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An Econometric Analysis of Determinants of House Rents in Istanbul

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Abstract
In this study, the hedonic pricing model, demonstrating the relationship between residential properties and housing rentals and based on revealed preference, has been estimated by the spatial quantile regression method. The data set collected for each housing rental consists of cross-sectional data of the variables such as housing size, number of bathrooms, housing age, distance dummies etc. Additionally, spatial factor providing to measure the direction and intensity of the externality and interaction between locations, have also been added to the model. The findings show that the spatial effect is a statistically significant and it has a positive impact on housing rental prices. Proximity to the Trans European Motorway has a diminishing effect on housing rents while housing size, multiple bathrooms, appliances and security presence, ease of access to an important means of transport such as metro increase them. Although housing and heating type are the factors that could affect housing prices, a remarkable point is that these two factors is not effective on housing rents. The results of the study provide important clues about the functioning of the real estate market in Istanbul.
Keywords: housing rents, hedonic pricing model, quantile regression

1. Introduction

The housing market is a market consisting of heterogeneous products due to having housing with different properties. Housing is one of the heterogeneous goods according to their location and their structural, environmental and neighborhood characteristics. In order to analyze the complex relationship between prices of heterogeneous goods such as housing and their features 'Hedonic Pricing Approach' has been developed. The hedonic price approach is a valuation technique based on revealed preferences. The relationship between house prices and properties, in recent years, is analyzed with models assuming that also the spatial dependence vary according to locations and also taking into account the impact of this dependence. Applied to housing market which has in particular, micro-economic and macro-economically significant effects, housing hedonic pricing studies in the literature hold large.

In this study, the magnitude and direction of the spatial dependence was tried to present by including the spatial factor in the hedonic pricing model. This dependence can be positive, negative or neutral. In case of positive dependence, adjacent locations are very similar to one another in terms of housing rents and thus positive externalities are involved in the analysis. While in case of negative dependence reverse situation is concerned and finally neutral dependence refers to the spatial independence. The spatial dependence is very important factors to make accurate predictions and the right policies in the presence of spatial effects in data. In case of the presence of spatial effects, because of observation independence assumption which is violated, OLS estimator does not provide the desired properties (Zhukov, 2010). There are two factors that give rise to the spatial dependence when analyzing the housing market. These ones; the existence of interaction between different spaces and the error in the model specification. It is very important to accurately identify the cause of the spatial dependence because it plays a major role in the selection of the correct spatial model (LeGallo, 2002).

The purpose of this study is to examine the directions and magnitudes of the relationship between housing rental prices and residential properties and of the interaction between the adjacent residential rents at the different rent levels in Istanbul which is the largest real estate market of Turkey. As a first step in the study, with the idea that the factors which affect housing rents vary in different rent levels, quantile regression model estimates are made. Quantile regression allows us to examine more comprehensive pictures for different house rental prices. This regression has the potential of generating different responses in the dependent variable at different quantiles. Later by adding also the spatial factor in the model, the spatial quantile regression model was estimated by the two-stage regression quantile (2SQR), method. This method solves the endogeneity problem revealed in the model with the addition of spatial factor. It also provides more effective results when working with large sample. In the second part of the study, after introduction, the hedonic pricing studies made in recent years in the literature were examined. In the third and fourth parts, respectively, the spatial quantile regression model being the method of the study and data used in the model are presented. In the last part, the model results are evaluated.

2. Earlier Studies

Based on the 1920s, 'Hedonic Pricing Approach' is an approach also used in the evaluation of housing market

that keeps an important place in the economy and which preserves his actuality. Therefore, there are many studies that analyze the relationship between housing prices and housing characteristics using different econometric methods. In recent years, the quantile regression model that provides robust estimates against frequently encountered problems (such as heteroscedasticity, outliers etc.) in the analysis of housing prices, is used very often. Understanding the importance of the spatial effect in housing prices, increased interest in the use of the model taking into account this effect. The examination of the spatial dependence via quantile regression model is quite new. In Table 1, in particular quantile regression and spatial quantile regression studies and their findings are summarized.

Table 1. Earlier Studies

Authors	Country	Variables	Methods	Conclusion
Wang, Potoglou, Orford, Gong (2014)	UK	property sale price in british pound sterling, natural logarithm of price of the property when sold, number of bus-stops, floor area of a property in square metres, flat as the reference category	quantile bivariate regressions, ols	Evidence with regard to the positive externalities of Cardiff Bus network towards the market values of nearby residential properties. Given the uneven externality distribution between properties at different price levels, we call for a progressive land value tax scheme.
Mueller, Loomis (2014)	USA	natural log of the real sale price, square feet, building age, median household income, percent with no high school degree, environmental and location variables, elevation of the house lot (feet) above sea level.	quantile regression, ols	A quantile regression approach can provide policymakers and researchers more information about the marginal implicit price in hedonic models as it relates to the distribution of the dependent variable.
Basu-Thibodeau (1998)	USA	transaction price, per square foot price, living area, servants' quarters, dwelling age, number of bathrooms, garage space, central heating system, gas heating system	generalized least squares	They find substantial spatial autocorrelation in the log of transaction prices across housing submarkets
Anselin-Gallo (2006)	USA	Elevation of the house, interior living space, number of bathrooms, number of fireplaces, indicator variable for pool, age of the house, central air conditioning, central heating, poverty level, median household income, indicator variable for riverside county	spatial econometrics, maximum-likelihood, generalized method of moments	They find very strong evidence of the presence of positive spatial autocorrelation, even after controlling for the same house characteristics and neighborhoods variables used in previous empirical analyses of this housing market.
Osland (2010)	Norway	House price, price per square meter, lot size, size of house, number of toilets, minutes to cbd by car, garage, age of house	spatial regression model, geographically weighted regression, maximum likelihood	The spatial model alternatives have higher explanatory power compared to the initial base model.
Zietz, Zietz, Sirmans (2008)	USA	House price, lot size , square feet , brick, bathrooms , rooms , full baths, fireplace, air-conditioning, basement, garage spaces, pool	quantile regression, ols	The effect of housing characteristics on selling price can be better explained by estimating quantile regressions across price categories.
Liao, Wang (2010)	China	House price, floor area, bedroom, floor number, external share, plot ratio, greening rate, cbd distance, urban park distance, natural park distance	spatial autocorrelation, spatial quantile regression model, two stage quantile regression	The integration of spatial econometrics and quantile regression is helpful, because the estimated spatial dependence varies substantially across quantiles.
Furtado,Oort (2011)	Brazil	House price, transaction value per surface, estate's surface, construction quality levels, age of estate, apartment, house, shop	spatial quantile regression, quantile regression, ols	the quantile estimation should always be tested against in real estate estimation, as preferences of households seem to differ significantly for different levels of prices.
Su, Yang (2011)	A.B.D.	per capita crime rate, square feet, house age, access, distance, tax rate, proportion of blacks,	spatial quantile autoregression, quantile regression , the instrumental variable quantile regression	The IVQR method is less demanding on the moments of the error and is quite robust against non normality and heteroscedasticity of the errors.
Fletcher, Gallimore, Mangan (2000)	UK	The external area of the property in square metres, age, dummy variables for property type, number of bedrooms, living-rooms, bathrooms, garages and central heating.	hedonic house price models, ols, generalized least squares	Heteroscedasticity is a problem in hedonic house pricing models. Interactions between age and external area and other variables, suggest that these results are not due to model misspecification.
Caglayan, Arikan (2009)	Turkey	Housing price, the floor area of the apartment, the age of the apartment, bathroom, swimming pool, the apartment faces, distance, public school.	semi-logarithmic form of the hedonic price , ols, quantile regression.	The results suggest that construction quality, floor area, having an additional bathroom and being on the ground floor or below are the most influential structural characteristics in determining an apartment's price.
Caglayan-Akay, Bekar (2014)	Turkey	Housing price, housing area, number of rooms, number of bathrooms, housing age, balcony, housing type, heating type	two stage quantile regression estimates of the spatial lag model.	Towards the high-priced housing, it is observed in general that spatial effect have an increasing importance. Housing size and number of bathrooms are important factors for all segments of society.
Kim, Phipps, Anselin (2003)	South Korea	Housing price, house and neighborhood characteristics and socioeconomic variables for each household, household fuel choice, total floor space of house, number of rooms, number of bathrooms, age of house, accessibility to the nearest hospital, school and park or swimming pool.	hedonic housing price model, spatial hedonic models, the spatial-lag model, the spatial two-stage least-squares estimates	The regression diagnostics showed that the spatial-lag model specification is valid for the housing market in Seoul. The value of air quality capitalized into the price of the house is the present value of air quality. The owner expects to receive over the life of the house.

3. The Spatial Quantile Regression:

The spatial regression models are those that use spatial effect as a source of information when are concerned these effects in the data. Sample data is understood to have a spatial component status when called spatial effects. Events in a location can affect the conditions elsewhere with tools such as goods, people, capital and spatial externalities and this interaction constitutes the source of the spatial dependence. Moreover, also the wrong determination of the model and the measurement error situation arises spatial dependence. In determining the spatial interaction between observations and modeling, the spatial weight matrix has an important role. These matrices are used for the quantification of the relationship between locations. Explicitly the weight matrix,

$$W = \begin{bmatrix} 0 & w_{12} & \cdots & w_{1n} \\ w_{21} & 0 & \cdots & w_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ w_{n1} & w_{n2} & \cdots & 0 \end{bmatrix}$$

$$w_{ii=0}, w_{ij} \geq 0$$

$$\sum_{j=1}^{n} w_{ij} = 1, \forall i$$

can be represented as this form. This matrix is a square matrix with rows and columns number as the number of geographical locations studied in this work. w_{ij}, represents the form of the relationship between i and

j positions. In this context, the most commonly used matrices are the neighborhood and distance matrices. First, matrix elements has binary values (0 and 1) according to the neighborhood state of the current position. Afterward, matrix elements of each row are normalized by dividing them with the sum of the corresponding line and as such are included in the analysis (LeGallo, 2002).

Depending on the cause of the spatial dependence, various spatial models are available. In this study, the spatial lag model will be described in order to analyze the presence of spatial interaction between locations and its power. The spatial lag model,

$$y = \rho Wy + X\beta + \varepsilon \qquad \varepsilon \sim N(0, \sigma^2 I_n)$$

can be represented as this. Where, ρ is spatial autoregressive coefficient, Wy is spatial lag term, X is explanatory variables matrix and ε is error term vector. The effect of spatial lag term in this model is taken into account by adding on the spatially lagged dependent variable at the right-hand side of the model. Otherwise, the OLS estimators are biased and standard errors are incorrect (Anselin, 1999).

In the spatial lag model, when there exist problems such as misspecification due to heteroscedasticity, existence of outliers in data, non-normality and other error terms problems and measurement error, it is unable to obtain reliable results. Therefore, it is necessary to pass to the quantile regression model which is robust to these problems and also renders possible to analyze the conditional distribution of dependent variable. Linear quantile regression model,

$$y = X'\beta(\tau) + \varepsilon(\tau) \quad \text{or} \quad Q_\tau(y \mid X) = X'\beta(\tau)$$

can be represented as this (Koenker and Bassett, 1978). Here; X is explanatory variables matrix, β is coefficient vector, $\varepsilon(\tau)$ are error terms and $Q_\tau(\varepsilon(\tau) \mid x) = 0$.
The linear programming solution of the model,

$$min_{\beta \in R^p}[\sum_{i \in \{i: y_i \geq X'\beta\}} \tau |y_i - X'\beta| + \sum_{i \in \{i: y_i < X'\beta\}} (1-\tau)|y_i - X'\beta|]$$

can be obtained by solving this expression. The estimated coefficients of quantile regression are not sensitive to outliers on the dependent variable.

The model combining spatial lag regression and quantile regression is called 'the Spatial Quantile Regression Model'. In this model, the spatial lag term is added to the quantile regression. This model,

$$Y = \gamma_\tau WY + X\beta_\tau + \varepsilon$$

can be presented as this (Pietrzykowski, 2012). Here, τ is the analyzed quantile, X is explanatory variables matrix and $\varepsilon(\tau)$ are error terms. WY is endogenous variable.

To place the spatially lagged dependent variable on the right-hand side of the model leads to the endogeneity problem. In this case, two different methods are used to estimate the spatial quantile regression model. These ones; 'Two-Stage Quantile Regression (2SQR)' and 'Instrumental Variable Quantile Regression (IVQR)' methods. In this study, because of the large sample size, the spatial quantile regression is estimated efficiently using two-stage quantile regression method proposed by Kim and Muller (2004). Firstly, for each τ values, WY's quantile regression is estimated where instrumental variables such as X and WX are used as explanatory variables .In this way, $\widehat{WY}(\tau)$ values are obtained. Secondly, for the same τ value, other quantile regression is estimated. In this stage, the dependent variable is Y and X ,$\widehat{WY}(\tau)$ are explanatory variables.

4. Data and Variables

In this study, based on the sample selected from 39[1] districts, 504[2] rental housing which represent Istanbul real estate market through March-April 2014 period, the effects of the characteristics of rental housing on rental housing prices has been investigated using quantile regression and spatial quantile regression models according to the hedonic pricing approach. The most important reason to examine Istanbul residential market in this study is due to the fact that Istanbul is the Turkey's largest real estate market. In addition, apart from the thousands of years of history and its historical structure, Istanbul provides geographically significant advantages in terms of international transportation and is a city attracting domestic and foreign migration by reason of linking Asia with Europe continent.

Considering the empirical studies in the literature, the residential properties that affect housing prices even vary by cities, countries, regions and housing characteristics are usually seen to be divided into structural features (housing age, square meter etc.), spatial characteristics (proximity to shopping center, hospital, subway,

[1] Data were obtained from 'www.sahibinden.com'

[2] Sample size (n) was calculated by this formula: $n = (NpqZ^2)/((N-1)d^2 + pqZ^2)$, here N: population size, Z: normal distribution critical value at the (1-α) confidence level, d: significance level, p: the probability of preferring rental housing, q= the probability of not preferring rental housing.

etc.) and neighborhood characteristics (crime rates etc.)

In our study, most of the major residential properties used in the literature are discussed but only the explanatory variables which were found significant in the estimated models are shown in Table 2. Upon analyzing the table, it is understood that structural and spatial features have an impact on rental housing prices.

Table 2. Variable Definitions

Variable	Definition
Rental housing prices	Turkish liras
Subway	Dummy variable: if close to subway 1, otherwise 0
Housing area	m^2
Highway	Dummy variable: if close to highway 1, otherwise 0
White Goods	Dummy variable: if there are white goods 1, otherwise 0
Jacuzzi	Dummy variable: if there is a jacuzzi 1, otherwise 0
Security	Dummy variable: if there are guards 1, otherwise 0
Bathroom	Dummy variable: if there is one bathroom 1, otherwise if there is more than one 0
Housing age	The age of the apartment building as year

5.Estimation Results

In the study, the regression quantile estimates were made to examine the relationship between rental housing prices and housing characteristics in the Istanbul Real Estate Market, and then the estimates were made with the spatial quantile regression to investigate the presence of the spatial effect and the spatial dependence. In the study, the models are estimated by taking nine different quantiles (τ = 0.10, 0.20, ..., 0.90) into consideration and both quantile effects and spatial effects are analyzed together. Logarithmic linear equation form is used as the most convenient functional form of the hedonic price model in both quantile and spatial quantile regression estimates.

Based on the hedonic price approach, the quantile regression model is estimated as follows:

$$Quant_{\tau}(\ln(p)|X) = X\beta_{\tau} + \varepsilon_{\tau}$$

where p is the rental housing prices and X is the matrix of housing characteristics. τ is the quantile being analyzed. Following Liao and Wang (2010), The Spatial Quantile Regression is estimated as follows:

$$\ln(p) = \delta_{\tau} W(\ln(p)) + X\beta_{\tau} + \varepsilon_{\tau}$$

where p is the rental price, W(ln(p)) is the spatially lagged endogenous variable, X is the housing characteristics variable matrix and τ represents quantile in which parameters are estimated[1].The estimation results of the quantile regression are given in Table 3.

[1] Weight matrix for spatial model estimation is calculated according to the k-nearest neighbor criteria based on the Euclidean distances. Spatial effect is included in the model by using appropriate weight matrix.

Table 3. Quantile Regression Model Estimation Results (between 0.1-0.9)

τ	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
constant	6.18531*** (0.14742)	6.13974*** (0.10004)	6.21522*** (0.09407)	6.30053*** (0.07893)	6.34961*** (0.07810)	6.40938*** (0.10511)	6.40931*** (0.11384)	6.58553*** (0.10175)	6.72049*** (0.18049)
m^2	0.00234** (0.00111)	0.00350*** (0.00060)	0.00403*** (0.00048)	0.00387*** (0.00039)	0.00411*** (0.00039)	0.00409*** (0.00063)	0.00486*** (0.00060)	0.00450*** (0.00049)	0.00488*** (0.00059)
Housing age	0.01171*** (0.00269)	0.01332*** (0.00279)	0.01116*** (0.00241)	0.01199*** (0.00232)	0.01307*** (0.00242)	0.01304*** (0.00289)	0.01393*** (0.00387)	0.02004*** (0.00435)	0.02749*** (0.00864)
Bathroom	-0.32191*** (0.07048)	-0.22736*** (0.05661)	-0.19041*** (0.06069)	-0.20264*** (0.05248)	-0.19461*** (0.05321)	-0.20998*** (0.06116)	-0.16336** (0.07008)	-0.23845*** (0.06981)	-0.19148* (0.10139)
Security	0.19594*** (0.05376)	0.20575*** (0.05516)	0.24362*** (0.05524)	0.30480*** (0.04943)	0.31348*** (0.04874)	0.31230*** (0.05093)	0.32032*** (0.05656)	0.29167*** (0.06509)	0.40761*** (0.10435)
Subway	0.23901*** (0.04805)	0.25883*** (0.05303)	0.28946*** (0.04938)	0.28527*** (0.04155)	0.26308*** (0.04414)	0.29502*** (0.05337)	0.29163*** (0.05750)	0.32108*** (0.06233)	0.31655*** (0.08531)
White Goods	0.26820*** (0.08147)	0.27072*** (0.05912)	0.32349*** (0.06353)	0.31825*** (0.05475)	0.30407*** (0.06009)	0.36106*** (0.05951)	0.34198*** (0.06075)	0.33949*** (0.07478)	0.24482*** (0.08884)
Jacuzzi	0.20413*** (0.05108)	0.22811*** (0.04811)	0.16252*** (0.04644)	0.19308*** (0.04361)	0.19796*** (0.04319)	0.21727*** (0.04748)	0.16544*** (0.05167)	0.20436*** (0.05730)	0.15818* (0.08960)
Highway	-0.04683 (0.04953)	-0.08409* (0.04838)	-0.16023*** (0.04507)	-0.16945*** (0.04002)	-0.17305*** (0.04356)	-0.13970*** (0.04872)	-0.13710*** (0.05254)	-0.12304** (0.05513)	-0.24938*** (0.08925)

Not: i. τ, denotes the quantile
ii. ***0.01, **0.05, *0.10 refers to the significance level
iii. values in parentheses are standard errors.

According to Table 3., the estimated quantile regression coefficients for the variables generally vary across the distribution regarding the size but not regarding the signs. A glance at the quantile regression estimates reveals that all coefficients are statistically significant. while the housing size (m^2) has similar positive effects on logaritmic housing rents in the middle quantiles, this effect increases toward the high quantiles and while the impact of the housing age on rental housing prices is expected to be negative, shows in contrast a significant positive impact on the very high rental priced housing close to the Bosphorus. In this region, due to the construction ban except for restoration activities, there are quite high aged housings and it is believed that this situation causes the positive effect. While not to have more than one bathroom in housing has a decreasing effect on housing rental prices in all segments of society this negative effect was decreased when the only bathroom is a Jacuzzi. While the proximity to an important transport as subway which facilitates and shortens transportation have a positive effect on rental prices, the proximity to the Trans European Motorway (TEM), especially in middle and high quantiles, decreases housing rents much more than the lowest quantiles due to environmental factors such as air and noise pollution. The existence of white goods in rental housing has a increasing effect on rental prices as expected due to reducing the financial burden on tenants. The fact that housing is protected by security guards makes a larger positive impact especially at the segments of society having welfare which attracts the attention of thieves.

The spatial quantile regression estimation results are presented in Table 4. In all quantiles, according to the 0.01 significance level, the spatial dependence coefficients are seen to be statistically significant. These results also indicate that the spatial effect exists in the model. The dependence between rental prices as a result of neighborhood effect are taken into account via this model. It is seen that the coefficients from the spatial quantile regression are obtained according to the economic expectations.

Table 4. Spatial Quantile Regression Model Estimation Results (between 0.1-0.9)

τ	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Spatially Lagged Logarithmic Housing Rental	0.27282*** (0.06282)	0.31414*** (0.04876)	0.34629*** (0.05459)	0.30500*** (0.06021)	0.30054*** (0.06530)	0.28064*** (0.05397)	0.24387*** (0.05877)	0.28380*** (0.06165)	0.46611*** (0.07641)
constant	4.29803*** (0.44444)	4.08333*** (0.32539)	3.91853*** (0.36973)	4.24434*** (0.41437)	4.35314*** (0.45142)	4.50857*** (0.37585)	4.79350*** (0.41953)	4.62511*** (0.43587)	3.26800*** (0.58872)
m^2	0.00310** (0.00144)	0.00372*** (0.00033)	0.00361*** (0.00035)	0.00357*** (0.00037)	0.00356*** (0.00049)	0.00392*** (0.00049)	0.00423*** (0.00048)	0.00419*** (0.00072)	0.00507*** (0.00087)
Housing age	0.00791** (0.00360)	0.00630** (0.00255)	0.00762*** (0.00231)	0.00927*** (0.00233)	0.00800*** (0.00252)	0.00891*** (0.00279)	0.00983*** (0.00382)	0.01328*** (0.00344)	0.01882*** (0.00496)
Bathroom	-0.26693*** (0.09049)	-0.20357*** (0.04712)	-0.16733*** (0.05051)	-0.18477*** (0.05696)	-0.17176*** (0.05570)	-0.15823*** (0.05447)	-0.18499*** (0.06961)	-0.20980*** (0.07100)	-0.07812 (0.08585)
Security	0.15967*** (0.05292)	0.17960*** (0.04446)	0.20513*** (0.04977)	0.21652*** (0.05534)	0.24789*** (0.05068)	0.26647*** (0.04868)	0.28398*** (0.05994)	0.27092*** (0.05741)	0.28060*** (0.06755)
Subway	0.22365*** (0.08245)	0.21244*** (0.03991)	0.22495*** (0.04182)	0.21019*** (0.04444)	0.16449*** (0.04517)	0.19828*** (0.05741)	0.23162*** (0.06548)	0.27474*** (0.06100)	0.23410*** (0.05660)
White Goods	0.24256*** (0.06217)	0.24591*** (0.04620)	0.27015*** (0.05993)	0.28712*** (0.06691)	0.32356*** (0.05703)	0.36046*** (0.05316)	0.29974*** (0.05849)	0.28964*** (0.05103)	0.20619*** (0.06273)
Jacuzzi	0.17025*** (0.06114)	0.17158*** (0.03962)	0.16261*** (0.04333)	0.22293*** (0.04609)	0.20587*** (0.04370)	0.16772*** (0.04455)	0.16678*** (0.05363)	0.17667*** (0.05029)	0.12251** (0.05017)
Highway	0.02574 (0.04987)	-0.07262* (0.04127)	-0.12475*** (0.03984)	-0.13395*** (0.04492)	-0.14923*** (0.04319)	-0.16922*** (0.04309)	-0.13765*** (0.05356)	-0.15820*** (0.04986)	-0.14237*** (0.05284)

Not: i. Spatially lagged rental price variable is Wy
ii. τ, denotes the quantile
iii. ***0.01, **0.05, *0.10 refers to the significance level
iv. values in parentheses are standard errors.

The estimated spatial quantile coefficients show differences in variables along the conditional price distribution regarding the size. In the 10th quantile, the spatial effect is statistically significant as in the other quantiles. Accordingly, current location and neigbouring locations house rents have been determined to be related ie spatial weighted average of house rents in the neigbouring locations affects current location house rents in the same direction because of the positive sign. This positive impact is greater in high quantiles. As seen from the spatial coefficient, because of the high interaction between the housing rents in these areas having welfare, rent increases influence each other very quickly and consist almost a multiplier effect. The fact that this effect is higher in these segments of society which have a higher socio-cultural level than others, shows that all kinds of positive activities in the region such as luxury building construction, public activities of municipalities effect very quickly the rents in the relevant area. This rapid effect show that the rents in the area never drops below a certain level, therefore only the person who captures a certain income level is no difficulty in finding rental housing.

In the 10th quantile, the coefficients of the variables are statistically significant except TEM. Bathroom has the biggest reducing effect in this quantile among others and the other variables have increasing effects on housing rents. Up to the 10th quantile except 90th, all variables are statistically significant. Bathroom and TEM have reducing effect on the house rents while others have increasing effects. This situation shows that houses with more than one bathroom are preferred frequently in all segments of the population. The houses near TEM have lower rent due to air and noise pollution. White goods, has the most important effect especially in the middle quantiles where exist people with low income after paying the rent. Security is more important as expected in the higher quantiles because the houses where rich people live are more attractive to thieves. In the 90th quantile, the spatial effect is the biggest one among others because the population in the current location (district etc.) is more homogeneous than others in both economic and socio-cultural aspects.

When looking at both quantile regression and spatial quantile regression model coefficients, in the spatial quantile regression model where the spatial effect is taken into account, the effects of the coefficient magnitudes belonging to almost all residential properties for all quantiles has decreased according to the quantile regression coefficients.

5. Conclusion

Istanbul is a city in Turkey's central location and for this reason there is much migration from other regions. The fact that Istanbul is the financial and business center has a very significant effect on rapid increase in the population. Given that people's one of the basic needs is housing need, for rapidly growing population, housing are made in different styles that appeal to different segments. Therefore, an overview of the analysis of the Istanbul residential market can not capture the differences between locations and the different segments of the society. Therefore in the study, beside the quantile regression, the spatial quantile regression model, where these differences may be demonstrated, is also used. Thus, the spatial effects and spatial dependence are taken into account and are allowed to estimate the coefficient where the spatial effect can be seen.

In our study, considering the spatial dependence, it was found that a reducing effect of same housing

characteristics on housing rents occurs and that the inclusion of the spatial effect in the model has a reducing effect on the coefficients magnitudes. The spatial effect seems to be significant and has a positive effect on all rental housing prices. In this case, it is realized that there is a positive externality between neighboring locations and that this effect exists mostly in the best part of society as socio-economic situation. Also this conspicuous homogeneity in the relevant locations is a result of rapid interaction from past to present. In the locations where judge an improved economic and socio-cultural structure, this homogeneity make also a significant impact on the housing rent and it is becoming almost impossible to find rental housing in these segments below a certain rental price level due to the rapid interaction. Therefore, to make real estate investments in these regions is quite a profitable business because a powerful and fast realization of the positive externalities is adding value to these regions of Istanbul.

The size of housing has an increasing impact on housing rents. Only one bathroom in the housing, has a diminishing effect on rental housing prices. This effect is stronger in less developed parts of society where larger families are living. Having more than one bathroom in housing and Jacuzzi among them, has an enhancing effect on rental housing prices. The presence of white goods, has a larger increasing effect on rental housing prices in the middle part of the society. The importance of the presence of security services, is increasing towards more developed areas in terms of social welfare. If the richer sections of society are considered to be more attractive for thieves, this result also is in line with expectations. Moreover, the housing proximity to the highway has a negative impact on housing rents. The noise and air pollution are considered to be important factors in this effect. The proximity to the metro that provides convenience in terms of both speed and comfort in urban transport has an increasing impact on housing rents. Despite the fact that housing type and heating type are significant factors on housing prices, insignificance of these effects on housing rents, can be explained by staying temporarily in rental housing and being able to move on to another rental housing at any time ie by the ease of mobility.

There seems to be a significant impact of spatial and neighborhood characteristics on rental housing prices, when the results are evaluated in general in the Istanbul housing market. In addition, housing size and number of bathrooms were found to be important factors for all segments of society. The presence of white goods in rental housing is among the factors that influence rental prices positively. People want to buy few items as possible for rental housing where they won't live permanently because it is easier to carry the few belongings when moving to another location. In today's metropolises, to be quite close to the metro is very important due to facilitating access to all sections of the community. For all these reasons, rental housings having more living area (m^2), multiple bathrooms, being furnished and close to the means of transport will have higher rental prices and the neighbors' rental housing prices will be affected more or less in different parts of the rent increase due to the positive externalities.

Due to the fact that the fluctuations in the Turkey real estate market are influenced largely by the Istanbul real estate market, the findings from this study can provide information's for the correct implementation of housing policies for this market. This is a fact that the policies which can be applied for the Istanbul real estate market, will affect also the fluctuations of the housing markets in other regions.

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