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THE GEOGRAPHY OF HOUSING PRICES IN THE GREATER ATHENS REGION, GREECE: PATTERNS, CORRELATIONS AND TRENDS

Abstract

In this paper the housing market in the Greater Athens region is examined in a spatial analysis framework, employing data for the supply of dwellings as well as socioeconomic data for the municipalities in the study region.
The sample includes several thousand dwellings for sale which are described in terms of their structural and locational characteristics. Asking prices before the economic crisis are compared to the prices in subsequent time periods, when the real estate market has already declined and a model for predicting prices is presented.
At first, the geographical distribution of property prices is examined and the attributes of the houses are described. The spatial patterns indicate that prices the southern and the northern suburbs are higher and resist decrease.
Secondly, several factors influencing housing prices are examined. Population characteristics of the municipalities in the Greater Athens region, such as education attainment, sector of economic activity, occupational status and unemployment are correlated with housing prices. It appears that higher prices are observed in municipalities with the most favorable characteristics. On the other hand, the impact of location on housing prices is approximated by the values of zones which are used for property tax purposes.
Finally several explanatory factors are tested to create a regression model in order to predict housing prices for the municipalities of the Greater Athens region. Both OLS and spatial regression models are employed and the factors which are significant for the prediction of housing prices are size, tax values, occupational status and educational attainment.

Keywords: housing prices; spatial analysis; hedonic regression; spatial regression; Greater Athens region

Introduction

The real estate market in Greece is one of the most important sectors of economic activity since the 1950's. The rate of home ownership as well as the share of investment in housing are among the highest in Europe (Eurostat, 2017). During the period 2001-2008 residential real estate market in Greece experienced rapid growth and a very large increase in housing prices, because of the entrance to the eurozone, the Olympic Games and the availability of abundant and low cost mortgages. Since the international economic crisis in 2008 the main characteristic of the real estate market is intensifying pressures on prices. In

the housing market, apartment prices dropped cumulatively by 40,8% during the decade 2007-2017. The decrease in prices was higher in the two major urban centers (Athens: -43,6% and Thessaloniki: -45,2%), when compared with other cities (-38,3%) and other areas (-35,9%) (Bank of Greece, 2018).

Apart from the general trends which are related to the economic environment, important differences are observed in the housing prices across geographical regions which can be attributed to physical attributes and locational influences (Baranzini, Ramirez, Schaerer & Thalmann, Eds., 2008; Bhattacharjee, Castro & Marques 2012; Xiao 2017). Physical attributes may be described as apartment size, age, floor and other characteristics of the specific property. Locational influences pertain to off-site neighborhood attributes such as parks, healthcare facilities and transportation (Anderson, & West, 2006; Cho, Poudyal & Roberts, 2008; Efthymiou & Antoniou, 2013; Luttik, 2000; McMillen & McDonald, 2004; Sander & Polasky, 2008). Demographic characteristics and unemployment have also been associated with housing prices and these characteristics are often treated as factors related to the economic environment, since they are associated with the disposable income (Cameron & Muellbauer, 2001; Reichert, 1990). Hedonic regression is the most common technique in order to explore the factors which contribute to property values (Baranzini et al., 2008; Raslanas, Tupenaite & Šteinbergas, 2006; Sander & Polasky, 2009). In these models data for specific regions are often analysed without employing techniques of spatial analysis. However, several studies employ spatial analysis and GIS techniques in order to study the spatial variation of housing prices (De Bruyne, & Van Hove, 2013; Lake, Lovett, Bateman & Day, 2000; Mimis, Rovolis & Stamou, 2013; Pace, Barry & Sirmans, 1998).

Materials and methods

In this paper the geography of the housing market in the Greater Athens region is analyzed employing data for the supply of dwellings as well as socioeconomic data for the municipalities in the study region. The study region consists of 58 municipalities[1] which roughly correspond to the Greater Athens area. The study region was delineated according to the density of the data on housing prices. Asking prices before the economic crisis are compared to the prices in subsequent time periods. Data were obtained by entries concerning property for sale, published on the internet by real estate agencies[2]. House prices data are not generally available in Greece, especially at the municipality level; therefore asking prices were employed for a spatial analysis of property values. It is known however, that asking prices are in general higher than market values. The sample comprises 9896 dwellings for sale for 2009, 8454 for 2014 and 5130 for 2017. The year 2009 is considered a base year for comparisons since house prices have icreased until 2008 (Bank of Greece 2018).

At first, the values and the specific attributes of the dwellings offered in the market are compared for the three time periods and the differences among the municipalities of the study region are discussed.

Second, the relationship of housing prices and certain population characteristics is examined. The mean property value for each municipality is correlated with socioeconomic characteristics of the population such as educational attainment, sector of economic activity,

[1] Municipalities correspond to the Kapodistrias administrative division

[2] www.xe.gr , www.spitogatos.gr and www.helona.gr (not currently operating)

occupational status and unemployment[3]. In addition the location factor on property values is approximated by the values of zones which are determined by the Ministry of Finance for taxation purposes[4]. Tax value is estimated as the mean of the tax values corresponding to zones designated by the Ministry of Finance in each municipality.

Finally, several explanatory factors are tested to create a regression model in order to predict housing prices for the municipalities of the Greater Athens region. A spatial regression model is presented in order to estimate the mean price of dwellings in the municipalities of the Greater Athens Region, employing as independent variables dwelling size and socioeconomic characteristics of the municipalities.

Results and Discussion

At first some descriptive statistics for the three time periods are presented in Table 1. The measures of central tendency indicate that the average price (median) for a dwelling in Athens was 235000€ in 2009 and has dropped significantly until 2017 to 150000€. However in the last three years 2014-17 it appears that median prices show small decrease. Great variation in property prices exist in the data set as indicated by the range of values and these differences can be attributed, among other factors, to spatial variation in house prices. The median price per sq.m. was 2692€ in 2009 and dropped to 1571€ in 2017. The mean age of the dwellings was 8 years in 2009, but the median only one year, indicating the large number of new dwellings in the data set of 2009. In 2017 mean age has increased to 27 years, due to the stagnation of construction activity during the economic crisis. Finally descriptive statistics for the size of dwellings indicate small fluctuations across different time periods.

The price differences among the municipalities of the Greater Athens regions for the year 2017 are presented in Figure 1. The price per sq.m. is higher in certain municipalities in the southern and northern suburbs of Athens, while lower prices are observed in the Western suburbs. For example, the highest mean price is observed in the municipality of Vouliagmeni (4115€/sq.m.) and the lowest in Ag. Varvara (807€/sq.m.). This spatial pattern is quite stable over the three time periods.

The price changes between 2009 and 2017 are presented in Figure 2. In all municipalities there is a significant decrease in housing prices. However several municipalities in the southern suburbs experienced smaller decrease in prices. For the period 2014-17 price changes show some interesting results; several municipalities, mostly in the northern and southern suburbs show increasing prices (Figure3). The largest increase is observed in Psychiko (42,8%), Ilioupoli, Voula and Glyfada (over 30%).

Consequently, a spatial pattern of prices is observed which indicates that the southern and the northern suburbs are more expensive and experience lower decrease in prices, while there is a trend for increasing prices in recent years.

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[3]Elaboration from 2011 Population Census, Hellenic Statistical Authority (EL.STAT): www.statistics.gr and unpublished data

[4] http://www.minfin.gr/web/g.g.-demosias-periousias//pinakas_6 και http://www.minfin.gr/documents/31361/664601/antikim_ax_ak_2016.pdf/e02ab172-b021-4e96-9b9d-bf18ab2d6291

	Price 2009	Price 2014	Price 2017	Price per sq.m. 2009	Price per sq.m. 2014	Price per sq.m. 2017
Mean	336314	272659	279132	2847	1806	1806
Median	235000	160000	150000	2692	1615	1571
Minimum	20000	10000	5500	458	176	160
Maximum	6500000	15000000	8500000	21176	19231	18519

	Size 2009	Size 2014	Size 2017	Age 2009	Age 2014	Age 2017
Mean	109	131	127	8	20	27
Median	90	98	95	1	14	26
Minimum	12	16	13	-1	0	0
Maximum	1258	1570	1500	109	113	136

Table 1. Descriptive statistics 2009-2017

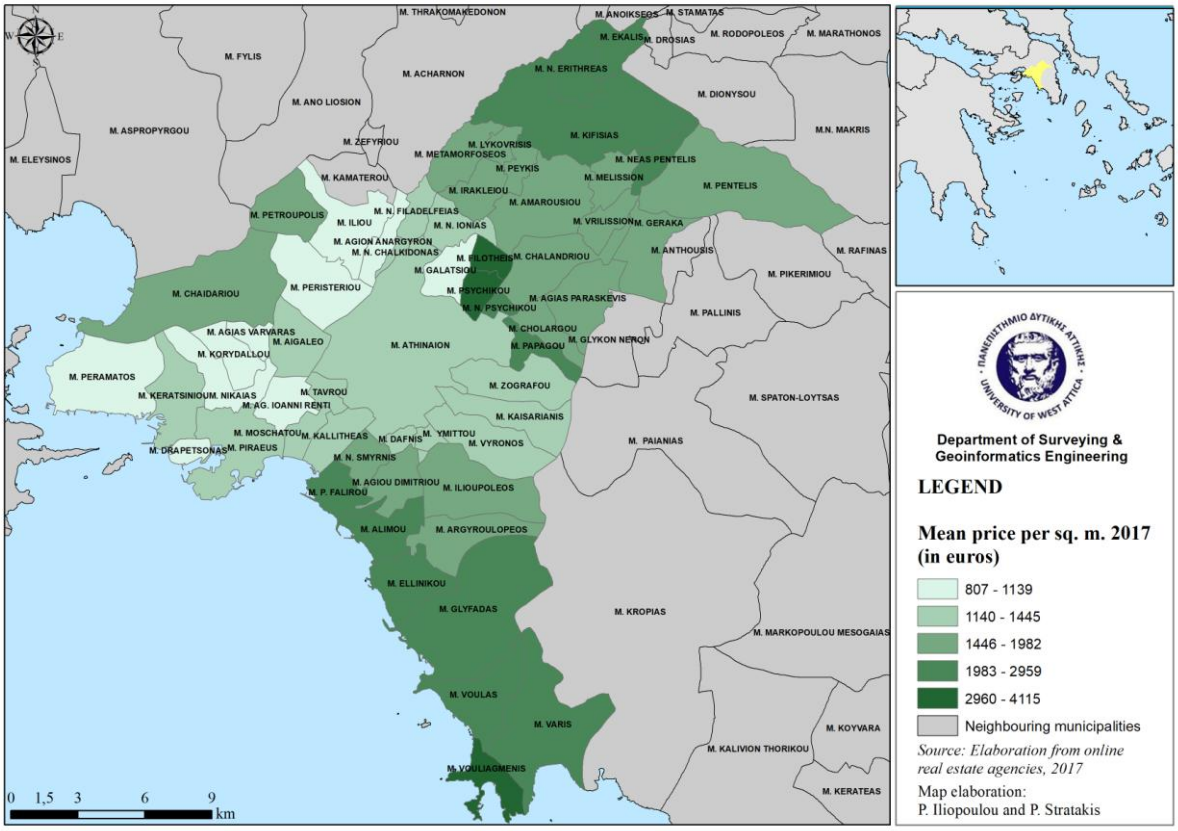

Figure 1. Mean price per sq.m. 2017

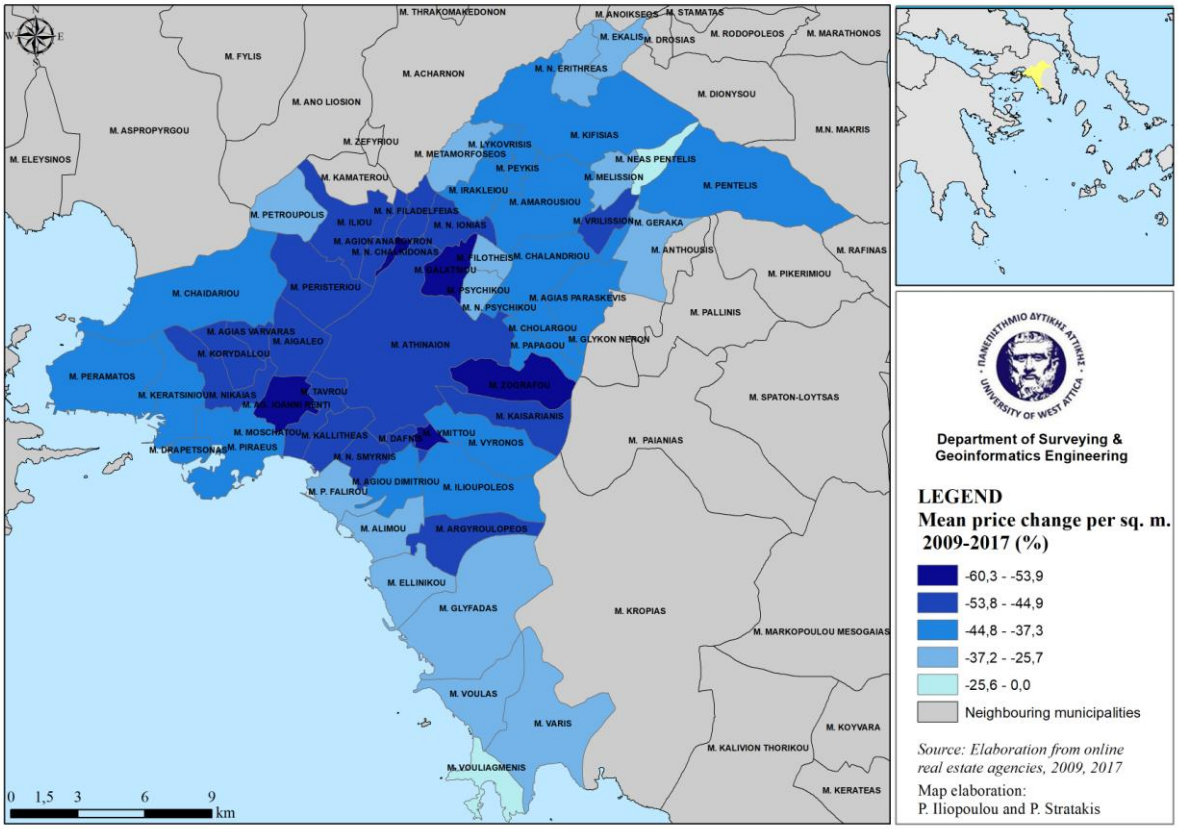

Figure 2. Mean price change per sq.m. 2009-2017

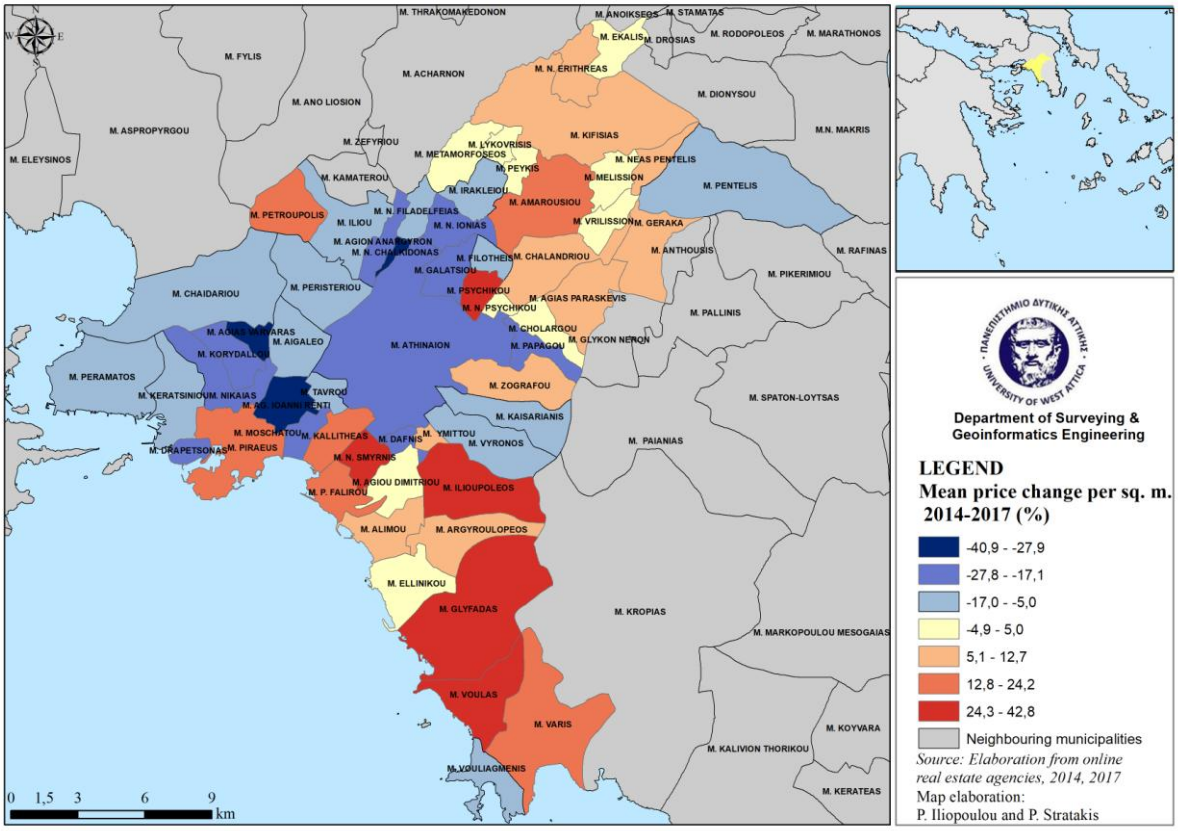

Figure 3. Mean price change per sq.m. 2014-2017

In order to examine the factors influencing housing values, the mean price and the mean price/sq.m. for each municipality were associated with attributes of the houses as well as characteristics of the municipalities, such as educational attainment, sector of economic activity, occupational status, unemployment and tax values. The most powerful Pearson correlation coefficients are presented in Table 2. Correlations are presented for Price and Price per sq.m. with the size and floor of the dwellings, the values of tax zones, occupational status (% employers and % salary employees in the population), employment by sector (% employed in the tertiary sector), unemployment, educational level (% with higher education and % with a postgraduate degree).

The dwelling size has the most powerful correlation with price. Both variables **"**Mean price" and "Mean price/sq.m.", present strong positive correlation with tax values (Table 3). Tax values are artificial values allocated to geographic regions for tax purposes and the comparison to market values might indicate cases of underestimation or overestimation. In this analysis the general trend indicates that tax values correspond to a great extent to market values in the Greater Athens Region.

Strong positive correlations for both "Mean price" and "Mean price per sq.m." are observed with "employers" occupational status, while the correlation with "salary employees" is negative. Over 15% of the population has employer's status in some of the more expensive municipalities in the Greater Athens Region: Vari-Voula-Vouliagmeni, while in municipalities such as Kifisia, Filothei-Psychiko and Alimos over 10% of population are employers.

		size	floor	tax value	% employer	% salary	% tertiary	% unemployed	% university	% master_phd	price change 2014-17
price	Pearson Correlation	,926**	-,594**	,883**	,775**	-,829**	,641**	-,664**	,591**	,755**	,341**
	Sig. (2-tailed)	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	,009
price_sq.m.	Pearson Correlation	,674**	-,364**	,836**	,841**	-,863**	,772**	-,782**	,702**	,752**	,494**
	Sig. (2-tailed)	0,000	0,005	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000

Table 2. Correlations: Prices (2017 data set), tax values and socioeconomic characteristics

Strong correlations between **"**Mean price" and the "Mean price/sq.m." are also observed with the percent of population with postgraduate (Master's and Ph.D.) and university education. The highest percentage of university graduates is found in the municipalities of Papagou-Cholargos and Filothei-Psychiko (over 30%), while the highest percentage of postgraduate degrees is found in Filothei-Psychiko.

Concerning employment in the three main sectors of economic activity, "Mean price per sq.m." is positively correlated with employment in the tertiary sector. Finally unemployment has quite strong negative correlation with both price variables.

It has to be noticed that strong correlations exist among the variables describing population characteristics. This is actually the multicollinearity problem which has been reported in many studies of real estate markets and it is a problem when a regression model is produced. For example, unemployment rate has a strong negative correlation with university and postgraduate education (r= -0,936 and r= -0,882 respectively). It is expected that higher educational attainment is related in general to higher occupational status and

higher disposable income which is related in turn to the choice of more expensive residential areas. This is possibly a generalization, it is however an evident trend in the data.

The final part of this study is to predict the mean prices of the municipalities employing both the attributes of the houses and the characteristics of the municipalities. Because of the multicollinearity problem, most variables were excluded from the analysis in a linear regression model. After several trials, the variables representing dwelling size, percent of employers and percent of population with postgraduate education were selected as independent variables, employing data for 2017. An Ordinary Least Square (OLS) regression model was originally produced in a GIS environment (Table 3). The explanatory power of the model as expressed by the coefficient of determination R^2 is very good. However the calculation of the measure of spatial autocorrelation Moran's *I* on the residuals of the OLS regression model indicated a clustered pattern which led to the calculation of a Geographically Weighted Regression (GWR) model (Fotheringham, Brunsdon, & Charlton, 2002). The explanatory power has increased to 97%, while the Akaike Information Criterion has decreased relative to OLS indicating an improvement of the model fit. The coefficients of the independent variables of the GWR model are not reported in Table 5 because they are different for each municipality, since the method produces local estimations of the dependent variable.

	OLS	GWR
	Coefficients and diagnostics	**Coefficients and diagnostics**
CONSTANT	-241823,979	
MEAN SIZE	2618,506	
% EMPLOYERS	16010,300	
% MASTER-PH.D.	12231,839	
R^2	0,892	0,973
AIC	1513,04	1464,73
RESIDUAL SQUARES	598 217 402 681,247	150 446 407 815,374

Table 3. Regression models

In figure 4 the residuals of the GWR model are presented which are random according to the Moran's *I* index of spatial autocorrelation. However, it appears that some underestimation remains in the municipalities of Psychiko and Vouliagmeni and some overestimation in Penteli.

An alternative model was tested employing dwelling size and tax values as independent variables. In this case the coefficient of determination is 0,975 and the residuals of OLS are random. It appears therefore, that the values of the tax zones represent adequately the locational attributes of dwellings in a regression model.

A final remark of the analysis is that although the change in prices between 2014 and 2017 is spatially autocorrelated, as indicated by a Moran's *I*=0,249 and a p-value=0,002, the variables in the data set could not explain adequately this spatial pattern and the resulting coefficient of determination would not exceed a value of 32%.

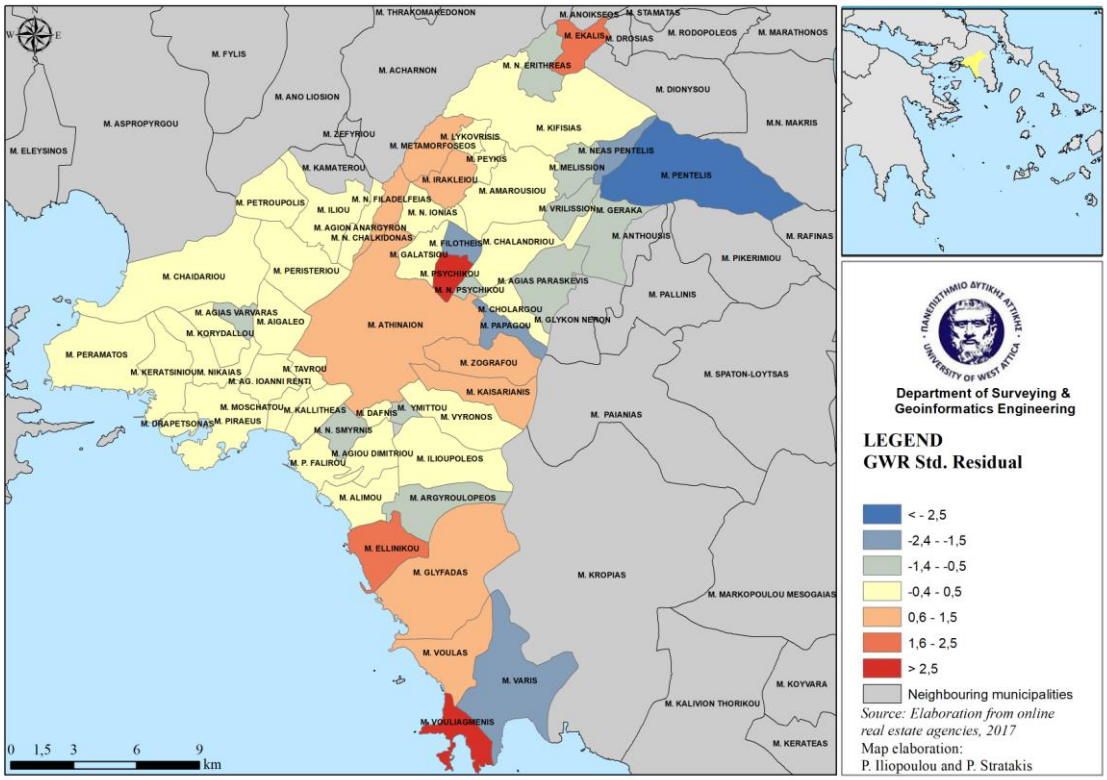

Figure 4. Residuals Geographically Weighted Regression

Conclusions

Housing prices in the Greater Athens Region have dropped significantly in the 2009-2017 period. A great number of dwellings for sale were analyzed and price changes for the municipalities of the study region were presented. The higher prices are observed in the northern and southern suburbs of the Greater Athens Region and the lowest in some western suburbs. The patterns of price changes for the period 2009-2014 indicate, as a general trend, that prices decreased at a lower rate in the southern and northern suburbs, while in the 2014-17 period these areas show increases in prices.

The examination of several factors representing population characteristics of the municipalities in the Greater Athens region indicated that educational attainment, occupational status as well as the sector of employment appear to be strongly correlated with the housing prices. Municipalities with higher mean prices per sq. m. are characterized by the presence of people with higher or postgraduate education, employment in the tertiary sector and employer occupational status. On the contrary low mean prices per sq. m. are associated with primary education, unemployment and employment in the secondary sector. Tax values also present strong positive correlation with housing prices.

Two regression models were produced in order to estimate housing prices in the municipalities of the Greater Athens Region. If dwelling size, percent of employers and percent of population with postgraduate education are selected as independent variables, a spatial regression model is appropriate. However similar results, in terms of the explanatory power, are produced if only two variables are selected as explanatory factors: dwelling size and tax values. In this case a classic regression model is sufficient.

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