SPATIAL ANALYSIS OF AIRBNB IN THE GREATER ATHENS REGION, GREECE

Abstract

Short term house rentals are a relatively recent phenomenon in the Greater Athens Region, Greece. Most rentals are offered through the Airbnb platform and have shown an impressive increase in the last years. As expected, the neighborhoods close to the city center and tourist attractions were the first to enter the Airbnb market. The recent trends however indicate that Airbnb activity expands towards areas quite away from the city center. This expansion is uneven and does not concern all areas in the Greater Athens region.

In this paper the spatial distribution of Airbnb rentals is examined, in terms of the number of rentals and the mean price per night, employing spatial analysis techniques. The spatial distribution of Airbnb activity is related to a variety of factors, such as population characteristics and house characteristics. In addition, several locational attributes are examined concerning proximity to hotels, metro stations, the city center and the beach.

The above factors are combined through regression analysis techniques. Ordinary Least Squares (OLS) and Geographically Weighted Regression (GWR) were employed in order to identify the factors which explain the spatial penetration of Airbnb and the spatial distribution of rents in the study region. The results indicate that the most important factors accounting for the spatial penetration of Airbnb are the presence of hotels and the number of vacant houses, while price per sq.m. is the most important factor for explaining the spatial distribution of Airbnb rents.

Keywords: short term house rentals; Airbnb; spatial analysis; spatial regression; Greater Athens region

Introduction

Greece is a major tourist destination attracting over 30 million tourists in recent years. Athens, the capital of Greece, attracts a large share of visitors, although the islands, such as Crete and Cyclades, are top destinations (Hellenic Statistical Authority, 2019).
Sharing economy grows rapidly worldwide and one important type is the short-term house rentals which are directly related to tourism. In Greece, short-term house rentals appeared in 2010 with only a few dozen of offers and they have sharply increased since then. Currently, it is estimated that approximately 130,000 houses are in the market of short-term rentals (Athanassiou and Kotsi, 2018).

In terms of the spatial distribution, the island of Crete concentrates most of the rentals in Greece (24%) and the Attica region is second with approximately 27,000 listings. The center of Athens concentrates most of the rentals in Attica (40% or approximately 11,000 rentals). The neighborhoods close to the city center and tourist attractions were the first to enter the Airbnb market, targeting mostly at visitors from abroad. Recent trends (www.airdna.com) indicate that Airbnb activity expands towards areas quite away from the city center and attract domestic visitors as well. This expansion is uneven and does not concern all areas in the Greater Athens region.

Several aspects of Airbnb rentals have been studied, for example the impact on rents for residents and the competition with the hotel sector (Ayoub et al, 2019; Balampanidis, Papatzani and Pettas, 2017; Coyle and Yeung, 2017; Fang, Ye and Law, 2016; Koolhoven et al, 2016; Zervas, Proserpio and Byers, 2016).

In this paper the factors associated with the differences in Airbnb spatial penetration in the Greater Athens Region will be explored. The spatial distribution of Airbnb houses in the Greater Athens region is examined in terms of the number of rentals and the mean price per night. These variables are correlated with the characteristics of the spatial units in the study region, which include population, household and accessibility indices.

The Airbnb website is the oldest and most popular platform for short term house rentals in Greece. Since there is no public data available, information on Airbnb rentals is derived from relevant websites (www.insideairbnb.com, www.airdna.com). Data were collected in June 2019. There are several problems with Airbnb data, for example they refer to a particular date and they do not include all the available rentals over time. In addition the information which is available for the rentals is rather limited.

The study region is the Greater Athens Region. There are great differences among the municipalities in the study region in terms of socioeconomic characteristics, quality of the built environment, amenities etc. which reflect the way the city has expanded in previous decades (Iliopoulou and Stratakis, 2019; Maloutas, 2018). Furthermore, within the municipality of Athens, there are also important differences in terms of socioeconomic characteristics. An important characteristic of the municipality of Athens is the large percentage of vacant houses (31% according to the Hellenic Statistical Authority), which is attributed to the population movements away from the city center in previous decades (Maloutas and Spyrellis, 2016). Vacant houses combined with low house prices in certain areas close to the center have been a favorable condition for transforming the buildings to Airbnb accommodations.

Experience from other cities and regions indicates several factors which contribute to Airbnb spatial penetration. Distance from the city center is probably the most important factor for the expansion of short term rentals, i.e. as the distance from the city center increases, the density of rentals decreases. Short distances from tourist attractions, hotels and other points of interest, also contribute to the density of Airbnb accommodations. Educational and employment characteristics are also considered important, for example the occupational status is examined in several studies as a determinant of Airbnb presence. Access to transportation does not have the same influence in all cities. High property values,
the supply of vacant or secondary dwellings, the presence of young population and
gentrification projects seem to be favorable factors for short-term rentals in some cities.

In terms of the rent of Airbnb houses, location and size are of great importance. The
type of the house is also important, i.e. entire house, independent or shared room.
Additional amenities, such as parking space and wireless internet also increase the rent.
Good reviews and “superhost” status also contribute to higher prices (Gibbs et al, 2018; Gutiérrez et al, 2017; Wang and Nikolau, 2017).

Materials and methods

The study region consists of 58 municipalities which roughly correspond to the Greater
Athens region. The population of the study region is 3 064 293 inhabitants (2011). The
municipality of Athens has 664 000 inhabitants (2011) and is divided into seven districts.
Taking into consideration the population size and the socioeconomic differences in the
municipality of Athens, the analysis was carried out for a total of 64 spatial units, including
the seven districts of Athens.
Short-term rentals in 2019 were extracted from two websites: airdna.com and
insideairbnb.com. Airbnb data are a snapshot of June 2019 and they do not represent all
offerings. Moreover, they do not include detailed information on the houses. Socioeconomic
data concerning population and dwellings characteristics are available from the Hellenic
Statistical Authority (Population and Housing Census 2011, www.statistics.gr), therefore they
refer to a period prior to Airbnb growth. House prices and the characteristics of the houses
for sale are available from own research on online property listings in 2017.

The following variables describing Airbnb activity were calculated from the airdna.com
and insideairbnb.com websites:

- Number of Airbnb listings 2019
- Mean price per night

These variables will be examined in relation to the characteristics of the spatial units in
the study area. The data collected for the spatial units of the analysis are shown in Table 1.

Results and Discussion

The description of Airbnb data is shown in Table 2. The maximum number of rentals
(4517) is observed in the central district of Athens, while the maximum rent (mean price per
night) is found in Vouliagmeni, which is one of the most expensive areas in the Athens
region.

The spatial distribution of Airbnb rentals in the study region is shown in Map 1. The
spatial pattern indicates concentration in the city center but also in areas with proximity to
the beach. Low numbers of rentals are observed in the western suburbs.

In Map 2 the average price per night of Airbnb rentals is presented. The higher rents are
at the central district of Athens, the southern suburbs with proximity to the beach and some
northern suburbs which are far away from the city center. Therefore, the spatial pattern of
the mean price per night is quite different than the pattern of Airbnb accommodations. The

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1 Municipalities correspond to the Kapodistrias administrative division
high density of Airbnb does not coincide with high rents and the rents on average are cheaper in the municipality of Athens.

<table>
<thead>
<tr>
<th><strong>Population characteristics</strong></th>
<th><strong>Household characteristics</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong> (percent of population in the age group 14-39)</td>
<td>Number of <strong>vacant houses</strong> and percent of houses offered for rent or sale</td>
</tr>
<tr>
<td><strong>Employment</strong></td>
<td><strong>Dwelling characteristics</strong> (age, size, access to internet)</td>
</tr>
<tr>
<td>- Sector of employment (percent of active population in the tertiary sector)</td>
<td><strong>House prices</strong> (price, price per sq.m. tax values)</td>
</tr>
<tr>
<td>- Occupational status (percent of salaried employees and employers)</td>
<td></td>
</tr>
<tr>
<td>- Unemployment (%)</td>
<td></td>
</tr>
<tr>
<td><strong>Educational level</strong> (percent of population with university degree, postgraduate degrees and illiterate)</td>
<td><strong>Accessibility indices</strong></td>
</tr>
<tr>
<td></td>
<td>Proximity to <strong>hotels</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Distances</strong> from the beach, the center and metro stations</td>
</tr>
</tbody>
</table>

Table 1. Characteristics of spatial units

<table>
<thead>
<tr>
<th></th>
<th>Rentals 2019</th>
<th>Average price per night (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum</td>
<td>16 689</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>260,77</td>
<td>55,2</td>
</tr>
<tr>
<td>Median</td>
<td>78</td>
<td>50</td>
</tr>
<tr>
<td>Minimum</td>
<td>0</td>
<td>26</td>
</tr>
<tr>
<td>Maximum</td>
<td>4 517</td>
<td>114</td>
</tr>
</tbody>
</table>

Table 2. Airbnb data

Correlation analysis (Table 3) indicates that the Airbnb rentals have strong positive correlation with the number of hotels in the spatial units (Map 3) and moderate positive correlation with the vacant houses and the age of houses for sale.

On the other hand, there are plenty of factors related to the spatial pattern of Airbnb rents (Table 3). There is positive correlation of rents with the price per sq.m. (concerning houses for sale), with access to internet, the employer’s occupational status, employment in the tertiary sector, the percent of university graduates and the size of houses for sale. Negative correlation is observed with salaried employees and unemployment. The above factors are also correlated to each other and characterize the areas of the Greater Athens Region according to their socioeconomic status.

The final part of this study is to explore the factors influencing (a) the presence of Airbnb rentals and (b) the mean price per night in the spatial units of the study region. Because of
multicollinearity issues, most explanatory variables were excluded from the linear regression model.

Map 1. Airbnb rentals 2019

Map 2. Airbnb rentals 2019: average price per night
Table 3. Correlations

<table>
<thead>
<tr>
<th></th>
<th>houses for rent or sale</th>
<th>size</th>
<th>age of house</th>
<th>house price (for sale)</th>
<th>tax value</th>
<th>price per sq.m. (for sale)</th>
<th>hotels</th>
<th>distance city center</th>
<th>distance beach</th>
<th>distance metro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airbnb listings 2019</td>
<td>0,581**</td>
<td>-0,084</td>
<td>0,511**</td>
<td>-0,056</td>
<td>0,034</td>
<td>-0,052</td>
<td>0,895**</td>
<td>-0,294</td>
<td>-0,097</td>
<td>-0,148</td>
</tr>
<tr>
<td>Mean cost per night</td>
<td>-0,046</td>
<td>0,523**</td>
<td>-0,268</td>
<td>0,498**</td>
<td>0,417**</td>
<td>0,646**</td>
<td>0,218</td>
<td>0,491**</td>
<td>-0,117</td>
<td>0,480**</td>
</tr>
</tbody>
</table>

Correlation is significant at the 0.01 level (2-tailed)

Map 3. Hotels
The regression models employed in the analysis are Ordinary Least Squares (OLS) and Geographically Weighted Regression (GWR). OLS was calculated in SPSS and ArcGIS and GWR was calculated in ArcGIS. The results are shown in Table 4.

When the number of Airbnb rentals is the dependent variable, the number of hotels is the most important independent variable, as indicated by the beta coefficients. In addition, the number of vacant houses for rent or sale, as well as the age of houses for sale are also quite important. All coefficients are positive. Therefore hotels and vacant houses increase Airbnb activity. The age of houses for sale contributes positively to Airbnb, possibly indicating the higher mean age of houses in the municipality of Athens. This model resulted to a coefficient of determination of 85.7%. The residuals were tested for spatial autocorrelation employing the Moran’s I index and their spatial pattern was found to be clustered. Therefore, a spatial regression model (GWR) was calculated which increased the coefficient of determination to 93%.

Although mean price per night is significantly correlated to several variables (Table 3), the regression model involves only one independent variable, price per sq.m. of houses for sale, because of multicollinearity among the independent variables. Price per sq.m. seems to summarize several socioeconomic variables in the data set. The coefficient of determination for the OLS model is 41.7%. The calculation of the Moran’s I index for the residuals of the OLS model indicated a clustered pattern. Therefore a Geographically Weighted Regression (GWR) model was calculated which increased significantly the explanatory power to 71%.

For both dependent variables, the Akaike Information Criterion of the GWR model has decreased relative to the OLS model, indicating an improvement of the model fit. The coefficients of the independent variables in the GWR model are not reported in Table 4 because they are different for each spatial unit, since the method produces local estimations of the dependent variable (Fotheringham, Brunsdon, & Charlton, 2002).

The GWR model has increased the explanatory power relative to OLS, as previous studies have indicated as well (Iliopoulos and Stratakis 2018a, 2018b).

The spatial distribution of Airbnb rentals is almost perfectly explained by the three independent variables which were included in the analysis. The mean price per night is partly explained by the price per sq. m. of houses for sale. Although the coefficient of determination of the GWR model is satisfactory, it indicates that there are variables missing from the analysis. These variables probably concern the individual characteristics of Airbnb rentals as well as the review ratings and the type of host.

Conclusions

Location is a very important factor for the penetration of Airbnb activity in the Greater Athens Region. The main locations which attract Airbnb are the center of the city and certain locations close to the beach. Distance from the center cannot adequately describe the spatial patterns of Airbnb in the study region: municipalities in the western part of the study region which are quite close to the center do not have strong presence of Airbnb, while some suburbs away from the center have significant Airbnb activity. Furthermore, the western districts in the municipality of Athens, despite their proximity to tourist attractions, have rather low number of Airbnb houses. In addition, the mean price per night is very high in areas away from the city center.
The present analysis indicated two factors which are strongly correlated to the number of Airbnb accommodations: the presence of hotels and the number of vacant houses.

On the other hand, the spatial pattern of mean price per night is related to many socioeconomic factors which correspond to the socioeconomic status in the spatial units: higher socioeconomic status is related to high prices and vice versa. Consequently, the proposed regression model includes only one independent variable, price per sq.m. of houses for sale which seems to summarize the socioeconomic variables.

The spatial distribution of the number of Airbnb rentals is adequately explained by the proposed regression model. The mean price per night is partly explained and other variables concerning the individual characteristics of Airbnb rentals should be included in the analysis. The GWR model is improving the results of OLS for both dependent variables, as it has been reported in several studies concerning real estate data.

Finally in this study, as in other similar studies, only the supply side of Airbnb is analyzed. The demand side is not taken into consideration, i.e. what are the characteristics and the preferences of the guests according to which the decisions as to the location and the price of the accommodation are taken. This would be a very interesting aspect to explore in future research.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>OLS</th>
<th></th>
<th>GWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airbnb rentals</td>
<td></td>
<td>Coefficients and diagnostics</td>
<td>Sig.</td>
</tr>
<tr>
<td>Constant</td>
<td>-258,590</td>
<td>0,020</td>
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<tr>
<td>Hotels</td>
<td>22,247</td>
<td>0,000</td>
<td>0,775</td>
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<tr>
<td>Vacant houses</td>
<td>0,038</td>
<td>0,009</td>
<td>0,164</td>
</tr>
<tr>
<td>Age of houses (for sale)</td>
<td>10,315</td>
<td>0,026</td>
<td>0,135</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0,857</td>
<td>0,930</td>
<td></td>
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<tr>
<td>AIC</td>
<td>890,264</td>
<td>869,528</td>
<td></td>
</tr>
<tr>
<td>Residual squares</td>
<td>3467593,467</td>
<td>1683731,644</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>OLS</th>
<th></th>
<th>GWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean price per night</td>
<td></td>
<td>Coefficients and diagnostics</td>
<td>Sig.</td>
</tr>
<tr>
<td>Constant</td>
<td>21,683</td>
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<tr>
<td>House price per sq.m.</td>
<td>0,020</td>
<td>0,000</td>
<td>0,646</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0,417</td>
<td>0,710</td>
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<tr>
<td>AIC</td>
<td>544,661</td>
<td>528,785</td>
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<tr>
<td>RESIDUAL SQUARES</td>
<td>16837,238</td>
<td>8390,454</td>
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</tbody>
</table>

Table 4. Regression models
References


