



Regression Analysis for the Factor Affecting on Farm Land/Urban Land Value in Urban Sprawl

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ABSTRACT

In this study, the factors affecting on land value in urban sprawl were analysed via regression analysis. In the analyse, the nominal value of land was taken to be dependent variable while factors affecting the value of the land in urban sprawl were considered to be independent variables. 9 factors that were thought to affect the value of the land were handled. In this study, 3 separate models were analyzed, and all models provided statistically significant results. The basic reason for applying three separate models is to be witness the effects by including the variables in different categories (environmental, social amenity and economical factors) separately to the model. As a result of these analyses, all of environmental, amenity and economic factors should be considered for valuation of urban sprawl.

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Kentsel Saçaklanma Alanlarındaki Arazilerin Değerini Etkileyen Faktörler için Regresyon Analizi

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ÖZ

Bu çalışmada, kentsel saçaklanma alanlarında bulunan arazilerin değerini etkileyen faktörlerin regresyon modeli ile analizi yapılmıştır. Analizde arazinin nominal değeri bağımlı değişken olarak alınırken, değeri etkileyen 9 faktör bağımsız değişken olarak alınmıştır. Çalışmada 3 ayrı model analiz edilmiş ve bütün modeller istatistiksel olarak anlamlı bulunmuştur. Üç ayrı model uygulamanın nedeni, farklı kategorilerdeki değişkenleri (çevresel, sosyal ve ekonomik faktörler) modele ayrı ayrı dahil ederek etkilerinin görülmek istenmesidir. Analizler sonucunda, kentsel saçaklanma alanlarının değerlendirilmesinde çevresel, ekonomik ve rahatlık sağlayan bütün faktörlerin dikkate alınması gerektiği ortaya konulmuştur.

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Introduction

The lands of urban sprawl are defined as lands that have lost their rural characteristics and yet cannot be defined as urban. These areas include specific uncertainties results in various problems such as unplanned urban growth and use of non-agricultural purpose. This problematic is considered as the main reason for the uncertainty of the land valuation in the urban sprawl areas.

Increase of demand for settlement area with the increase of population density in city center requires expansion beyond city boundaries in the sense of settlement (Cavailhes and Wavresky, 2003). Expansion of urban areas caused decrease of first-class agricultural lands around various big cities (Greene and Stager, 2001; Livanis et al., 2005). Increasing the demand of agricultural lands for urban use has caused over time increasing the value of agricultural lands especially in areas of rapid urban growth (Shi et al., 1997; Cavailhes and Wavresky, 2003; Livanis et al., 2005; Coisson et al., 2014). For example, in Poland it was observed that prices of agricultural land increased in the rate of 40% between 2000 and 2004 (EEA, 2006). In Beijing, the capital city of China, it was determined that 870 km² irrigable land was converted to urban utilization between 1996 and 2004 (Fang et al., 2007).

As the non-agricultural use of agricultural lands increase, it is observed that producers accept conversion of agricultural land on the grounds that opportunity cost is higher and they give up agricultural production (Adrian and Cannon, 1992). Rent obtained in urban area being higher and risk being less than agricultural income is regarded as one of the reasons of expansion of cities towards agricultural land. In spite of this, it is legally compulsory to protect agricultural land and use according to natural characteristics according to Law No. 5403 on Soil Preservation and Land Utilization. However in

Turkey, non-agricultural use of agricultural land through conversion of agricultural land into plots by making it zoned for housing within the scope of urban development is regarded as one of the most important problems.

Material and Methods

The study was conducted in 3 central sub-districts (Selcuklu, Meram, Karatay) of Konya province located in the Middle Anatolian Region of Turkey. These sub-districts divided into 264 quarters.

Nominal value explains the factors effective on the land values.

$$NV = \sum_1^i (ifactor_s * ifactor_w)$$

- n(nv)* : nominal value index for n quarter,
- ifactor_s* : scoring of i variable for n quarter,
- ifactor_w* : weight value of i variable for n quarter

Nominal valuation method average nominal values for each quarter in research area were detected. In this method, via functionalizing the factors effective on value, obtained coefficients can be exchanged into current value at any time. Thanks to value maps created with these coefficients, the values are safeguarded against any potential regional or national economic changes.

In the last stage of method process, in order to detect the variables effective on the land value of farm or urban land in Konya case, a statistical analysis was conducted. In statistical analysis nominal value index obtained in previous stage is taken as dependent variable while 9 variables were included in the model as independent variables (Table 1).

Table 1 The variables for regression analysis

Variable	Abbr.	Definition of Data	Source
Dependent Variable			
Nominal Value Index	NOMINAL	As mentioned above	This study
Independent Variable			
Land Use Capability Class	LUCC	I-IV. Class Land	10
		V-VI. Class Land	5
		VII-VIII. Class Land	1
Proximity to Centre of Urban	CITYDIS	Distance crow flies to Centre of quarter from centre of urban	Map
Urban Rent	RENT	$KAKS = \frac{\text{construction permit given by master plan}}{\text{total size of i quarter}}$	Master Plan
Infrastructure	INSTR	$\frac{\text{total asphalt path lenght for n quarter}}{\left(\frac{\text{size of i quarter}}{\text{total size of all quarter}}\right) \times \text{total asphalt path lenght}}$	Database of the municipality of Konya
Environmental Pollution	ENVPOL	$\frac{\text{number of building with solid fuel for n quarter}}{\text{total size of n quarter}}$	
Number of building	BUILT-UP	$\frac{\text{number of building for n quarter}}{\text{total size of n quarter}}$	
Education Unit	EDUC	n quarter have a education unit n quarter have not a education unit	
Health Unit	HEALTH	n quarter have a health unit n quarter have not a health unit	1 0
Income of Households	INCOME	Total income of households per a month (\$)	

The analysis was formulated such (Gujarati, 1995);

$$Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + \dots + b_nx_n + u$$

Where Y is nominal land value, b_0 consultant parameter and other parameters that are factors affecting land value. Regression analysis was used in many studies as an alternative to conventional methods (income, sale methods) (Sunderman and Brich, 2002; Vasquez et al., 2002; Karakayaci, 2011).

Soil types were divided into 3 categories and after scoring on the basis of the importance of each single category, they were included into the analysis. Proximity to city center variable represents air distance from the quarter center to city center. In present study asphalt road lengths in quarters were accepted as data standing for infrastructural amenities of quarters. Within this framework considering the fact that quarter sizes vary, instead of total length of asphalt road in every single quarter, per-unit area length of asphalt road in every single quarter was analyzed. In the same way, for each quarter, number of houses per unit area and number of houses using solid fuels were taken as factors affecting the value in sprawl lands. Aside from physical variables, the existence of education and health amenities in spatial units were accepted as social and human factors affecting the value because urban sprawl are identified as areas lacking amenities such as education and health (Sudhira and Ramachandra, 2007). In addition, as the economic factors, urban rent and average household income level are the determinant variables on the net value. One of the factors bearing utmost effect in changing farm lands to areas is that urban rent is greater than farm rent. Accordingly in Turkey, particularly in detecting land values, zoning plan resolutions play determinant role hence in this research, average construction area percentage given per parcel to each quarter by zoning plan resolutions was taken as urban rent.

Results and Discussions

In order to measure the degree and direction of the bilateral relation between the factors affecting the value of farm lands in urban sprawl areas and nominal value, correlation analysis was conducted; in order to measure effect degree of the factors, regression analysis was employed.

The results of correlation analysis revealed that there is a positive-direction and high-level significant relationship between nominal value and urban rent; a negative-direction and medium-level significant relationship with the proximity of area/land to the city; a positive-direction and medium-level significant relationship with environmental pollution and number of housing; a positive-direction and weak-level relationship with education, health units and household income (Table 2).

The spatial units within sprawl area, infrastructure amenities are rather insufficient and identical in quality; hence they bear no significance for regression analysis. However in the calculation of urban rent the use of zoning plan structuring densities, the co-inclusion of zoning status and rent variables into the analysis, an autocorrelation

would emerge. Therefore zoning status was not included into the analysis as a variable.

In this study, 3 separate models were analyzed and all three models provided statistically significant results. The basic reason for applying three separate models is to be witness the effects by including the variables in different categories separately to the model. In analysis, econometric problems such as autocorrelation and multiple connections were not found. In Model 1, environmental factors such as class of land-use capability, proximity to the city center and environmental pollution were analyzed and Determination Coefficient (R^2) of this model was detected as 46.3%. This ratio reveals that the factors analyzed in this model can explain the value of farm lands in urban sprawl areas up to 46.3% and that means these variables are not enough for description of the model. In Model 2, in addition to these environmental factors, social amenity factors such as health, education units and housing number were also counted. Model 2 was also found to be significant with respect to p value and social amenity factors included in this model increased determination coefficient up to 23.3% and rose to 69.6%. In Model 3, economical factors such as urban rent and household income were analyzed according to the model and significant results were received. In this model, R^2 coefficient was computed as 89.5% and it was concluded that analyzed factors were capable of explaining the model up to this rate (Table 3). It highlights that all of environmental, amenity and economic factors should be considered for valuation of urban sprawl.

In model 3 where all the variables were analyzed LUCC, health unit, education unit, urban rent and household income variables were found to be 1% significant whereas proximity to city, environmental pollution and housing number variables were found to be 10% significant. According to Model 3, on condition that all the other variables remain constant, when LUCC decreases 1 unit the value of farm lands in urban sprawl area increases 0.074 unit. I., II., III. and IV. Class lands are the most favorable ones for farming and farm lands in this group, compared to V.-VIII. Class lands, enables greater farm rent which in effect boosts the prices of farm lands. Although in the analysis it was determined that LUCC played effective role in the value of farm lands, it was also identified in the analysis of urban sprawl areas that city farm lands in urban sprawls lost their farm properties and fertile farm lands were now used for non-agricultural purposes.

According to Model 3, on condition that all the other variables remain constant, when the proximity to the city increases 1 unit, the value of the land decreases 0.034 unit. There is inverse proportion between proximity to the city and land value, and the closer to the city the higher is land value. As one gets closer to the city, it becomes more feasible to make use of urban amenities. In urban sprawl areas formed near the city and in the rise of the value of the farm lands selected for these areas, this factor is likely to have played a role. Likewise, on condition that all the other variables remain constant, a 1 unit increase in environmental pollution creates 0.022 unit decrease in land value. Indeed, environmental pollution in city center is listed among the reasons of urban sprawling (EEA, 2006).

Table 2 Correlations of the factors affecting land value

	CITYDIS	ENVPOL	BUILT-UP	EDUC	HEALTH	RENT	INCOME	NOMINAL
CITYDIS	1							
ENVPOL	-0.722*	1						
BUILT-UP	-0.701*	0.874*	1					
EDUC	-0.391*	0.544*	0.447*	1				
HEALTH	0.082	-0.088	-0.056	-0.133	1			
RENT	-0.596*	0.606*	0.714*	0.415*	0.054	1		
INCOME	-0.370*	-0.003	0.108	-0.015	-0.142	0.219	1	
NOMINAL	-0.659*	0.510*	0.634*	0.430*	0.268	0.814*	0.395*	1
	0.000	0.000	0.000	0.001	0.055	0.000	0.004	

*Correlation is significant at the 0.01 level

Table 3 Estimated Coefficients of Regression Models for sprawl areas Konya urban region

Variable	Model 1			Model 2			Model 3		
	Coeff.	SE	P	Coeff.	SE	P	Coeff.	SE	P
Constant	3.402	0.286	0.000	2.680	0.266	0.000	1.557	0.313	0.000
LUCC	-0.049	0.032	0.132	-0.035	0.026	0.185	-0.074	0.017	0.000
CITYDIS	-0.125	0.038	0.002	-0.112	0.030	0.001	-0.034	0.021	0.115
ENVPOL	0.012	0.019	0.510	-0.064	0.023	0.008	-0.022	0.015	0.155
HEALTH				0.368	0.096	0.000	0.293	0.061	0.000
EDUC				0.353	0.114	0.003	0.269	0.069	0.000
BUILT-UP				0.033	0.009	0.001	0.003	0.007	0.622
RENT							0.008	0.001	0.000
INCOME							0.001	0.000	0.008
R ²	46.3%			69.6%			89.5%		

It was also seen that the presence of education and health units increased the land value in urban sprawls respectively by 0.293 and 0.269 units. Due to the inadequate numbers of education and health amenities in urban sprawl areas and since these are the basic needs for the population, these factors bear utmost importance. Due to these reasons, in the analysis it is seen that these factors have higher coefficients than the other factors. These factors are important in the valuation of farm lands in rural areas as well (Karakayaci, 2011), however since population density in urban sprawl areas is even higher its significance rises even more. Likewise 1 unit increase in housing number stimulates land value in city sprawls per 0.003 unit. As a result of urban growth, urban sprawl areas are used as residences, hence in such areas housing number rapidly increases each new day.

Polyzos et al. (2013) in the regression analysis they conducted showed that illegal housing is among the top factors affecting urban sprawling so they drew attention to the gravity of urbanization and housing policy. In our research too, it is seen that in non-zoning areas there are construction activities which is another indicator of urban sprawling. Consequently in urban sprawl areas insufficient infrastructure amenities are seen. As a result, one of the outcomes of urban sprawling, a rise in infrastructure costs (Heimlich and Anderson, 2001; Humstone, 2004), emerges. The fact that presently infrastructure investments in research area fail to be sufficient indicates that there is

need for bigger infrastructure costs. In that case, urban rent surfaces as a crucial factor determining the value. In the analyses covering Konya case, the significance of urban rent is prioritized. According to this analysis 1 unit increase in urban rent initiates 0.008 unit climb in the value of lands in urban sprawls. Urban rent is the opportunity cost of farm rent and stands as quite an important factor for the farm lands in urban sprawl areas.

As indicated in the results of analysis, a 1 unit rise in household income drives 0.001 unit increase in the value of urban sprawl areas. In the urban sprawl area constituting the scope of this research it was detected that household income level is remarkably lower than the average household income level of Konya city hence it was concluded that in urban sprawl area the population is mostly low-income. The reasons are; in urban sprawl areas there are affordable houses with low rents, and these areas are mostly populated by low-income people who used to live in rural areas. In contrast to this result, Hirt (2007) in his Sofia-based study showed that residents of urban sprawl areas have higher income than the ones living in city center. These were the people who escaped from the hassle of city center to live in their comfortable houses. On the other hand, Wu (2006) noted that in societies with high income inequality the emergence of urban sprawling is more likely. Wu also analyzed the link between urban sprawl and environmental amenity & social characteristics and reported that places with greater environmental

amenity attract more people with higher household income level. He also underlined that high-income level and lower commuting costs create sprawling and better public services could be catered for the residents in such areas. On the other hand, our research indicated that in urban sprawl areas income level is lower and infrastructure services are poorer. This verifies that urban sprawling differs from one region to another.

In the study carried out by Eyoh et al. (2012), by using data of 1984-2000 for Lagos, the capital city of Nigeria, estimation modeling was made about how the urban expansion would be in 2030. In the model in which logistic regression was used, distance to water, distance to medium-density city (housing area), distance to dense city (industry and business centers), distance to main roads, distance to railway, distance to Lagos, distance to airport, distance to seaport and distance to university were used as variables. As a result of the study it was concluded urban expansion until 2030 would emerge in areas that are close to city center which is an outcome of urban sprawl.

In the United States and Western Europe, ineffective use of sprawl area resources, loss of green lands, deterioration of habitats and poor access to central regions may cause problems in the sustainability of urban development (Slaev and Nikiforov, 2013). In the same way, in our study, the use of farm lands in urban sprawls for urban growth and ineffective use of land resources will likely to create problems in the sustainability of urban development.

Conclusions

In present research analyzing the affecting factors of farm lands value in urban sprawls, it was concluded that particular farm lands were valued to be used for non-agricultural purposes hence they were treated as market-led immovable estates. Indeed Slaev and Nikiforov (2013) in their research emphasized that one of the basic features of sprawling is its acceptability as Market-led and this might stem from the failure of equilibrium between market trends and planning policies.

Urban rent is the opportunity cost of farm rent and stands as quite an important factor for the farm lands in urban sprawl areas. Since urban rent is much higher than farm rent, farm land owners prefer to transform their farm lands into urban lands which in effect leads to a remarkable rise in the value of lands within urban sprawls areas.

Consequently, it was revealed that the land value in urban sprawl is affected not only rural factors but also urban factors. In fact, it was seen to be more effective urban factors. The lands of urban sprawl which are defined as lands that have lost their rural characteristics and yet cannot be defined as urban include specific uncertainties results in various problems such as unplanned urban growth and use of non-agricultural purpose. To sum up it has been concluded that urban sprawling speeds up the transformation process occurred in land use. It is seen that in research area transformation from rural land to urban land takes place rapidly.

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