land price.

2.2 Hotel transaction prices and vivid downturns

Indicating whether the hotel transaction takes place during the COVID-19 pandemic have a huge association with prices in relation to retail, hospitality and office properties (Hoesli & Malle, 2021). On the contrary, there is an insignificant correlation between economic conditions and hotel sale prices (Lee et al., 2016). There is a difference in the magnitude of the effect on hotel values during COVID-19, and other economic downturns. The difference could be that the COVID-19 pandemic has had a long-lasting effect (almost two years) on the economy of nations. This pandemic was quite long timewise compared to other recent major downturns. Moreover, the COVID-19 pandemic corresponds to deadly viruses, rather than plain economic crisis, which have straight vulnerability to human health. This trend evidently caused almost all hotels to shut down during the pandemic leading to more severe effect on hotel markets in comparison with other major downturns. However, different countries took various measures against

COVID-19 which affected the annual number of tourists (also hotel markets) in different ways (European center for Disease Prevention and Control, 2022).

2.3 Hotel transaction prices and the annual number of tourists as well as location

Location is crucial to specify the transactional value of hotels. According to (Valentin and O'Neill, 2018) hotel location is a very important factor when it comes to their property market value. The location features such as accessibility and environment are significant determinants for how much the hotel actually costs. Moreover, the number of tourists could play an important role when determining the hotel transaction prices. There is a positive correlation between the number of tourists and the housing prices in EU countries. The appreciation in housing prices is due the spillover effect of tourism based on the geographical area (Peric et al., 2022). Furthermore, the average hotel value increases when shifting to locations with higher number of annual tourists. According to figure 1, Pacific region and Middle Atlantic regions in U.S, which account for the highest concentration of tourists, represent the highest average selling price per hotel room. The trend could be further justified by the rule of demand and supply: the higher the total number of tourists, the more expensive the hotel transaction price.

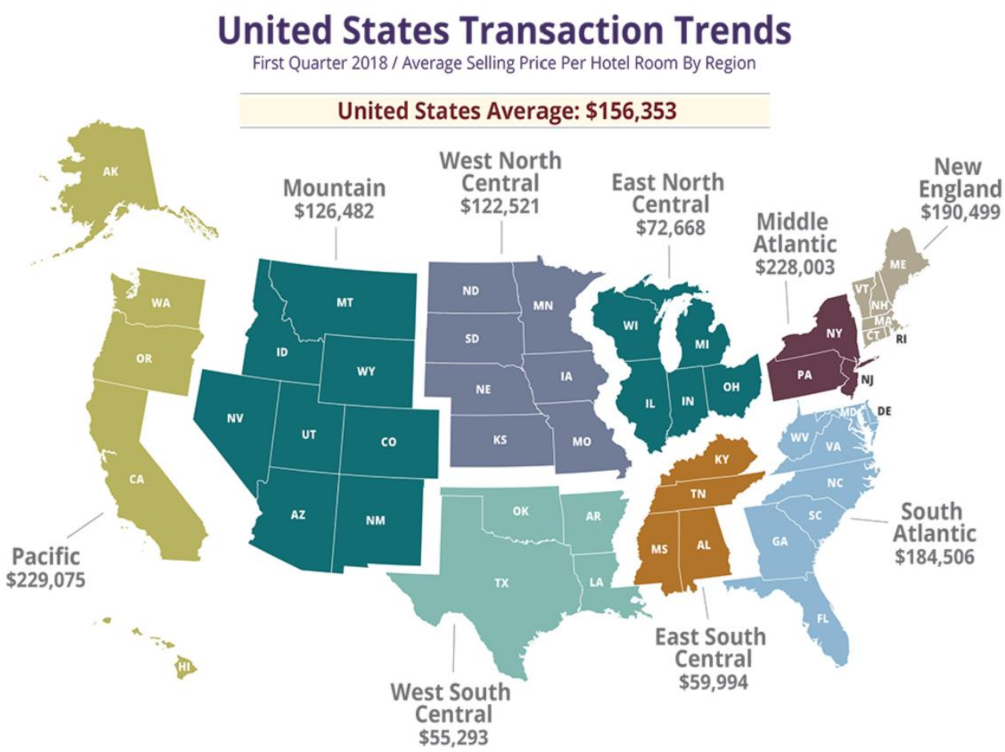

Figure 1: *The average selling price per hotel room in the first quarter of 2018 by different states in the U.S (New England Hotel Realty (NEHR), 2018)*

2.4 Hotel transaction prices and chain affiliation

It is probable that there is a significant price gap between independent and branded hotels. In this regard, hotel chains are widely known worldwide and benefit from having more guests. Thus, it is worth to investigate for any heterogeneity in transaction prices between independent and branded hotels.

Hotel chains generate economies of scale in cost (Hollenbeck, 2017). Besides, branded hotels might attract more demands thanks to their reputation. According to Hollenbeck (2017), there is a premium in revenue for large hotel chains, but no cost advantage in comparison to independent hotels. Although the analysis of chain affiliation of hotels is related to operating income, there might be also a premium for chain hotels as far as the hotel sale prices are concerned. This premium could be derived from the fact that branded hotels are more well-known leading to more hotel guests (the rule of supply and demand).

2.5 Hypothesis

Based on above descriptions, there are four logical hypotheses to be made:

1) Hotel transaction prices are negatively associated with vivid downturns, such as the COVID-19 pandemic

2) There exists heterogeneity in the association of COVID-19 with hotel transaction prices between major EU cities

3) The association of COVID-19 with hotel transaction prices is stronger in cities with a higher annual number of tourists

4) There exists heterogeneity in the association of COVID-19 with hotel transaction prices between branded and independent hotels

3. DATA & METHOD

3.1 Context

The preliminary data to use for the analysis were collected by a prominent hospitality consultancy firm[1]. The aforementioned data are obtained by YAYS aparthotels, a fast-growing hospitality firm in Europe focusing on short stays. At the beginning, there were 382 observations in the sample data, while the number decreased to 333 (the final number of observations) after the cleaning process (for details of the cleaning process see appendix 1). The data include transaction details from 2013 to 2022 across 23 major cities in Western, Southern, and Northern Europe. The rest of the data are gathered through different hotel and tourism websites as well as Google Maps. The initial data collected from the hospitality consultancy firm contain: the name of the asset, the address, the buyer and seller, the year in which the hotel transaction takes place (from 2013 to 2022), the number of keys per hotel, the total price of hotel transactions in the local currency, and the city in which the hotel property is located. Additional data from external sources are merged with the original database and they include: the number of tourists in 2019 per city from multiple tourism websites, the location rating from Booking.com, the number of hotel stars from Booking.com, the number of floors from several hotel and tourism websites, whether the property is close to water from Google Maps, whether is hotel or aparthotel from Booking.com, and whether the hotel is branded or independent from several hotel websites.

Among the data specified in the above paragraph, some of them are transferred to new variables in order to fit more into the analysis, while some others stay in the same format. The ones without any change consist of the location rating, number of hotel stars, city, whether is close to water, whether is hotel or aparthotel, and whether is branded or independent. On the other hand, the secondary variables are whether the transaction is during the COVID-19 pandemic, the categorical variable in terms of annual number of tourists in 2019, the categorical variable related to number of keys,

[1] the name of the firm is confidential and it is not allowed to disclose

the inflation-adjusted transaction price (the variable is further transformed to the natural logarithm of inflation-adjusted transaction price), and the categorical variable related to number of floors. All the variables are controlled if there is missing data.

As far as the transformed variables are concerned, the dummy variable is constructed for whether the transaction is during the COVID-19 pandemic (or pre pandemic). In this case, the data regarding transaction year are classified into less than 2020, and equal or greater than 2020. For simplicity of the analysis, the assumption here is that the COVID-19 pandemic has started in the beginning of 2020 (although it was at the end of 2019). The reason for choosing the start of 2020 as a threshold is that the transaction date is only available on an annual basis. Another secondary variable in the model is the categorical variable in terms of annual number of tourists in 2019 per city in which the hotel is located. The initial figure is based on 2019 for each city demonstrating the most updated annual number of tourists before the COVID-19 pandemic (this reflects the real number of tourists in the ordinary situation). The division in the number of tourists is applied in order to show how touristic the city is. At this rate, the total range within the data is divided into four subgroups: the least touristic city, not so touristic city, quite touristic city, and the most touristic city.

Similarly, the number of keys is transferred to the categorical variable in terms of number of keys. In this regard, the average and sample standard deviation regarding total number of keys per hotel is estimated. Then, four different ranges are created based on the mean and two standard deviations from the mean. The subgroups are low number of keys, average number of keys, high number of keys, and very high number of keys. The data outside the range of two standard deviations from the average are removed from the data as outliers. The similar strategy is applied to the variable describing the number of floors (the total number of floors per property excludes the ground floor). The number of floors is placed into four categories: low number of floors, average number of floors, high number of floors, and very high number of floors. Likewise, the outliers are omitted from the data.

Since all the initial data in relation to hotel transaction prices are based on a specific year, it seems logical to adjust it to a basic year in order to omit the inflation effect. For this research, all the transaction records for different years are adjusted to the year 2013 which is the lowest year in the data. The adjusted transaction prices are calculated according to the inflation rate of each country in which the hotel is located for different years from 2014 to 2022 (see appendix 2). Secondly, all non-Euro transaction prices are converted to Euro. Moreover, the final transformation of the dependent variable is the natural logarithm of inflation-adjusted transaction prices. The log-level of the dependent variable has a distribution which is much closer to the normal distribution compared to the one for the level dependent variable based on the data analysis in this study (appendix 3 and 4). At the end, all the transaction prices outside two standard deviations from the mean are deleted from the data in order to exclude outliers.

Concerning the non-transformed variables, location rating is the rating assessed by the guests (from 0 to 10) and it determines how attractive the location is. The higher the rating, the nicer the location of the property from their perspective. All the outliers in the data are omitted if they are outside two standard deviations from the mean. Star rating is also another variable depicting how luxurious the hotel is. The range in the data varies from three-star to five-star hotels. Another variable refers to the city in which the hotel is located. Initially, there are 26 cities in this research. But the total number decreases to 24 when deleting the outliers for other variables mentioned previously. The removed cities are Oslo and Porto (the final cities in the study and the number of hotels per city are available at appendix 5).

In addition, there is a dummy variable indicating how close the hotel property is to the water. The criterion is based on whether the property is within one kilometer radius of the major canal, river, water, sea, or lake. Google Maps is used to measure the distance between the property and the water. Next, there is a dummy variable to specify whether the property is hotel or aparthotel. Due to relatively very low number of aparthotels compared to hotels in the sample, this dummy variable is removed (the total number of observations remains the same) from the data. Last but not least, the dummy variable whether the hotel is branded or independent is utilized in the model to detect for heterogeneity in the models for both independent and branded hotels.

On each stage of the research, two different models with city-specific and categorical variables related to annual number of tourists (as explained before) are estimated. First, the model is estimated based on city-specific dummy variables to measure the effect of the pandemic on hotel values per city which is of interest of the author. Likewise, the study adds another statistical equation with the categorical dummy variables regarding annual number of tourists (instead of city-specific dummy variables). In this manner, it is feasible to investigate the price trend regarding hotel sales prices during the pandemic based on how touristic the city is. In summary, both city-specific and categorical variables for annual number of tourists are considered: one to estimate the price effect during the COVID-19 pandemic on each city, and the other one to estimate a more precise result based on the tourism level of each city in which the hotel is located.

3.2 Descriptive analysis

Following the descriptions and definitions of various independent regressors and the dependent variable in the model, the descriptive statistics is illustrated below in table 1.

Table 1: *Descriptive statistics of yearly observations regarding hotel transaction prices and some specific hotel characteristics (there are 333 transaction records after cleaning)*

Variable notation	Definition	(2) mean	(3) Standard deviation	(4) min	(5) max
$price$	Inflation-adjusted transaction price	51 M	43.97 M	3.71 M	221.2 M
$during\_COVID$	Whether the transaction is during the COVID-19 pandemic	0.23	0.42	0	1
$year$	Transaction year	2017.3	2.5	2013	2022
$tourist$	Number of tourists in 2019 per city	16.3 M	10.46 M	0.45 M	35.4 M
$keys$	Number of rooms per hotel	177.9	103.1	24	468
$location$	Location rating (by Booking.com)	8.94	0.55	7.7	10
$stars$	Number of stars	4	0.65	3	5
$floors$	Number of floors per hotel (excluding ground floor)	6.7	2.4	2	16
$city$	City in which the hotel is located[2]	12.3	6.8	1	26
$branded$	Whether the hotel is branded	0.65	0.48	0	1
$close\_to\_water$	Whether the property is close to water	0.32	0.47	0	1
$tourist\_level$	Categorical variable to indicate annual number of tourists	1.33	1.07	0	3
$keys\_level$	Categorical variable to indicate number of rooms per hotel	1.29	0.77	0	3
$floors\_level$	Categorical variable to indicate number of floors per hotel	1.27	0.59	0	3

[2] For the cities and the number of observations per city see appendix 5

Note: The reference category for city is Amsterdam=1. The rest are: Antwerp=2, Barcelona=3, Berlin=4, Birmingham=5, Brussels=6, Copenhagen=7, Dublin=8, Edinburgh=9, Hamburg=11, Lisbon=12, London=13, Madrid=14, Manchester=15, Milan=16, Munich=17, Oslo=18, Paris=19, Porto=20, Rome=21, Rotterdam=22, Stockholm=23, The Hague=24, Utrecht=25, and Vienna=26. The reference category for the categorical variable related to annual number of tourists is Least touristic=0. The rest are: Not so touristic=1, Quite touristic=2, and Most touristic=3. The reference category for the categorical variable related to number of rooms per hotel is Low number of keys=0. The rest are: Average number of keys=1, High number of keys=2, and Very high number of keys=3. The reference category for the categorical variable related to number of floors per hotel is Low number of floors=0. The rest are: Average number of floors=1, High number of floors=2, and Very high number of floors=3. The base year for the inflation-adjusted transaction price is 2013. The transaction is during the COVID-19 when it occurs in 2020 onwards.

In addition, the figure 2 depicts the exact number of observations per city both before and during the COVID-19 pandemic (only for cities which the data are available both pre and during the COVID-19 pandemic). In this regard, it is possible to observe how many hotel transaction records occurred before and during the pandemic.

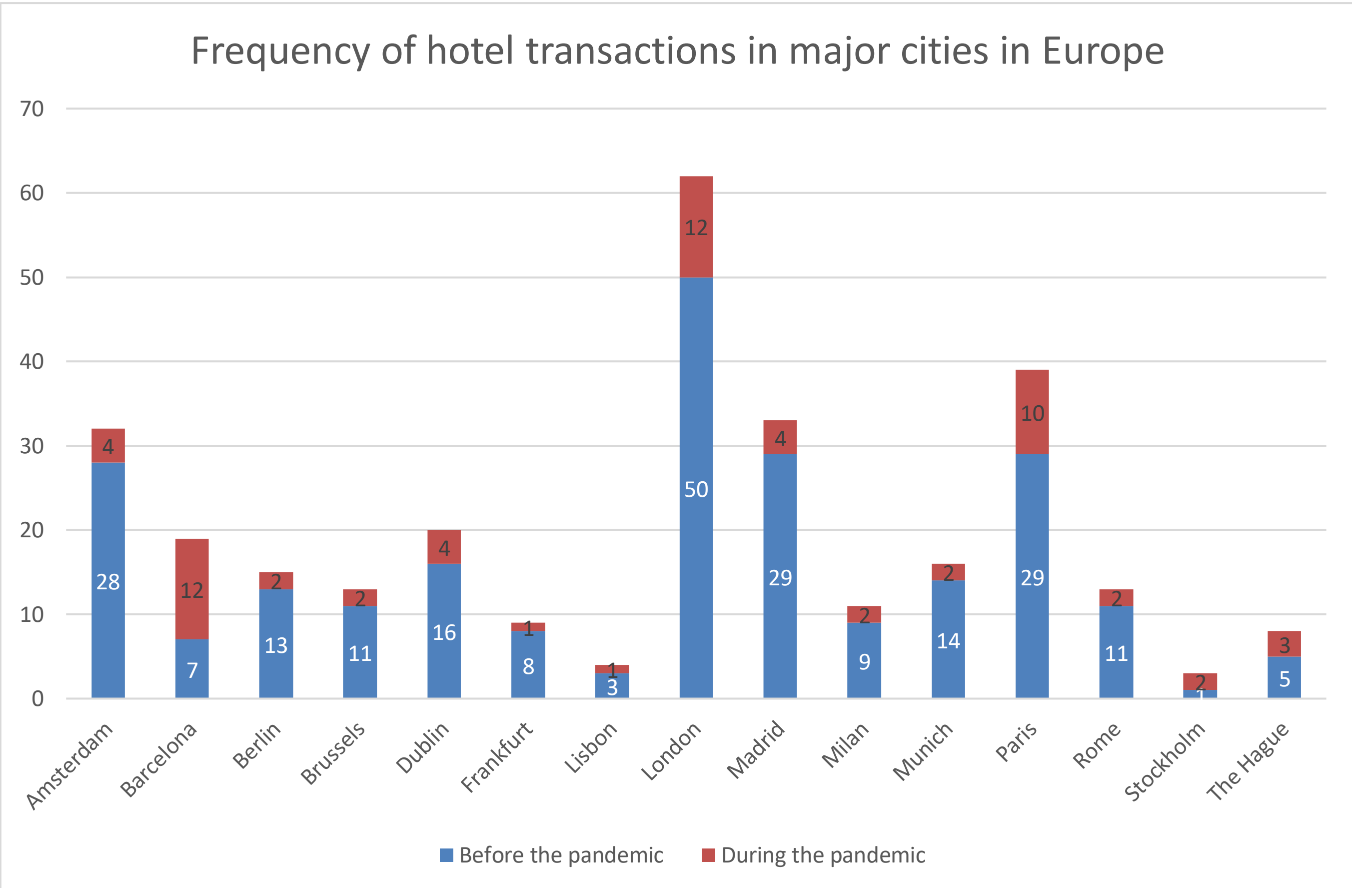

Figure 2: *the number of hotel transactions per city both before and during the COVID-19 pandemic*

3.3 Hedonic regression model

$$\text{ln\_price}_i = \beta_0 + \beta_1 during\_COVID_i + \beta_2 location_i \qquad model(1)$$

$$+ \sum_{m=1}^{2} \alpha_m stars_{mi} + \sum_{r=1}^{23} \gamma_r city_{ri} + \beta_3 close\_to\_water_i + \sum_{o=1}^{3} \theta_o keys\_level_{oi}$$

$$+ \sum_{p=1}^{3} \omega_p floors\_level_{pi} + \varepsilon_i$$

There are four hedonic regression models to be estimated (the variables used in empirical analysis are shown in appendix 6. First, the model with all the aforementioned variables (in the descriptive analysis section) excluding the categorical variable regarding the annual number of tourists. The aim is to measure the price effect (change in transaction prices) during the COVID-19 pandemic (the coefficient for the variable 'during_COVID'). But in this model, the cities are included themselves. The reference group for variable 'city' is city of Amsterdam. There are also dummy variables in the model for categorical variables 'stars', 'tourist_level', 'keys_level', and 'floors_level'. The reference group for these variables are '3-star hotel', 'least touristic', 'low number of keys', and 'low number of floors' respectively. Besides, the reference group for 'during_COVID' and 'close_to_water' are 'pre COVID' and 'not close to water' respectively. The equation of the first model is illustrated above in model (1) The other models are just mentioned without showing relevant statistical models.

Secondly, the model includes the interaction terms between whether the transaction is during COVID-19 pandemic, and the dummy variables for different cities (city-specific dummies) which allow for cross-city comparison. With this model, the study investigates the degree of influence that the pandemic has on different cities where the hotels are located (the coefficient of interaction terms between 'during_COVID' and different dummy variables). Similar to the first model, the third model focuses on identifying the relationship between whether the transaction is during COVID-19 pandemic and transaction prices. However, in this model the categorical dummy variables related to annual number of tourists are considered rather than the city dummy variables themselves. All the other variables utilized in the third model are the same as the ones for the first model. The reference group for the categorical variable related to annual number of tourists is when the city in which the hotel is located is considered the least touristic.

In the fourth model, there are interaction terms in addition to the existing variables in the third model. At this rate, the interaction terms include the 'during_COVID' variable with different categorical dummy variables pertaining to annual number of tourists for a place where the property is located. The study measures the degree of the COVID-19 pandemic effect on transaction values based on different city characteristics as far as the annual number of tourists is concerned (the coefficients between the variable 'during_COVID' and different categorical dummy variables regarding annual number of tourists). In other words, this classification could further strengthen the difference in hotel values before and during the COVID-19 pandemic for different cities by focusing on how touristic that city is.

The multicollinearity issue is checked by VIF analysis for different independent variables. As far as the four models are concerned, the specific test is performed to check whether the conditional mean of the residuals is zero. In addition, the four models were tested for homoscedasticity (see chapter 4).

For answering the third research question, the dummy variable whether the hotel is branded or independent is included in the analysis to detect for heterogeneity. The final two pooled models with interaction terms (model 2 and 4) are used for the Chow test. In this case, the test is performed for both models when the hotels are either branded or independent to discover any potential heterogeneity in the model (the result is discussed in the chapter 4).

4. RESULTS

In this chapter the results of the different tests and models are shown and described. First, an ANOVA test is performed. Secondly, the variance inflation factor is calculated to see if there is multicollinearity between variables. Finally, the four regression models are run.

Initially, to observe how the dependent variable changes based on different amounts of regressors the analysis of variance (ANOVA) is performed. Specifically, the Bartlett's test shows significant variation among different amounts for all the variables in the model except the one related to whether the transaction is during the COVID-19 pandemic (appendix 7). The variation between the transactions before and during the COVID-19 pandemic is insignificant at a 95% confidence interval. The variance inflation factor (VIF) is calculated to address for any multicollinearity between variables. The VIF analysis is implemented initially starting from two independent variables until it covers all the regressors. One model consists of the city-specific dummy variables (model 1), and another one consists of the categorical dummy variables related to annual number of tourists (model 3). The two separate VIF analyses investigate the multicollinearity issue for both models (appendix 8). All the VIFs are between 1 and 1.18. This demonstrates that there is no strong correlation among variables. Appendix 9 and 10 show the pairwise correlation among the regressors including city-specific variables and categorical variables in terms of annual number of tourists respectively.

A general check (regcheck command in Stata) for all four regression models (model 1 to 4 in table 2) is performed. For each model, based on the statistical software, there is no heteroskedasticity and multicollinearity issue, residuals are normally distributed, no specification problem was found, the functional form was appropriate and no influential observations were present (see appendix 11-14).

Table 2 illustrates the four different OLS regression models and their estimated coefficients based on the models explained in chapter 3. Table 2 contains the four models. Below each model is shortly elaborated upon:

- Model 1 constitutes different city-specific dummy variables.
- Model 2 is the same as model 1, yet it also includes the interaction terms between city-specific dummy variables, and the dummy variable regarding the COVID-19 pandemic.
- Model 3 includes categorical dummy variables related to annual number of tourists.
- Model 4 is the same as model 3 with the added interaction terms between categorical dummy variables related to annual number of tourists, and the dummy variable in relation to the COVID-19 pandemic.

TABLE 2: ESTIMATION RESULTS FOR PRICE MODELS, OLS ESTIMATES

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4
Whether the transaction is during the COVID 19 pandemic	-0.00518	-0.372*	-0.0707	-0.326**
	(0.0836)	(0.215)	(0.0856)	(0.160)
Not so touristic			-0.0104	-0.152
			(0.0988)	(0.114)
Quite touristic			0.252**	0.172
			(0.0976)	(0.106)
Most touristic			0.00528	-0.0767
			(0.110)	(0.120)
During COVID * not so touristic				0.536**
				(0.221)
During COVID * quite touristic				0.294
				(0.221)
During COVID * most touristic				0.301
				(0.276)
the location rating of the hotel	0.503***	0.507***	0.376***	0.388***
	(0.0663)	(0.0680)	(0.0647)	(0.0655)
4-star rating of the hotel	0.186**	0.169*	0.248***	0.239***
	(0.0810)	(0.0905)	(0.0869)	(0.0883)
5-star hotel	0.681***	0.645***	0.781***	0.759***
	(0.105)	(0.111)	(0.113)	(0.114)
Average number of floors	-0.00504	-0.0179	0.0281	-0.00527
	(0.198)	(0.205)	(0.197)	(0.202)
High number of floors	0.242	0.229	0.308	0.261
	(0.206)	(0.209)	(0.208)	(0.212)
Very high number of floors	0.382	0.390	0.322	0.258
	(0.233)	(0.237)	(0.262)	(0.268)
whether the property is close to sea, canal, river, or lake	0.139*	0.145*	0.0327	0.0378
	(0.0787)	(0.0802)	(0.0799)	(0.0802)
Average number of keys	0.797***	0.784***	0.756***	0.754***
	(0.117)	(0.122)	(0.104)	(0.104)
High number of keys	1.434***	1.427***	1.256***	1.261***
	(0.125)	(0.133)	(0.121)	(0.121)
Very high number of keys	1.821***	1.798***	1.691***	1.687***
	(0.139)	(0.146)	(0.170)	(0.162)
Constant	11.50***	11.55***	12.67***	12.68***
	(0.647)	(0.663)	(0.589)	(0.592)
Observations	333	333	333	333
Adjusted R-squared	0.592	0.589	0.495	0.501

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Dependent variable is log of inflation-adjusted transaction price. The reference category includes 3-star hotel for variable star rating of the hotel, low number of floors for categorical variable indicating number of floors per hotel, is not close to water for variable whether is close to water, low number of rooms for categorical variable related to number of rooms per hotel, pre COVID for variable whether the transaction is during COVID, least touristic for categorical variable related to annual number of tourists, Amsterdam for variable city. The 23 dummy variables for cities and their interaction terms with dummy variable COVID are not in the table (to save space), but are included in analysis. The star sign (*) among the variables represents the interaction between two variables. All models include constant term.

The results from model 1 and 3 help answer the first research question. The estimated coefficients for the dummy variable whether the transaction took place during COVID-19 pandemic in model 1 and 3 are -0.00518 and -0.0707, respectively, and not significant at the 5% significance level. The estimated coefficients in model 2 and 4 provide an answer to the second research question. In model 2 the coefficients for different dummy variables for cities as well as the coefficients for the interaction terms between the COVID dummy variable and different city-specific dummy variables (23 different dummy variables with Amsterdam as a reference group) are not included in Table 2. These data can be found in Appendix 15. According to figure 2, for 9 out of the 23 cities there are no estimated coefficients for the interaction terms. This is because there are no transaction records for both pre and during the COVID-19 pandemic. Consequently, those cities were removed and the remaining 14 cities are available for further analysis.

The price trend in hotel transaction prices during the COVID-19 pandemic for hotels in different cities compared to the ones in Amsterdam is shown in figure 3. The model 4 coefficients for the interaction terms between the COVID dummy variable and not so touristic city, quite touristic, and most touristic are 0.536, 0.294, and 0.301 respectively. The interpretation is as follows: during the COVID-19 pandemic cities which are not so touristic saw an increase of the transaction price by 70.9% compared to cities which are least touristic, other variables being constant. Among cities which are quite touristic, the transaction price increased by 34.2% compared to cities which are least touristic during the pandemic, other variables being constant. Among cities which are most touristic, the transaction price increased by 35.1% compared to cities which are least touristic during the COVID-19 pandemic, other variables being constant. The price trend is significant during the pandemic at 5% significance level for hotel transaction prices which are located in cities that are not so touristic compared to the ones in cities which are least touristic. This trend is insignificant for hotels located in cities which are quite touristic or most touristic.

The second research question is about measuring the association of the COVID-19 pandemic with transaction prices for hotels located in different cities (rather than different city characteristics regarding how touristic cities are). As depicted in figure 3, hotel transaction prices in Stockholm and Munich show negative growth compared to those in Amsterdam. This means that the hotel market in these cities responded worse during the COVID-19 pandemic when compared to the market in Amsterdam. On the other hand, hotel markets in other cities reflect a positive growth in comparison with the one in Amsterdam. This demonstrates a better outlook in those locations.

After specifying the hedonic regression models the various statistical tests are performed to check: whether the conditional mean of residuals is zero (appendix 16), the homoscedasticity for all models (see appendix 17), and whether all of the four models are jointly significant (appendix 18). In addition, diagnostic and distribution graphs of all four models are drawn (appendix 19-26).

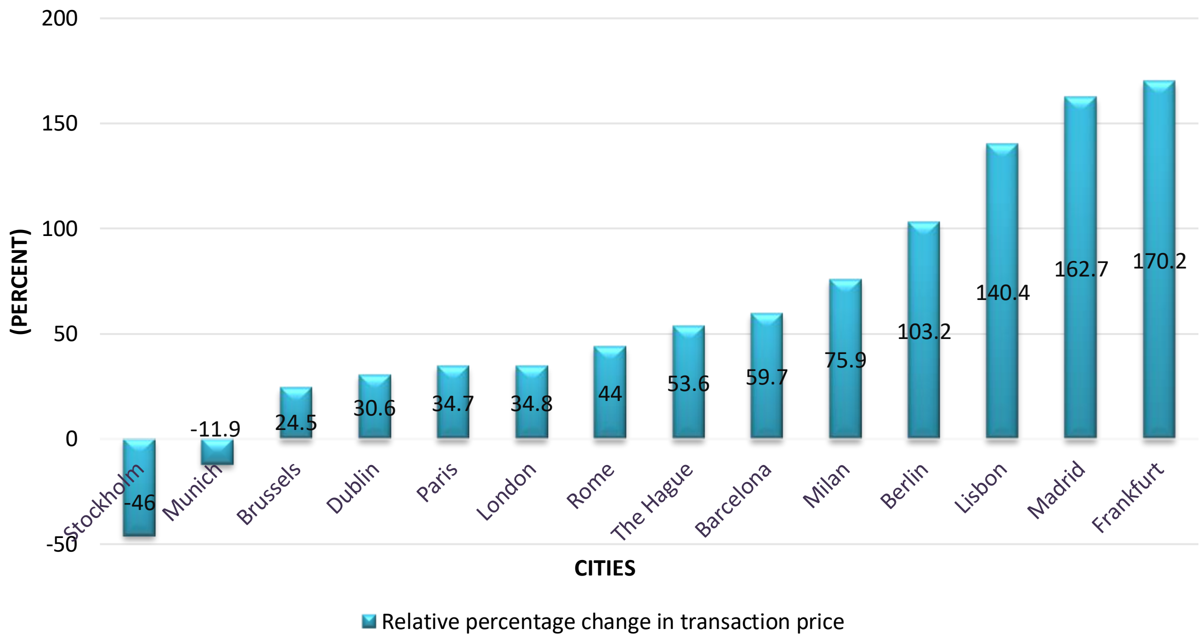

Figure 3: *the effect of the COVID-19 pandemic on hotel transaction prices per city relative to the one for Amsterdam*

The aim of the third research question is to discover whether there is any heterogeneity in the OLS regression models for branded and independent hotels. In this regard, the dummy variable whether the hotel is branded or independent is used ('branded' variable defined in the descriptive analysis section). The second and the fourth regression models including the interaction terms (in chapter 3, hedonic regression model section) are built for both cases when hotels are independent and branded (see table 3 and 4).

Table 3: a pooled OLS model in case of including categorical dummy variables related to annual number of tourists, and two separate models for branded and independent hotels

VARIABLES	(1) Pooled model	(2) Independent	(3) Branded
Whether the transaction is during the COVID-19 pandemic	-0.326**	-0.307	-0.252
	(0.160)	(0.318)	(0.182)
Not so touristic	-0.152	-0.346	-0.0822
	(0.114)	(0.291)	(0.118)
Quite touristic	0.172	0.105	0.211
	(0.106)	(0.222)	(0.136)
Most touristic	-0.0767	0.156	-0.162
	(0.120)	(0.239)	(0.155)
During COVID * not so touristic	0.536**	0.561	0.433*
	(0.221)	(0.436)	(0.259)
During COVID * quite touristic	0.294	0.315	0.424*
	(0.221)	(0.452)	(0.230)
During COVID * most touristic	0.301	-0.0940	0.479*
	(0.276)	(0.443)	(0.271)
the location rating of the hotel	0.388***	0.416***	0.377***

	(0.0655)	(0.121)	(0.0756)
4-star hotel	0.239***	0.00176	0.278***
	(0.0883)	(0.159)	(0.0995)
5-star hotel	0.759***	0.502**	0.855***
	(0.114)	(0.229)	(0.124)
Average number of floors	-0.00527	-0.466	0.483**
	(0.202)	(0.317)	(0.194)
High number of floors	0.261	-0.260	0.755***
	(0.212)	(0.345)	(0.200)
Very high number of floors	0.258	-0.240	0.756***
	(0.268)	(0.511)	(0.288)
whether the property is close to sea, canal, river, or lake	0.0378	-0.0805	0.121
	(0.0802)	(0.163)	(0.0995)
Average number of keys	0.754***	0.842***	0.787***
	(0.104)	(0.137)	(0.132)
High number of keys	1.261***	1.231***	1.299***
	(0.121)	(0.257)	(0.142)
Very high number of keys	1.687***	0.133	1.706***
	(0.162)	(0.302)	(0.174)
Constant	12.68***	13.02***	12.21***
	(0.592)	(1.105)	(0.632)
Observations	333	117	216
Adjusted R-squared	0.501	0.363	0.545

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Dependent variable is log of inflation-adjusted transaction price. The reference category includes 3-star hotel for variable star rating of the hotel, low number of floors for categorical variable related to number of floors per hotel, is not close to water for variable whether is close to water, low number of rooms for categorical variable related to number of rooms per hotel, pre COVID for variable whether the transaction is during COVID, least touristic for categorical variable related to annual number of tourists. The star sign (*) among the variables represents the interaction between two variables. All models include constant term.

Table 4: a pooled OLS model in case of including city-specific dummy variables, and two separate models for branded and independent hotels

VARIABLES	(1) Pooled model	(2) Independent	(3) Branded
Whether the transaction is during the COVID-19 pandemic	-0.372	-0.283	0.0763
	(0.308)	(0.302)	(0.342)
the location rating of the hotel	0.507***	0.570***	0.480***
	(0.0680)	(0.146)	(0.0828)
4-star hotel	0.169*	-0.0975	0.258**
	(0.0905)	(0.212)	(0.108)
5-star hotel	0.645***	0.549*	0.771***
	(0.111)	(0.292)	(0.134)
Average number of floors	-0.0179	-0.396	0.468
	(0.205)	(0.349)	(0.296)
High number of floors	0.229	-0.265	0.706**
	(0.209)	(0.406)	(0.292)
Very high number of floors	0.390	0.286	0.980***

	(0.237)	(0.576)	(0.341)
whether the property is close to sea, canal, river, or lake	0.145*	-0.0895	0.215**
	(0.0802)	(0.208)	(0.0954)
Average number of keys	0.784***	0.933***	0.856***
	(0.122)	(0.185)	(0.167)
High number of keys	1.427***	1.487***	1.485***
	(0.133)	(0.278)	(0.183)
Very high number of keys	1.798***	1.645***	1.851***
	(0.146)	(0.319)	(0.195)
Constant	11.55***	11.62***	11.02***
	(0.663)	(1.302)	(0.797)
Observations	333	117	216
Adjusted R-squared	0.589	0.423	0.630

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Dependent variable is log of inflation-adjusted transaction price. The reference category includes 3-star hotel for variable star rating of the hotel, low number of floors for categorical variable related to number of floors per hotel, is not close to water for variable whether is close to water, low number of rooms for categorical variable related to number of rooms per hotel, pre COVID for variable whether the transaction is during COVID, Amsterdam for variable city. The 23 city-specific dummy variables and their interaction terms with dummy variable COVID are not in the table (to save space), but are included in analysis. The star sign (*) among the variables represents the interaction between two variables. All models include constant term.

The Chow test was performed separately for two models with city-specific dummy variables, and categorical dummy variables related to annual number of tourists (see appendix 27 and 28). According to the Chow test, the regression model for independent and branded hotels including categorical dummy variables in terms of annual number of tourists does not differ significantly at 5% significance. Similarly, there is no significance difference for hedonic regression model including city-specific dummy variables for independent and branded hotels at 5% significance level. At this rate, the test statistics for both models are below the relevant critical value.

5. DISCUSSION

The main independent variable for this study is a dummy variable whether the transaction took place during the COVID-19 pandemic. The study aims to show whether the prices changed significantly during the COVID-19 pandemic (not necessarily mean the change in price is due the COVID-19 pandemic). Previous research has proven this was the case for tourism company valuations (Nemec Rudež, 2022), but no similar research has been performed on hotel property valuations.

The decline in transaction prices during the COVID-19 pandemic was found to not be significant at the 5% significance level when including either city-specific dummy variables, or categorical dummy variables related to annual number of tourists. The findings do not align with research by Nemec Rudež (2022) which show a significant downward association during the COVID-19 pandemic, only then for stocks of tourism-related companies. The Hilton and Accor hotel groups also show this significant downward move (Nemec Rudež, 2022). On the other hand, the decrease in price aligns with Singh's (2020) theory that hotels in distress conditions have lower valuations. Yet, also in this case the downward move due to the distress of the COVID-19 pandemic cannot be confirmed with any certainty as the results were not statistically significant. This may be due to the whole market experiencing distress rather than an individual hotel. Individual hotels are benchmarked against the whole market. The whole market is not as easily affected as is an individual hotel.

Likewise, it is surprising to find insignificant change in hotel sale prices during the COVID-19 pandemic given the fact that the hotel industry has been hit hard by the COVID-19 pandemic in terms of revenue. The demand for hotel rooms showed a significant downturn with a bleaker outlook for the market. Moreover, relatively small number of hotel transactions took place during the COVID-19 pandemic (compared to pre COVID) according to the sample data for the current research (see figure 2) which might cause a significant price change in hotel properties. However, according to Evans (2004) the residential attachment, politics, economy, society, land ownership rules, land banking and availability, and problem of contiguity are all issues which affects price of land. These factors could indeed influence land price, and as a result, the insignificant change in hotel sale prices could be justified (by having effect in opposite direction of what the rule of supply and demand have, so that they compensate each other and at the end, the result is insignificant).

The independent variables chosen for this study are mainly based on the choice of variables in the study by Roubi (2015) which looked at constructing a transaction-based hotel price index for Europe. Variables included are stars of the hotel, chain affiliation (branded or not), sales price, time of sale and location. Another selected variable was suggested in the study by Roubi (2015), but not included there. This is the number of floors. Therefore, it was decided to add this variable to this study. Additionally, the source suggested number of tourists as a variable, as this helps take into account aggregate tourist demand (Roubi, 2015). How close the hotel is to the water (river, canal, lake or sea) has also been identified as an independent variable. Finally, the number of keys (hotel rooms) has been added as an independent variable. This was also included as a variable in a hedonic pricing model for hotels in Chicago (Valentin & O'Neill, 2019). In that study a very strong correlation (0.807) between the number of keys and price is shown.

The interaction terms for cities allow for cross-city comparison causing a researcher to identify the price trend per city during the COVID-19 pandemic compared to pre COVID-19. At this rate, a comparison of cities conveyed that Stockholm and Munich properties show negative growth when compared to Amsterdam. These cities responded worse during the pandemic as far as the hotel transaction prices are concerned. In other cities the outlook was better than in Amsterdam. In other words, hotel property prices were hit harder in some cities than others. This may be explained by the measures that were in place in different countries. However, further research would be needed on how these differences came about.

The cities are then subdivided into the categories least touristic, not so touristic, quite touristic and most touristic. This classification allows to strengthen the difference in price change among cities by identifying the price trend during the COVID-19 pandemic (compared to before) based on city characteristics. In this case, only in the not so touristic category was the change in transaction prices significant compared to the one for least touristic cities at the 5% significance level. This implies that as cities reach a certain level of popularity with tourists, the value of hotel properties becomes more resilient to the COVID-19 pandemic. This somewhat aligns with the theory of Roubi (2015), which states the number of tourists needs to be taken into account when valuing a hotel. What it adds to this literature is that not only does it need to be taken into account in hotel valuation, but also as a factor that determines the resilience of its valuation during a crisis such as the COVID-19 pandemic. A few of the independent variables showed themselves to be statistically significant in the valuation of the hotels. These were the location, the star-rating and the number of keys.

Heterogeneity among chain hotels and independent hotels, as previously proven by Hollenbeck (2017) was not proven in the models. Chain hotels do not transact at a significantly higher price than independent hotels. A reason for this could be that independent hotels are bought by chain hotels. Additionally, it may be that the underlying property is valued rather than the hotel that occupies it. On the other hand, chain hotels could bring the promise of higher revenues as they can charge higher room rates, but this has not been reflected in the hotel property transactions.

This research has limitations that needs to be addressed. There could be more independent variables used in the model such as size of different types of rooms (standard room, double room, etc.), age of property, scale system for hotels (Economy, Midscale, Upper Midscale, Upscale, Upper Upscale, Luxury), total land area or total gross square feet of the hotel. The data regarding those variables are quite limited for the current research. Moreover, there are a few numbers of hotels for some cities. This might not be a good representative for hotel transaction prices for those cities. Lack of hotels for some cities also remove some interaction terms, because there is no transaction record before and during the COVID-19 pandemic for those cities (for the full detail see figure 2). In addition, the number of observations in the whole sample is quite limited (333 transaction records) leading to inconsistency in results (the sample does not represent the whole population which are all hotel transactions in Europe). Besides, there are very few aparthotels in the data resulting in omitting the further classification of hotels and aparthotels.

Finally, there is a scope for future research in finding the association of the COVID-19 pandemic with hotel transaction prices. In this regard, it is possible to include other independent variables such as the type of hotel in terms of location (whether it is resort, airport hotel, interstate hotel, etc.) to strengthen the result. Furthermore, the model could have more interaction terms between the main regressor, which is the COVID-19 variable in this study, and other independent variables. Next, hotel-specific indicators can be used in the research to estimate the hotel-related price index on a macro level. The estimated model is especially helpful in order to predict the price index in the future. Lastly, this study contains 333 individual transaction records with quite limited number of cities. This might lead to biasedness in results. Hence, there is a potential for further research in this area with considerably more data in hand.

6. CONCLUSION

This article attempts to answer three main research questions based on the research conducted among hotel sale prices in major cities in Europe. The relevant trend regarding hotel transaction prices (how the prices change during the COVID-19 pandemic compared to before) for each question is specified based on two models: including city-specific dummy variables, and including categorical dummy variables in terms of annual number of tourists per city in 2019. The three questions are: 1) to investigate the price trend during the COVID-19 pandemic based on two models 2) to investigate the price trend based on each specific city, or based on each city characteristics related to how touristic the city is (including interaction terms for both models) 3) to detect if there is any heterogeneity in the model between independent and branded hotels using two models with interaction terms.

The results reveal that there is an insignificant difference in hotel values before and during the COVID-19 pandemic. Moreover, the hotel transaction prices differ dramatically for some major European cities before and during the pandemic with Amsterdam as a reference category (this trend also applies when utilizing categorical variables regarding total number of tourists instead of city-specific variables with least touristic as a reference category). Likewise, the results suggest no significant heterogeneity in hotel values as far as the type of hotel is concerned (no significant difference in prices between branded and independent hotels).

Acquiring knowledge about the association of the COVID-19 pandemic with hotel transaction prices could benefit investors and developers greatly. In this regard, they have a deep insight about what the hotel market reacts in case of any major pandemic in the future so that they can exploit the market in several ways: First, investors and developers can purchase a relatively low-priced asset at the beginning of any crisis with the anticipation of price appreciation and high returns post crisis. The amount that investors and developers pay for the property could be even lower than expected. The reason is that some hotel owners run out of cash due to low vacancy rate of hotels and they are willing to even sell the asset at lower price than market value. Secondly, they can efficiently diversify the investment portfolio when knowing about the effect of any major pandemic based on each specific city. In this regard, their investment portfolio contains hotel properties in cities which are less vulnerable to pandemic or any other crisis.

This research has some limitations to be addressed and there is a scope for future research in this area. At this rate, there could be more independent variables as well as more interaction terms between them and the COVID-19 dummy variable to deliver more accurate results. In addition, there are quite few observations per city which might not be representative of the hotel market in that specific city. This issue also holds for the whole number of observations in the sample data (333 hotel transaction prices) which is quite limited and might not be representative of the hotel market in Europe. Last but not least, there could be use of hotel-specific indicators rather than individual independent variables to yield a price index on a macro level in order to give a comprehensive information about the hotel market.

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REFERENCES

Agmasiparn, C. (2014). Hedonic pricing analysis of hotel room rates in Bangkok. *ABAC Journal*, 34(2), pp. 1-17.

Altexsoft (2021). *RevPAR, Occupancy Rate, ADR, and Other Hotel Metrics: How to Evaluate Your Property's Performance*. Retrieved on May 26, 2021 from https://www.altexsoft.com/blog/revpar-occupancy-rate-adr-hotel-metrics/.

Boston Hospitality Review (2021). *COVID-19's Impact on the U.S. Hotel Sale Transaction Market*. Retrieved on April, 2021 from https://www.bu.edu/bhr/2021/03/25/covid-19s-impact-on-the-u-s-hotel-sale-transaction-market/.

Camilleri, D. (2015). Hotel valuations earning multipliers – terminal value: Malta's scenario. *JPIF*, 33(3), pp.212–241.

Dolnicar, S., Zare, S. (2020). COVID19 and Airbnb – Disrupting the Disruptor. Retrieved on May, 2022 from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7242963/.

European Center for Disease Prevention and Control. *Data on country response measures to COVID-19*. Retrieved on August 25, 2022 from https://www.ecdc.europa.eu/en/publications-data/download-data-response-measures-covid-19.

Evans, W. (2004) *Economics, Real Estate and the Supply of Land*. John Wiley & Sons, Incorporated.

Hoesli, M. & Malle, R. (2021) *Commercial real estate prices and Covid-19*. Geneva: Swiss Finance Institute.

Hollenbeck, B. (2017. The economic advantages of chain organization. *The Rand Journal of Economics*, 48(2), pp. 1103-1135.

Hospitalitynet (2021). *What Drove Hotel Values to Decline in 2020?. Retrieved on March 4*, 2021 from https://www.hospitalitynet.org/opinion/4103275.html.

Hung, W. T., Shang, J. K. and Wang, F. C. (2010). Pricing determinants in the hotel industry: Quantile regression analysis. *International Journal of Hospitality Management*, 29(3), pp. 378–384.

HVS (2020). *The Impact of COVID-19 on Hotel Values*. Retrieved on April 10, 2020 from https://www.hvs.com/article/8745-the-impact-of-covid-19-on-hotel-values.

Lee, S., O'Neill, J. & McGinley, S. (2016). Effects of economic conditions and other factors on hotel sale prices. *International journal of contemporary hospitality management*, 28(10), pp. 2267-2284.

Nemec Rudež, H. (2022). The impact of the Covid-19 pandemic on investor sentiments: evidence from 12 selected major tourism-related companies. *University of Primorska*, 20(1). pp. 43-58.

New England Hotel Realty (NEHR) (2018). *Average selling price per room for hotel sales prices on the upswing- by Shane Vahey*. Retrieved on July 20, 2018 from https://nerej.com/average-selling-price-per-room-for-hotel-sales-prices-on-the-upswing-by-shane-vahey.

Peric, B. S., Smiljanic, A. R. & Kezic, I. (2022). Role of tourism and hotel accommodation in house prices. *Annals of Tourism Research Empirical Insights*, 3(1).

Roubi, S. (2015). Towards a transaction-based hotel property price index for Europe. *Journal of Property Investment & Finance*, 33(3), pp. 256-281.

Singh, A. (2020). Estimating the Foreclosure Discount in Financially Distressed Hotels. *Cornell Hospitality Quarterly*, 62(4), pp. 409-425.

Thrane, C. Examining the determinants of room rates for hotels in capital cities: The Oslo experience. *Journal of Revenue and Pricing Management*, 5(4), pp. 315-323.

Valentin, M. & W. O'Neill, J. (2018). The Value of Location for Urban Hotels. *Cornell Hospitality Quarterly*, 60(1), pp. 5-24.

Zenker, S. and Kock, F. (2020). The coronavirus pandemic – A critical discussion of a tourism research agenda. *Tourism Management*, 81.

APPENDIX A: NOTATIONAL GLOSSARY

Empirical model (1)	
$\beta, \alpha, \gamma, \theta, and\ \omega$	Parameters to be estimated
i	Hotel property i=1,…, 333
m	Different dummy variables for star ratings. M=1, 2 (four and five-star hotels)
o	Different categorical dummy variables related to number of keys per hotel. o= 1, 2, and 3 (average number of keys, high number of keys, and very high number of keys)
p	Different categorical dummy variables related to number of floors per hotel. P=1, 2, and 3 (average number of floors, high number of floors, and very high number of floors)
r	Different dummy variables for different cities. r=1,…, 23

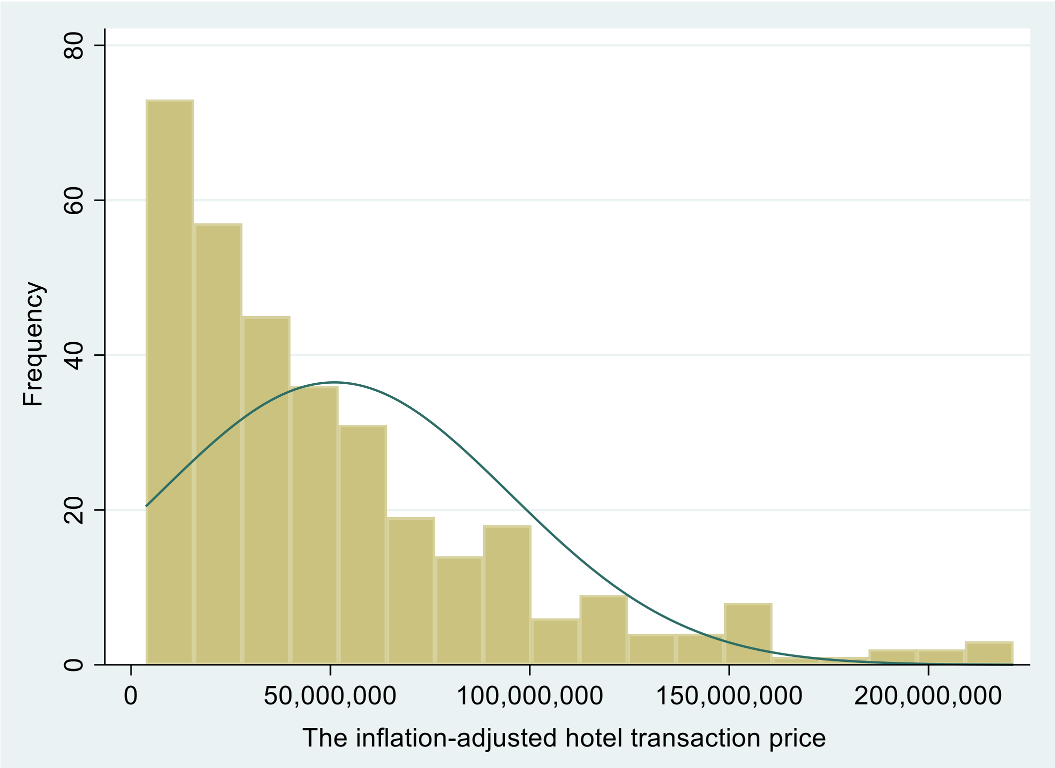
FIGURES & TABLES

Appendix 1: *the details of the cleaning process of the initial acquired data*

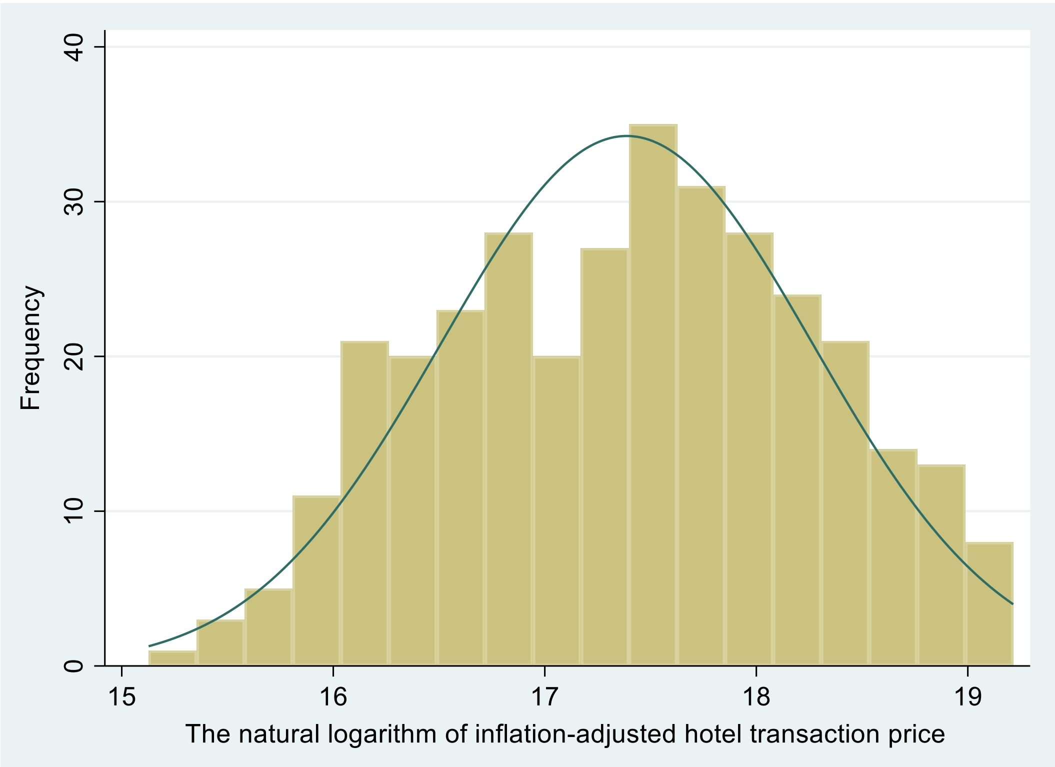
Details of the data cleaning process	The number of observations
The number of observations for raw data at the beginning	**382**
Dropping the outliers if they lie outside two standard deviations from the mean, drop if: 1) inflation adjusted price **is bigger than 229,424,647** 2) location rating is **lower than 7.7** 3) number of floors is **higher than 16** 4) number of rooms is **lower than 493**	47 (deleted)
Dropping two transaction records due to influential observations identified with the regcheck command in Stata: **one for Oslo & one for Antwerp** (So, nothing for Oslo and one left for Antwerp afterwards)	2 (deleted)
The finalized number of observations after the cleaning process	**333**

Appendix 2: *The inflation rates from 2014 to 2022 for some European countries*

Country	2014	2015	2016	2017	2018	2019	2020	2021	2022
Netherlands	0.32%	0.22%	0.11%	1.29%	1.60%	2.67%	1.12%	1.94%	1.70%
Belgium	0.49%	0.62%	1.77%	2.22%	2.31%	1.25%	0.43%	2.36%	2.23%
Spain	-0.15%	-0.50%	-0.20%	1.96%	1.68%	0.70%	-0.32%	2.24%	1.65%
Germany	0.76%	0.67%	0.37%	1.70%	1.94%	1.35%	0.37%	2.88%	1.51%
UK	1.46%	0.04%	0.66%	2.68%	2.48%	1.79%	0.85%	2.19%	2.62%
Denmark	0.35%	0.23%	0.02%	1.06%	0.71%	0.73%	0.33%	1.40%	1.56%
Ireland	0.30%	-0.03%	-0.18%	0.26%	0.71%	0.86%	-0.46%	1.90%	1.90%
Portugal	-0.16%	0.51%	0.64%	1.56%	1.17%	0.30%	-0.12%	0.89%	1.16%
Italy	0.23%	0.11%	-0.05%	1.33%	1.24%	0.63%	-0.15%	1.66%	1.79%
Norway	2.04%	2.17%	3.55%	1.88%	2.77%	2.17%	1.29%	2.60%	2.00%
France	0.61%	0.09%	0.31%	1.17%	2.10%	1.20%	0.53%	1.96%	1.62%
Sweden	0.21%	0.70%	1.14%	1.87%	2.04%	1.72%	0.66%	2.04%	1.60%
Austria	1.47%	0.81%	0.97%	2.23%	2.12%	1.49%	1.39%	2.45%	2.45%



Appendix 3: *the graph related to the distribution of the inflation-adjusted hotel transaction price*



Appendix 4: *the graph related to the distribution of the natural log of the inflation-adjusted hotel transaction price*

Appendix 5: *List of cities and the number of hotels per city in the sample data*

City	Number of hotels per city
Amsterdam	32
Antwerp	1
Barcelona	19
Berlin	15
Birmingham	3
Brussels	13
Copenhagen	2
Dublin	20
Edinburgh	3
Frankfurt	9
Hamburg	8
Lisbon	4
London	62
Madrid	33
Manchester	4
Milan	11
Munich	16
Paris	39
Rome	13
Rotterdam	4
Stockholm	3
The Hague	8
Utrecht	3
Vienna	8

Appendix 6: *the list of variables appeared in data analysis in Excel*

Name of the variable shown in data analysis	Definition
ID	The identification of the hotel property
Year	The transaction year of the hotel
Tourists	The number of tourists per city in 2019
Keys	The number of rooms per hotel
priceinf	The inflation-adjusted transaction price (in Euro)
Location	The location rating assessed by guests
Stars	The number of hotel stars
Floors	Total number of floors per hotel excluding ground floor
city	The city in which the hotel property is located
wheth_branded	Whether the hotel is branded (or independent)
Close_to_water	Whether the property is close to lake, river, canal, or sea
ln_price	The natural logarithm of inflation-adjusted transaction price
tourist_level	The categorical variable to indicate annual number of tourists
during_COVID	Whether the transaction is during the COVID-19 pandemic
keys_level	The categorical variable to indicate number of rooms per hotel
floors_level	The categorical variable to indicate number of floors per hotel

Appendix 7: *the ANOVA analysis between the natural logarithm of inflation-adjusted transaction price and different variables (final outcome is P-value)*

The variable	P-value
Number of stars	0*
Categorical variable related to number of floors per hotel	0*
City in which the hotel is located	0.0009*
Whether the transaction is during the COVID-19	0.3862
The location rating of the hotel assessed by guests	0*
Categorical variable related to number of rooms per hotel	0*
Categorical variable related to annual number of tourists in 2019	0.0031*

Note: there are three, four, and five-star hotels in the analysis. The different categories of hotels in terms of number of floors include: low number of floors, average number of floors, high number of floors, and very high number of floors. There are 24 cities in the analysis. The location rating ranges between 0 and 10. The four categories of hotels in terms of number of rooms are low number of keys, average number of keys, high number of keys, and very high number of keys. The four categories of cities in terms of annual number of tourists are least touristic, not so touristic, quite touristic, and most touristic. The (*) next to P-value indicates that the natural logarithm of inflation-adjusted transaction price varies significantly (5% significance level) among different amounts of a specific variable.

Appendix 8: *the variation inflation factor (VIF) results for both models including city-specific variables, and categorical variables regarding annual number of tourists*

Variable	VIF for the model including City-specific variables	VIF for the model including categorical variables related to annual number of tourists
Number of hotel stars	1.16	1.18
The location rating by guests	1.17	1.17
The category of hotel in terms of number of keys	1.16	1.15
The category of hotel in terms of number of floors	1.10	1.10
Whether the hotel is close to major canal, lake, river, or sea	1.07	1.07
Whether the transaction is during the COVID-19 pandemic	1.01	1.01
City in which the hotel is located	1.04	-
The category of city in which the hotel is located in terms of annual number of tourists in 2019	-	1.06
Mean VIF	**1.10**	**1.11**

Note: Number of hotel stars range between 3 and 5 stars. The location rating by guests is measured from 1 to 10. There are four categories for hotels in terms of number of keys: low number of keys, average number of keys, high number of keys, and very high number of keys. The same classification applies for hotels in terms of number of floors: low number of floors, average number of floors, high number of floors, and very high number of floors. There are 24 cities in which the hotel properties are located. To see how touristic the city is, there are four categories: least touristic, not so touristic, quite touristic, and most touristic.

Appendix 9: *Pairwise correlations (including city-specific variable)*

Variables	Ln (price)	Location	Stars	Floors level	Close to water	During COVID	Keys level	City
Ln (price)	1.000							
Location	0.260*	1.000						
Stars	0.445*	0.291*	1.000					
Floors level	0.273*	-0.038	0.110*	1.000				
Close to water	0.066	0.158*	0.000	-0.109*	1.000			
During COVID	-0.048	-0.006	-0.011	0.039	-0.034	1.000		
Keys level	0.533*	-0.130*	0.164*	0.256*	0.060	-0.001	1.000	
City	-0.080	0.009	0.038	0.009	-0.125*	-0.078	-0.131*	1.000

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

Note: ln (price) is the natural logarithm of hotel transaction prices, location is the location rating provided by guests, stars is the star rating system for hotels, floors level is the category of the property in terms of number of floors, close to water is dummy variable whether the property is close to river, lake, sea, or canal, during COVID is dummy variable whether the transaction is during the COVID, keys level is the category of the property in terms of number of rooms, city is the city in which the hotel is located.

Appendix 10: *Pairwise correlations (including categorical variable related to annual number of tourists)*

Variables	Ln (price)	Location	Stars	Floors level	Close to water	During COVID	Keys level	Tourist level
Ln (price)	1.000							
Location	0.260*	1.000						
Stars	0.445*	0.291*	1.000					
Floors level	0.273*	-0.038	0.110*	1.000				
Close to water	0.066	0.158*	0.000	-0.109*	1.000			
During COVID	-0.048	-0.006	-0.011	0.039	-0.034	1.000		
Keys level	0.533*	-0.130*	0.164*	0.256*	0.060	-0.001	1.000	
Tourist level	-0.064	-0.026	-0.160*	-0.035	-0.129*	-0.089	-0.126*	1.000

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

Note: ln (price) is the natural logarithm of hotel transaction prices, location is the location rating provided by guests, stars is the star rating system for hotels, floors level is the category of the property in terms of number of floors, close to water is dummy variable whether the property is close to river, lake, sea, or canal, during COVID is dummy variable whether the transaction is during the COVID, keys level is the category of the property in terms of number of rooms, city is the city in which the hotel is located.

Appendix 11*: regcheck command in Stata statistical software for the regression model with categorical dummy variables related to annual number of tourists without interaction terms with COVID-19 dummy variable*

```
+-----------------------------------------------------------------------------------------+
   Regression assumptions:                |  Test:                              We seek values
|-----------------------------------------------------------------------------------------|
 1) no heterokedasticity problem          |  Breusch-Pagan hettest                > 0.05
                                          |  Chi2(1): 1.014
                                          |  p-value: 0.314
|-----------------------------------------------------------------------------------------|
 2) no multicollinearity problem          |  Variance inflation factor            < 5.00
                                          |  during_COVID : 1.04
                                          |  2.keys_level : 1.24
                                          |  3.keys_level : 1.80
                                          |  1.tourist_level : 1.92
                                          |  2.tourist_level : 5.54
                                          |  3.tourist_level : 5.44
                                          |  Location : 1.68
                                          |  4.Stars : 1.20
                                          |  5.Stars : 2.89
                                          |  1.floors_level : 2.94
                                          |  2.floors_level : 1.69
                                          |  3.floors_level : 1.59
                                          |  close_to_water : 1.58
                                          |  1.keys_level : 1.46
|-----------------------------------------------------------------------------------------|
 3) residuals are normally distributed    |  Shapiro-Wilk W normality test        > 0.01
                                          |  z: 1.280
                                          |  p-value: 0.100
|-----------------------------------------------------------------------------------------|
 4) no specification problem              |  Linktest                             > 0.05
                                          |  t: -0.881
                                          |  p-value: 0.379
|-----------------------------------------------------------------------------------------|
 5) appropriate functional form           |  Test for appropriate functional form > 0.05
                                          |  F(3,315):1.837
                                          |  p-value: 0.140
|-----------------------------------------------------------------------------------------|
 6) no influential observations           |  Cook's distance                      < 1.00
                                          |  no distance is above the cutoff
+-----------------------------------------------------------------------------------------+
```

Appendix 12*: regcheck command in Stata statistical software for the regression model with categorical dummy variables related to annual number of tourists with interaction terms with COVID-19 dummy variable*

```
+-------------------------------------------------------------------------------------------------------------+
   Regression assumptions:                          |  Test:                                      We seek values
|-------------------------------------------------------------------------------------------------------------|
 1) no heterokedasticity problem                    |  Breusch-Pagan hettest                        > 0.05
                                                    |  Chi2(1): 0.250
                                                    |  p-value: 0.617
|-------------------------------------------------------------------------------------------------------------|
 2) no multicollinearity problem                    |  Variance inflation factor                    < 5.00
                                                    |  Location : 1.25
                                                    |  3.keys_level : 1.83
                                                    |  1.during_COVID : 1.95
                                                    |  1.tourist_level : 5.60
                                                    |  2.tourist_level : 5.50
                                                    |  3.tourist_level : 1.70
                                                    |  1.during_COVID#1.tourist_level : 1.21
                                                    |  1.during_COVID#2.tourist_level : 2.92
                                                    |  1.during_COVID#3.tourist_level : 2.97
                                                    |  4.Stars : 1.71
                                                    |  5.Stars : 2.98
                                                    |  1.floors_level : 2.08
                                                    |  2.floors_level : 1.98
                                                    |  3.floors_level : 1.85
                                                    |  close_to_water : 2.26
                                                    |  1.keys_level : 1.94
                                                    |  2.keys_level : 1.89
|-------------------------------------------------------------------------------------------------------------|
 3) residuals are normally distributed              |  Shapiro-Wilk W normality test                > 0.01
                                                    |  z: 0.572
                                                    |  p-value: 0.284
|-------------------------------------------------------------------------------------------------------------|
 4) no specification problem                        |  Linktest                                     > 0.05
                                                    |  t: -0.607
                                                    |  p-value: 0.544
|-------------------------------------------------------------------------------------------------------------|
 5) appropriate functional form                     |  Test for appropriate functional form         > 0.05
                                                    |  F(3,312):1.026
                                                    |  p-value: 0.381
|-------------------------------------------------------------------------------------------------------------|
 6) no influential observations                     |  Cook's distance                              < 1.00
                                                    |  no distance is above the cutoff
+-------------------------------------------------------------------------------------------------------------+
```

Appendix 13: *regcheck command in Stata statistical software for the regression model with city-specific dummy variables without interaction terms with COVID-19 dummy variable*

```
+-------------------------------------------------------------------------------------------------------------+
   Regression assumptions:                         |  Test:                                        We seek values
|-------------------------------------------------------------------------------------------------------------|
  1) no heterokedasticity problem                  |  Breusch-Pagan hettest                          > 0.05
                                                   |  Chi2(1): 0.259
                                                   |  p-value: 0.611
|-------------------------------------------------------------------------------------------------------------|
  2) no multicollinearity problem                  |  Variance inflation factor                      < 5.00
                                                   |  during_COVID : 1.33
                                                   |  2.keys_level : 1.44
                                                   |  3.keys_level : 1.88
                                                   |  2.city : 2.02
                                                   |  3.city : 6.26
                                                   |  4.city : 6.18
                                                   |  5.city : 1.88
                                                   |  6.city : 1.51
                                                   |  7.city : 3.15
                                                   |  8.city : 3.31
                                                   |  9.city : 1.92
                                                   |  Location : 1.13
                                                   |  10.city : 1.79
                                                   |  11.city : 1.47
                                                   |  12.city : 1.18
                                                   |  13.city : 1.49
                                                   |  14.city : 1.14
                                                   |  15.city : 1.63
                                                   |  16.city : 1.19
                                                   |  17.city : 1.37
                                                   |  19.city : 1.32
                                                   |  21.city : 1.16
                                                   |  4.Stars : 2.69
                                                   |  22.city : 2.22
                                                   |  23.city : 1.26
                                                   |  24.city : 1.41
                                                   |  25.city : 1.58
                                                   |  26.city : 2.25
                                                   |  5.Stars : 1.44
                                                   |  1.floors_level : 1.14
                                                   |  2.floors_level : 1.14
                                                   |  3.floors_level : 1.29
                                                   |  close_to_water : 1.13
                                                   |  1.keys_level : 1.30
|-------------------------------------------------------------------------------------------------------------|
  3) residuals are normally distributed            |  Shapiro-Wilk W normality test                  > 0.01
                                                   |  z: 1.406
                                                   |  p-value: 0.080
|-------------------------------------------------------------------------------------------------------------|
  4) no specification problem                      |  Linktest                                       > 0.05
                                                   |  t: 0.454
                                                   |  p-value: 0.650
|-------------------------------------------------------------------------------------------------------------|
  5) appropriate functional form                   |  Test for appropriate functional form           > 0.05
                                                   |  F(3,295):2.475
                                                   |  p-value: 0.062
|-------------------------------------------------------------------------------------------------------------|
  6) no influential observations                   |  Cook's distance                                < 1.00
                                                   |  no distance is above the cutoff
+-------------------------------------------------------------------------------------------------------------+
```

Appendix 14: *regcheck command in Stata statistical software for the regression model with city-specific dummy variables with interaction terms with COVID-19 dummy variable*

```
+---------------------------------------------------------------------------------------------------------+
   Regression assumptions:                     |  Test:                                       We seek values
|---------------------------------------------------------------------------------------------------------|
 1) no heterokedasticity problem               |  Breusch-Pagan hettest                          > 0.05
                                               |  Chi2(1): 0.377
                                               |  p-value: 0.539
|---------------------------------------------------------------------------------------------------------|
 2) no multicollinearity problem               |  Variance inflation factor                      < 5.00
                                               |  Location : 1.49
                                               |  3.keys_level : 2.02
                                               |  1.during_COVID : 2.13
                                               |  2.city : 6.33
                                               |  3.city : 6.25
                                               |  4.city : 1.93
                                               |  5.city : 1.55
                                               |  6.city : 3.32
                                               |  7.city : 3.48
                                               |  8.city : 2.02
                                               |  9.city : 17.45
                                               |  4.Stars : 1.31
                                               |  10.city : 3.43
                                               |  11.city : 1.67
                                               |  12.city : 1.82
                                               |  13.city : 1.71
                                               |  14.city : 1.58
                                               |  15.city : 1.93
                                               |  16.city : 1.82
                                               |  17.city : 1.52
                                               |  19.city : 1.34
                                               |  21.city : 1.53
                                               |  5.Stars : 3.10
                                               |  22.city : 2.44
                                               |  23.city : 2.12
                                               |  24.city : 1.67
                                               |  25.city : 1.78
                                               |  26.city : 2.72
                                               |  1.during_COVID#3.city : 1.65
                                               |  1.during_COVID#4.city : 1.15
                                               |  1.during_COVID#6.city : 3.13
                                               |  1.during_COVID#8.city : 1.89
                                               |  1.during_COVID#10.city : 1.15
                                               |  1.floors_level : 1.32
                                               |  1.during_COVID#12.city : 6.20
                                               |  1.during_COVID#13.city : 1.81
                                               |  1.during_COVID#14.city : 1.79
                                               |  1.during_COVID#16.city : 2.42
                                               |  1.during_COVID#17.city : 1.43
                                               |  1.during_COVID#19.city : 1.67
                                               |  1.during_COVID#21.city : 4.70
                                               |  1.during_COVID#23.city : 2.32
                                               |  1.during_COVID#24.city : 1.83
                                               |  2.floors_level : 1.75
                                               |  3.floors_level : 4.26
                                               |  close_to_water : 1.80
                                               |  1.keys_level : 3.67
                                               |  2.keys_level : 2.49
|---------------------------------------------------------------------------------------------------------|
 3) residuals are normally distributed         |  Shapiro-Wilk W normality test                  > 0.01
                                               |  z: 1.962
                                               |  p-value: 0.025
|---------------------------------------------------------------------------------------------------------|
 4) no specification problem                   |  Linktest                                       > 0.05
                                               |  t: 0.472
                                               |  p-value: 0.637
|---------------------------------------------------------------------------------------------------------|
 5) appropriate functional form                |  Test for appropriate functional form           > 0.05
                                               |  F(3,281):2.156
                                               |  p-value: 0.093
|---------------------------------------------------------------------------------------------------------|
 6) no influential observations                |  Cook's distance                                < 1.00
                                               |  no distance is above the cutoff
+---------------------------------------------------------------------------------------------------------+
```

Appendix 15: estimated coefficients along with robust standard errors for city-specific variables and interaction terms between them and COVID-19 variables for model 9 and 10 (in table 2)

VARIABLES	Model 9	Model 10
Antwerp	-0.227	0.0725
	(0.229)	(0.234)
Barcelona	0.154	0.0585
	(0.175)	(0.273)
Berlin	-0.0369	-0.118
	(0.162)	(0.182)
Birmingham	0.0112	0.332
	(0.601)	(0.626)
Brussels	-0.474***	-0.486***
	(0.168)	(0.180)
Copenhagen	-1.887***	-1.557***
	(0.143)	(0.204)
Dublin	0.340**	0.321**
	(0.145)	(0.155)
Edinburgh	-0.0199	0.309
	(0.372)	(0.403)
Frankfurt	0.237	0.138
	(0.169)	(0.171)
Hamburg	-0.365	-0.401
	(0.261)	(0.267)
Lisbon	-0.336	-0.514**
	(0.216)	(0.235)
London	0.435***	0.412**
	(0.140)	(0.159)
Madrid	-0.00642	-0.112
	(0.150)	(0.158)
Manchester	-0.354	-0.0321
	(0.244)	(0.284)
Milan	-0.142	-0.217
	(0.238)	(0.285)
Munich	0.557***	0.587***
	(0.163)	(0.170)
Paris	0.0676	0.0426
	(0.158)	(0.181)
Rome	0.319	0.285
	(0.221)	(0.257)
Rotterdam	-0.353	-0.388*
	(0.221)	(0.228)
Stockholm	-1.188***	-0.564***
	(0.334)	(0.148)
The Hague	-0.376	-0.434
	(0.233)	(0.287)
Utrecht	-0.326	-0.366
	(0.228)	(0.239)
Vienna	-0.228	-0.270*
	(0.152)	(0.161)
COVID-19 * Barcelona		0.468
		(0.366)
COVID-19 * Berlin		0.709**
		(0.282)
COVID-19 * Brussels		0.219
		(0.395)
COVID-19 * Dublin		0.267
		(0.358)
COVID-19 * Frankfurt		0.994***
		(0.246)
COVID-19 * Lisbon		0.877***
		(0.306)
COVID-19 * London		0.299
		(0.278)
COVID-19 * Madrid		0.966***
		(0.346)
COVID-19 * Milan		0.565

	(0.344)
COVID-19 * Munich	-0.127
	(0.328)
COVID-19 * Paris	0.298
	(0.353)
COVID-19 * Rome	0.365
	(0.365)
COVID-19 * Stockholm	-0.618**
	(0.302)
COVID-19 * The Hague	0.429
	(0.474)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: the cities represent the location of hotels. The reference category for cities is the city of Amsterdam. The COVID-19 variable demonstrates if the hotel transaction is during the pandemic. The (*) sign in variables indicates the interaction term between two variables. In model 10, there are 14 available cities (out of 23) which have interaction terms with the COVID-19 variable.

Appendix 16: *the t-test for the purpose of finding if the conditional mean of residuals for four different models is zero (by providing the 95% confidence interval)*

Model	**95% confidence interval**
The model including categorical dummy variables related to annual number of tourists without the interaction terms with COVID-19 dummy variable	**(-0.066, 0.066)**
The model including categorical dummy variables related to annual number of tourists with the interaction terms with COVID-19 dummy variable	**(-0.065, 0.065)**
The model including city-specific dummy variables without the interaction terms with COVID-19 dummy variable	**(-0.057, 0.057)**
The model including city-specific variables with the interaction terms with COVID-19 dummy variable	**(-0.056, 0.056)**

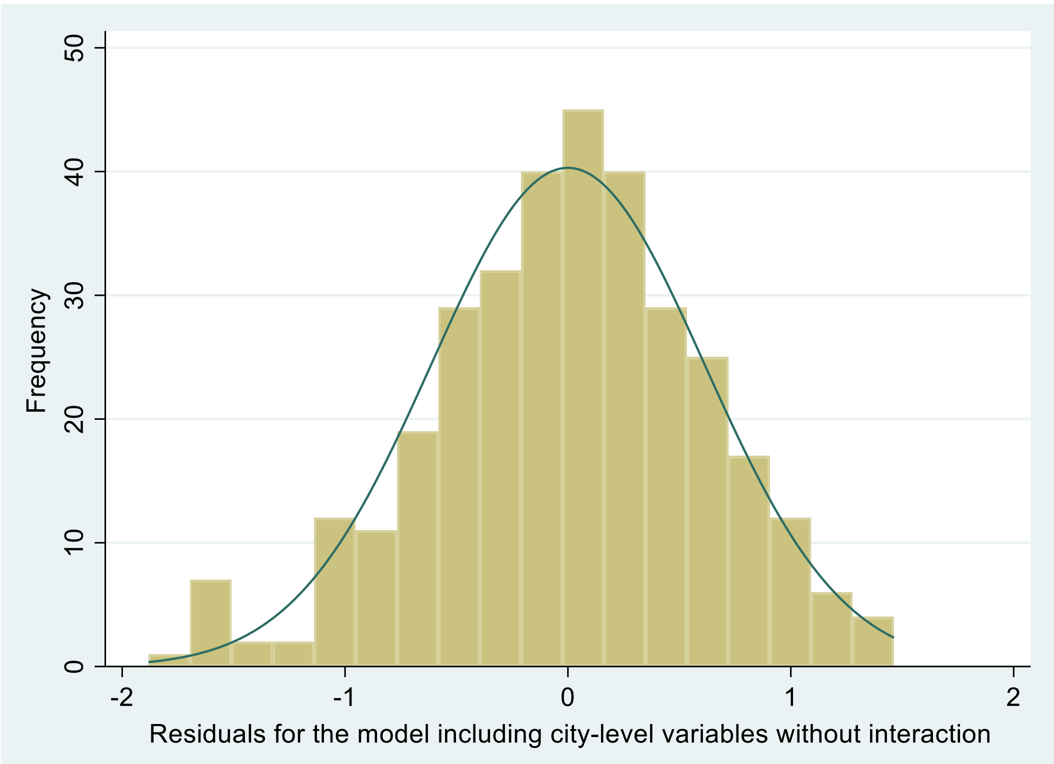
Appendix 17: *the Breusch-Pagan test regarding heteroskedasticity at 5% significance level for four different models (final outcome is P-value in the table)*

Model	**P-value**
The model including categorical dummy variables related to annual number of tourists without the interaction terms with COVID-19 dummy variable	0.31
The model including categorical dummy variables related to annual number of tourists with the interaction terms with COVID-19 dummy variable	0.62
The model including city-specific dummy variables without the interaction terms with COVID-19 dummy variable	0.61
The model including city-specific variables with the interaction terms with COVID-19 dummy variable	0.54

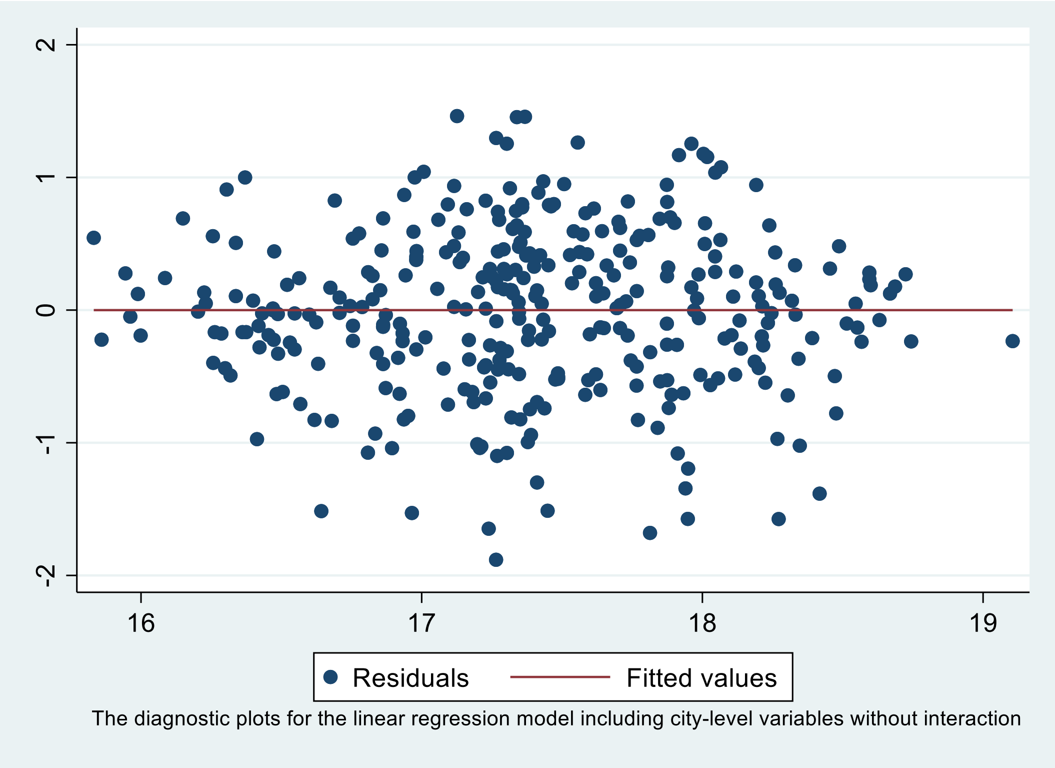
Appendix 18: *the joint significance test (F-test) at 5% significance level for four different models (two different models with city-specific dummy variables, and categorical dummy variables related to annual number of tourists as well as with their interaction terms with COVID-19 dummy variable)*

Model	P-value
The model including city-specific dummy variables without the interaction terms with COVID-19 dummy variable	0
The model including city-specific variables with the interaction terms with COVID-19 dummy variable	0
The model including categorical dummy variables related to annual number of tourists without the interaction terms with COVID-19 dummy variable	0
The model including categorical dummy variables related to annual number of tourists with the interaction terms with COVID-19 dummy variable	0

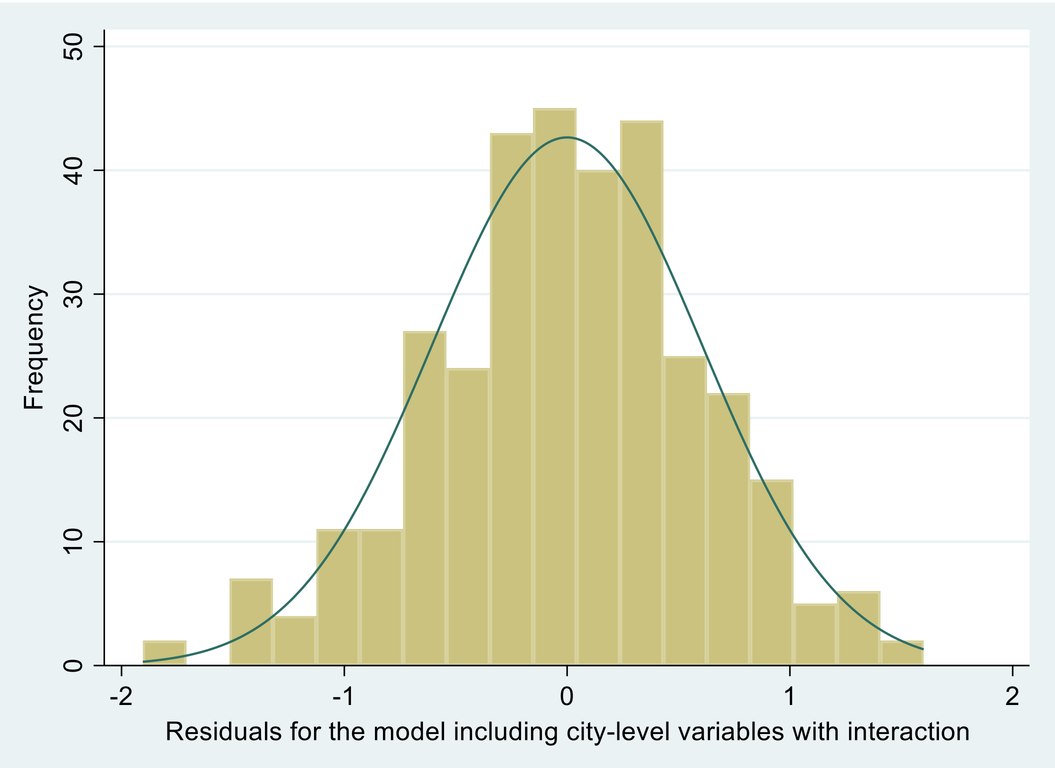
Note: There are 23 city-specific dummy variables with Amsterdam as a reference category. The COVID-19 dummy variable represents whether the hotel transaction is during the pandemic. There are 3 categorical dummy variables related to annual number of tourists including: not so touristic, quite touristic, and most touristic. The reference category in this case is least touristic.



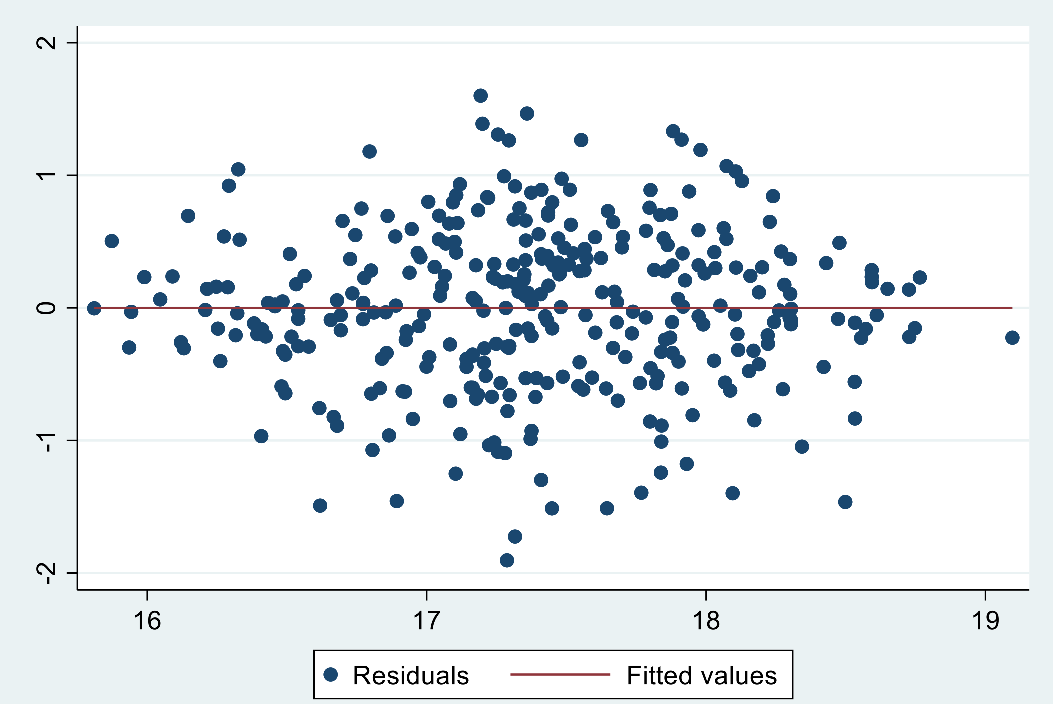
Appendix 19



Appendix 20

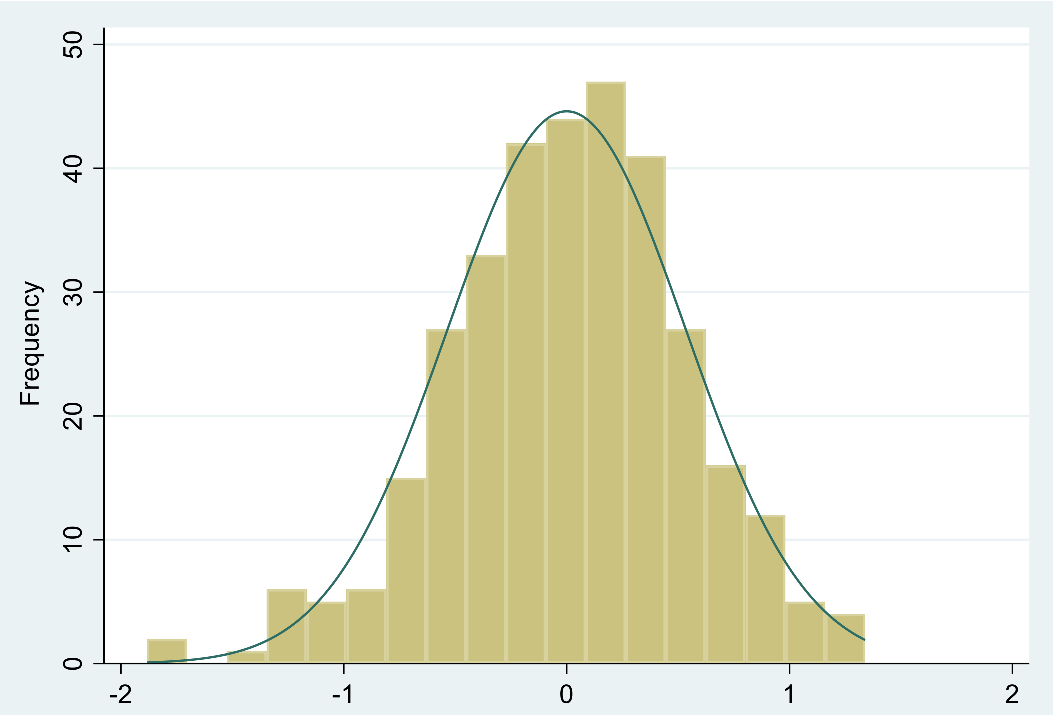


Appendix 21



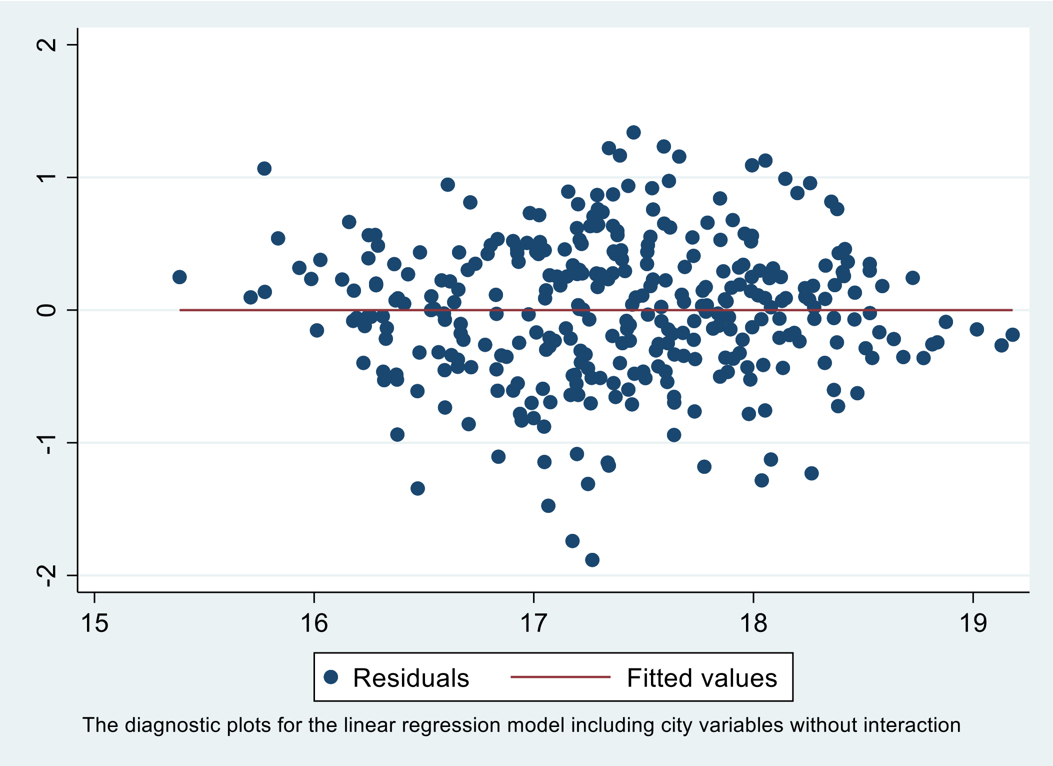
The diagnostic plots for the linear regression model including city-level variables with interaction

Appendix 22

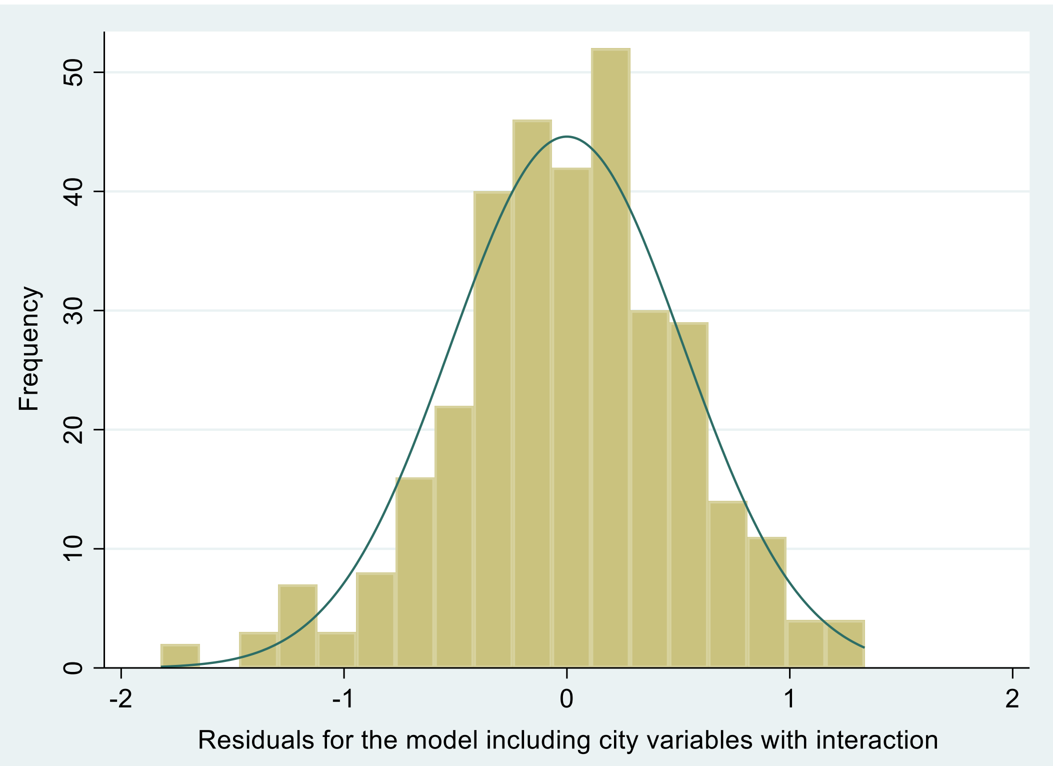


Residuals for the model including city variables without interaction

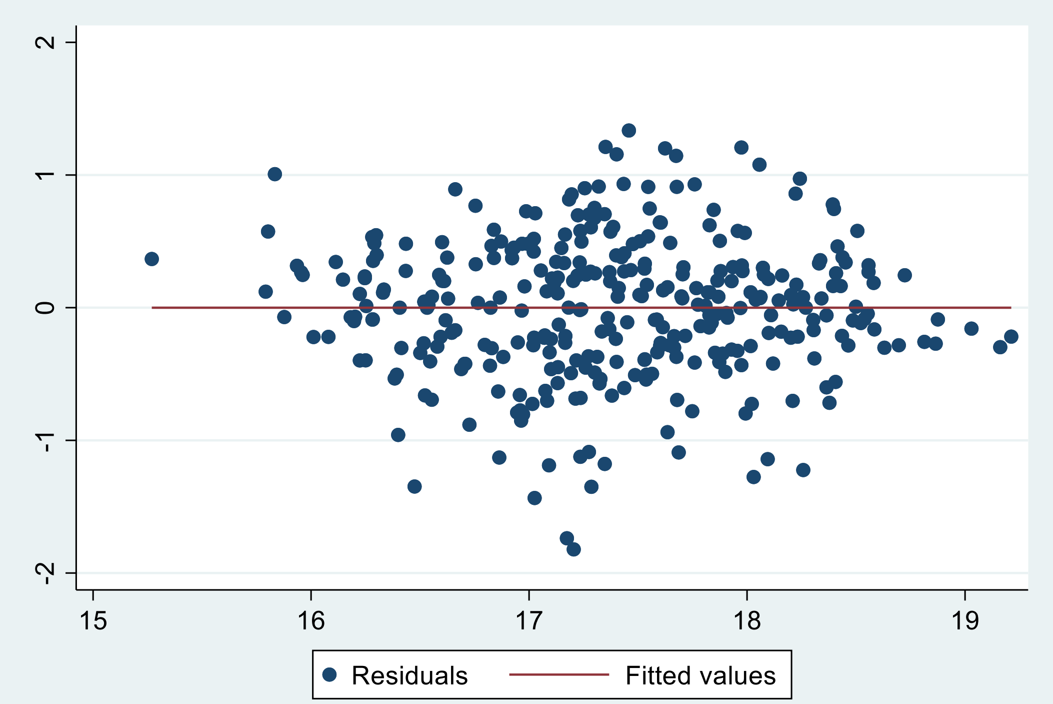
Appendix 23



Appendix 24



Appendix 25



The diagnostic plots for the linear regression model including city variables with interaction

Appendix 26

Appendix 27: *Chow test at 5% significance level including categorical dummy variables related to annual number of tourists for branded and independent hotels*

	Pooled model	**Independent**	**Branded**
SSR (Sum of the Squares of Residuals)	122	46	66
Number of estimated parameters (including the constant)	18		
Number of observations	333	117	216
Test statistic (Chow test)	1.47		
Critical value (at 5% significance level)	1.62		

Appendix 28: *Chow test at 5% significance level including city-specific dummy variables for branded and independent hotels*

	Pooled model	**Independent**	**Branded**
SSR (Sum of the Squares of Residuals)	91	31	46
Number of estimated parameters (including the constant)	49		
Number of observations	333	117	216
Test statistic (Chow test)	0.87		
Critical value (at 5% significance level)	1.35		