JOEEP

Journal Homepage: http://dergipark.org.tr/joeep

Araştırma Makalesi ● Research Article

Analysis of the Relationship Between Economic Growth and Housing Demand for Türkiye with Spatial Panel Econometrics Approach

Türkiye İçin Ekonomik Büyüme ile Konut Talebi Arasındaki İlişkinin Mekânsal Panel Ekonometri Yaklaşımıyla Analizi

Ayça Doğaner [a, *]

[a] Dr., İstanbul Ticaret Odası, Meslek Komiteleri Müdürlüğü, 34112, Eminönü, İstanbul/Türkiye
ORCID: 0000-0003-4277-9326

MAKALE BİLGİSİ

Makale Geçmişi:
Başvuru tarihi: 1 Ekim 2022
Düzeltme tarihi: 6 Ekim 2021
Kabul tarihi: 17 Ekim

Anahtar Kelimeler:
Ekonomik Büyüme
Konut Talebi
Mekansal Ekonometrik Modeller

ÖZ

Bu çalışmanın amacı, 2019 yılında Türkiye'de tüm illerde konut talebi ile ekonomik büyüme arasındaki ilişkilerin saptanmasıdır. Bu çalışmada, mekânsal etkileri ortaya koyabilmek için yatay kesit veri kullanılmıştır. Bu çalışmada, şehirlerin mekânsal komşuluk durumu bulunduğundan, bağımlı ve bağımsız değişkenlerin birbirleri üzerindeki etkilerinin birbirlerine yakınlık durumuna göre etkileri tespit edilmek istenmekte olduğundan mekânsal ekonometrik modeller kullanılmıştır. Mekânsal ağırlık matrisi ise sınır komşuluğuna göre oluşturulmuş olup, standardize edilmiş hali elde edilmiştir. Çalışma kapsamında, Genel Yuvalanmış Mekânsal Model (GNS), Genel Mekânsal Model (SAC), Mekânsal Durbin Hata Modeli (SDEM), Mekânsal Durbin Model (SDM), Mekânsal Gecikme Modeli (Mekânsal Otoregresif Model:SAR), Mekânsal Hata Modeli (SEM), Mekânsal Gecikmeli X Modeli (Bağımsız Değişkeni Mekânsal Gecikmeli Model:SLX) sonuçları tespit edilmiştir. Araştırma sonucunda, GSYH değişkeninin tüm modellerde anlamlı ve pozitif etkili bir parametre olduğu belirlenmiştir. Mekânsal gecikmeli GSYH parametresi de mekânsal gecikmelerin dikkate alındığı modellerde anlamlı, SDM ve GNS modellerinde negatif etkili, SDEM, SLX ve SDEM-GMM modellerinde pozitif etkili olarak tespit edilmiştir. Yapılan Global ve Lokal Moran'ın I testi sonuçlarına göre ise, Türkiye'nin tüm illerinde konut talebinin belirleyicisi olduğu GSYH değişkeninin, kendilerine komşu olan illerle pozitif mekânsal otokorelasyonlu olduğu, GSYH değişkeninde meydana gelen şokların ya da etkilerin, diğer iller üzerindeki konut talebini de etkilediği tespit edilmiştir.

ARTICLE INFO

Article history:
Received: Oct 7, 2022
Received in revised form: Oct 6, 2022
Accepted: Oct 17, 2022

Keywords:
Economic Growth
Housing Demand
Spatial Econometric Models

ABSTRACT

This study aims to determine the relationship between housing demand and economic growth in all provinces of Turkiye in 2019In this study, horizontal section data was used to reveal the spatial effects. In this study, spatial econometric models were used since cities have spatial neighborhood status and the effects of dependent and independent variables on each other are to be determined according to their proximity to each other. The spatial weight matrix was created according to the border neighborhood and its standardized form was obtained. Within the scope of the study, General Nested Spatial Model (GNS), General Spatial Model (SAC), Spatial Durbin Error Model (SDEM), Spatial Durbin Model (SDM), Spatial Lag Model (Spatial Autoregressive Model: SAR), Spatial Error Model (SEM), Spatial Lagged X Model (Independent Variable Spatial Lagged Model: SLX) results were determined. As a result of the research, it is determined that the GDP variable is a significant and positively effective parameter in all models. The spatially lagged GDP parameter is also found to be significant in models where spatial lags are taken into account, negatively effective in SDM and GNS models, and positively effective in SDEM, SLX, and SDEM-GMM models. According to the results of the Global and Local Moran's I test, the GDP variable, which is the determinant of housing demand in all provinces of Turkiye, is positively spatially autocorrelated with the neighboring provinces, and the shocks or effects occurring in the GDP variable also affect the housing demand in other provinces.

1. Introduction

In both developed and developing countries, the construction sector has a very important place. It is prioritized in economic policies due to the added value it provides, the employment it generates, and its ability to

* *Sorumlu yazar/Corresponding author*.
e-posta: *ayca.doganer@gmail.com*

Atıf/Cite as: Doğaner, A. (2022). Analysis of the Relationship Between Economic Growth and Housing Demand for Türkiye with Spatial Panel Econometrics Approach. *Journal of Emerging Economies and Policy*, 7(2) 214-223.

stimulate many other sub-sectors to grow, and it is seen as the most important factor in increasing economic growth rates. While the construction sector plays an important role in the macroeconomic policies of countries, it also supports development by causing changes in the social structure.

The most important item of the construction sector is housing production. In addition to meeting people's need for shelter, the housing sector also contributes to redistributing income and ensuring a stable economic structure (Yetgin, 2007: 312). Production in the field of housing, which is important due to these characteristics, should not be evaluated alone but should be considered in connection with other sectors and the general course of the economy.

In particular, the effects of changes in housing demand, which can be expressed as housing sales, on macroeconomic variables such as growth and employment are the subject of econometric studies in the literature. The relationship between housing demand and economic growth is an area that is emphasized by government administrators and policymakers in terms of the economy. Governments also take steps to support housing demand through regulations on the development of the construction sector and housing supply.

The demand for housing is increasing day by day for both housing and investment purposes. Housing, which is also seen as an indicator of the living standards of individuals in society, is seen as a luxury image in some societies as well as a necessity. With the rise in population and income levels, the tendency of individuals to acquire housing or to change their existing housing is increasing. Especially for Turkiye, it can be said that there has been a rapid increase in housing demand due to factors such as migration. This situation shows that, especially in recent years, regional or provincial housing demand can also be affected by specific variables.

While a shock/impact that causes these factors to change may lead to an increase or decrease in housing demand, region-specific factors may also affect housing demand. Geographically, a shock/impact in one region may also affect other neighboring regions. Generally, econometric models, which have been extensively used in the literature, do not measure the outcome of geographical neighborhood effects. In this respect, spatial econometric methods have been developed that take into account the geographical neighborhood relations between variables and the effects that may arise due to these relations. Due to the above-mentioned conditions, the relationship between housing demand and macroeconomic variables of countries is scientifically intriguing and is of great importance for the vitality of the economy in countries like Turkiye where the construction sector has a significant share in the economic functioning.

This study investigates the effects of economic growth on housing demand in Turkiye. This study aims to contribute to the literature by determining whether economic growth increases the demand for housing and the direction and the extent of this increase through tests that take into account spatial effects based on provinces in Turkiye. For this purpose, economic growth rates and housing demand are used as variables. The study consists of four chapters: an introductory section followed by a literature review, the third chapter explains the methodology of the study, and the final chapter presents the results of the empirical analysis.

2. Literature Review

In the literature, there are studies in which housing-related variables are taken as a basis, and comparisons are made with various macroeconomic variables. Macroeconomic variables in these studies generally include variables such as inflation rate, economic growth, and interest rates. Some studies include demographic variables.

There are cases where individuals demand housing for investment purposes as well as for housing needs. Therefore, regardless of whether it is for housing or investment purposes, housing demand may increase in countries with the growing population and economic growth. However, the relationship between housing demand and economic growth is a process that involves different dynamics for each country and economy. For this reason, this study examines the relationship between housing demand and economic growth in Turkiye, while also reviewing the related literature. The table below presents examples of studies on the housing market and housing demand and economic growth.

Gelfand (1966), one of the first studies in this field, identified credit conditions and loan interest rates as the most important factors affecting housing demand. In the study, it is stated that loans with flexible payments, especially for middle-income earners, have a significant impact on housing demand. Bocutoğlu and Ertürk (1992) analyzed the housing demand in Turkiye and found that the most important variable affecting the housing demand in Turkiye is the high population growth. Dornbusch and Fischer (1994), on the other hand, state that housing demand depends on household income and wealth as well as the price of housing in the market.

In the study by Lopes et al. (2002), investments in the construction sector and per capita income variables are analyzed by correlation analysis for 15 sub-Saharan African countries with data for the period 1970-1992. As a result of the analysis, it was found that investments in the construction sector have positive results to ensure sustainable growth in the economy.

Chang and Nieh (2004) conducted a cointegration analysis to determine the relationship between the housing sector and economic growth in Taiwan using data for the period 1979Q1-1999Q4. As a result of the analysis, it was found that developments in the housing sector lead to economic growth in the short and long run.

Rivero (2008), in his study, made a regression analysis using GDP, population, housing stock, mortgage interest expectations and number of immigrants data for Spain and its autonomous regions for the period 1995-2007. As a result of the analysis, it has been determined that the increase in housing prices is determined by the gross domestic product, population, housing stock, and mortgage interest expectations.

In their study, Öztürk and Fitöz (2009) conducted the Johansen cointegration test to determine the relationships between national income per capita, house prices and interest rates, and housing demand for Turkiye with 1968-2006 data. While there is a positive relationship between national income per capita, house prices and interest rates, and housing demand, there is an insignificant relationship between demographic factors and housing demand.

Lebe and Yiğit (2009) found that in the long run, Turkiye's housing demand is positively affected by per capita income, population and the number of marriages, while the general level of prices, real interest rate, housing cost and employment rates in the agricultural sector affect it negatively.

In their study, Degen and Fischer (2010) examined housing prices for 85 counties for Switzerland in the 2001-2006 period. By analyzing the variables of population change based on immigrants, changes in housing prices, the ratio of immigrants to the population and the amount of vacant space that can be housed, they determined that immigration increases the demand for housing and housing prices.

Alagidede and Mensah (2016) analyzed the relationship between housing sales and economic growth for Sub-Saharan African countries. As a result of the analysis, they determined a positive relationship between the housing sector and economic growth.

Uysal and Yiğit (2016) evaluated the demand market for housing in Turkiye. They examined in their study where Johansen and Johansen-Juselius applied cointegration tests, they found a one-way relationship between per capita income, urbanization rate, interest rates and housing demand, while an inverse relationship between unit price and CPI (Consumer Price Index) and housing demand.

Hatipoğlu and Tanrıvermiş (2017) examined the factors affecting investment preferences in terms of housing supply and demand in Turkiye and found that housing demand and housing loans given by banks were affected due to population growth and urbanization.

Mussa et al. (2017), for the housing market in the USA, housing rental and sales prices, number of immigrants, per capita income. They analyzed the Spatial Durbin Model using data on murder rate, theft, population, unemployment rate, population density, immigrant density, number of foreign population with residence permit and amount of land per capita. As a result, it has been determined that immigration to a city increases the housing demand, housing rents and prices in that city and neighboring cities.

Trofimov, Aris, and Xuan (2018), examined housing prices in Malaysia between macroeconomic and demographic determinants. They used Cointegration, Granger causality and variance decomposition analysis. As a result of their analysis low interest rates and increasing consumer prices also supported the housing price increase and GDP. They did not find any relationship between the level of housing prices and the increase in housing prices.

Kıral and Çelik (2018) aimed to determine the factors affecting the housing sales of provincial groups in Turkiye by using the balanced panel data analysis method for the period 2008-2015. According to the results of the analysis, it was determined that the housing price index and gross domestic product significantly affect housing demand.

Sabyasachi (2019) examined the relationship between real housing prices and various macroeconomic determinants for 43 countries. It has been determined that urbanization, age structure of the population, price-income ratio, price-rent ratio and GDP, exchange rate and inflation variables are effective in stabilizing housing prices.

In the study by Canbay and Mercan (2020), VAR/VECM analyses were conducted to test the functioning of the house price channel for Turkiye with data for the period 2010Q1-2019Q2. As a result of the analysis, short-run and long-run causality from interest rates to loan volume, and from loan volume to housing prices and consumer price index were found. On the other hand, short and long-run causality was found in the growth of housing prices.

Karadaş and Salihoğlu (2020) investigated the macroeconomic factors affecting the change in house prices for Turkiye with ARDL analysis using data for the period 2012:12-2018:07. As a result of the analysis, interest rates, inflation, total housing loans and the price index of construction materials affect house prices in the same direction, but the industrial production index affects house prices in the opposite direction.

In the study by Bayrak and Telatar (2021), Engle-Granger Cointegration test and VAR analysis were performed to determine the relationship between the construction production index and GDP for Turkiye with data for the period 2005:01-2016:04. As a result of the analysis, it was found that the construction sector does not affect economic growth in the long run, but there is a unidirectional causality relationship from economic growth to the construction sector in the short run.

In the study by Yardımcı (2021), VAR analysis was conducted to determine the relationship between the number of housing sales and economic growth for Turkiye with data for the period 2013Q1-2020Q4. As a result of the analysis, a long-run cointegration relationship was found between housing sales and economic growth. Housing sales have a positive effect on economic growth.

As can be seen, there are many studies in the literature that analyze the relationship between housing prices, housing demand and macroeconomic variables. In these studies, it is seen that mostly time series analyzes are applied. As a result of the examinations, it is seen that the studies that find a relationship between macroeconomic variables and housing demand and housing prices are in the majority in the relevant literature.

3. Method

This study aims to determine the effects of macroeconomic factors on the demand in the housing market in all provinces in Turkiye. Horizontal cross-sectional data is used in the study. In the empirical model to be constructed within this framework, the relevant variables are calculated with the spatial panel data method using 2019 data. Data from 81 cities with neighborhood relations between them were used. The data set of the study was accessed by using TurkStat Geographical Statistics website. In order to determine the demand for housing, data on the number of housing sales were taken as the basis. Spatial econometrics was used as the methodology and the analysis was carried out in Stata 17 program.

In an econometric regression model, spatial effects can be mentioned if the horizontal cross-section data consist of geographical locations such as a city, country, region, or continent. Spatial econometric models are used if there is a spatial neighborhood between the settlements in question and if it is desired to determine the effects of the dependent and independent variables on each other according to their proximity to each other.

3.1. Spatial Effect

The interaction between spaces is defined as spatial influence. Spatial effects influence the models in 2 ways.

3.2. Spatial Autocorrelation (Spatial Dependence)

Changes that occur depending on the neighboring space indicate spatial autocorrelation/dependence. Spatial autocorrelation is frequently observed in studies on spatial data since the changes occurring in geographical units such as cities, countries, regions and continents that are neighboring each other are not independent of each other and may react together and similarly to external shocks. The relationship and interaction between units that are close and neighboring to each other are higher than those that are far away. Spatial autocorrelation can occur in the dependent variable, independent variable, or error terms (Yerdelen Tatoğlu, 2022: 2).

3.3. Spatial Heterogeneity

In spatial models, neighboring geographical units such as cities, countries, regions, continents, etc. may be heterogeneous and the coefficients of the model or the variance of the error term may not be constant across locations. In the first case, heterogeneity can be estimated by reflecting it in various ways in the models. In the second case, heteroskedasticity may be caused (Yerdelen Tatoğlu, 2022: 3).

3.4. Spatial Weight Matrix

In analyzes conducted in the context of spatial econometrics, the measure of interactions between units is spatial weight matrices. Spatial econometric models are created and estimations are made according to spatial weight matrices. For this reason, weight matrices are very important in the spatial analysis of each unit with certain criteria for other units.

Spatial weight matrices are determined according to border neighborhoods or distances. The spatial weight matrix W is a positive definite symmetric matrix with n X n dimensions. n is the number of units. Each element wi,j in the matrix is related to the interactions in i and j. In the case of border neighborhood, it takes the value 1 if regions i and j are border neighbors and 0 otherwise. In addition to weighting by neighborhood, weighting can also be done by distance. In this case, the coordinates of the distances between the centers of two locations are used (Yerdelen Tatoğlu, 2022: 3-4).

3.5. Global and Local Moran's I Statistics

In spatial econometric analyses, some tests are conducted to determine which model will be appropriate. These tests provide information about the existence and type of spatial effect. One of the most widely used tests for testing spatial autocorrelation is Moran's I test developed by Moran (1950). The test detects spatial dependence in the dependent and independent variables and the error term. Global Moran's I test is used to test whether there is spatial dependence in the model in general. The Local Moran's I test is used when the relationship between a region and its neighboring regions is to be determined regionally.

$$I = \frac{N}{S_0} \frac{\sum_{i=1}^{N} \sum_{j=1}^{N} w_{ij} (Y_i - \bar{Y})(Y_j - \bar{Y})}{\sum_{i=1}^{N} (Y_i - \bar{Y})^2} \quad (1)$$

$$I = \frac{n}{S_0} \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij} \hat{u}_i \hat{u}_j}{\sum_{i=1}^{n} \hat{u}_i^2} \quad (2)$$

$$Z = \frac{I - E(I)}{[V(I)]^{1/2}} \quad (3)$$

$$E(I) = -\frac{1}{n-1} \quad (4)$$

$$Var(I) = \left(\frac{1}{S_0^2 (N^2 - 1)} (N^2 S_t - N S_2 + 3 S_0^2) \right) - E(I)^2 \quad (5)$$

$$S_0 \sum_{i=1}^{N} \sum_{j=1}^{N} w_{ij} = N \qquad S_1 = 2 \sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij} \qquad S_2 = 4 \sum_{i=1}^{n} w_i^2 \quad (6)$$

In the equations, wij is the spatial weight matrix, N is the number of observations, S is the standardization vector. E(I) is the expected value of Moran I and V(I) is its variance.

If the Moran I statistic is significant and the z score is high, the result is positive. If it is high and/or low, it is spatially clustered. If the Moran I statistic is significant but the z score is negative, it is not possible to talk about clustering.

3.6. Spatial Econometric Models

Classical linear regression models can first be estimated in a comparative sense due to the absence of spatial effects before proceeding to spatial analysis. After estimating the linear regression model, the presence of spatial effects is tested and the model is extended accordingly. This process is called the specific-to-general approach in the literature (Elhorst, 2014: 7).

3.6.1. General Nested Spatial Model (GNS)

In classical linear regression models, spatial dependence is characterized by two models: spatial correlation in the dependent variable and spatial correlation in the error term. The general nested spatial model, which includes all effects of spatial interaction, was developed by Manski (1993).

$$Y = \rho WY + X\beta + WX\theta + u \qquad u = \lambda Wu + \varepsilon \qquad (7)$$

Y: (Nx1)-dimensional dependent variable vector, X: (Nxk)-dimensional independent variables matrix with k being the number of parameters, β: (kx1)-dimensional parameters vector, W: (NxN)-dimensional spatial weight matrix, u: (Nx1)-dimensional error term vector (Yerdelen Tatoğlu, 2022, p.54).

In the general nested spatial model, there is a spatially lagged dependent variable, spatially lagged independent variables and a spatially autoregressive error term. The model is estimated by maximum likelihood.

3.6.2. General Spatial Model (SAC)

The general spatial model includes a spatially lagged dependent variable and a spatially autoregressive error term. In other words, it is obtained by subtracting lagged exogenous variables from the nested spatial model. In the general spatial model, the dependent variable is related to the dependent variable of the neighboring locations. At the same time, the error terms of the locations also interact.

$$y = \rho WY + X\beta + u \qquad u = \lambda Wu + \varepsilon \qquad (8)$$

The model can be estimated by maximum likelihood (MLE), generalized moments (GMM), two-stage ECT (2SLS) and generalized two-stage ECT (2SLS).

3.6.3. Spatial Durbin Error Model (SDEM)

The spatial Durbin error model is obtained by imposing the constraint ρ=0 on the general nested spatial model. Therefore, there is no spatially lagged dependent variable in the spatial durbin error model.

$$Y = X\beta + WX\theta + u \qquad u = \lambda Wu + \varepsilon \qquad (9)$$

In this model, the spatial weight matrices WXθ and λWu can be different from each other. Here, β stands for direct and θ for indirect effects. The model can be estimated by maximum likelihood (MLE) and generalized moments (GMM).

3.6.4. Spatial Durbin Model (SDM)

The spatial Durbin model is calculated by subtracting the spatially autocorrelated error terms (λ=0) from the general nested spatial model. There is a spatial effect in the dependent and independent variables.

$$Y = \rho WY + X\beta + WX\theta + u \qquad (10)$$

The model can be estimated by maximum likelihood (MLE) and two-stage ECT (2SLS).

3.6.5. Spatial Lag Model (Spatial Autoregressive Model: SAR)

It is a model in which the dependent variables of the locations are interrelated. It includes only spatially lagged dependent variables. Therefore, it is also referred to as a spatial autoregressive model. It differs from the general nested spatial model with θ=λ=0, the spatial Durbin model with θ=0 and the general spatial model with λ=0 due to the constraint.

$$Y = \rho WY + X\beta + \epsilon \qquad (11)$$

The model can be estimated by maximum likelihood (MLE) and two-stage ECT (2SLS).

3.6.6. Spatial Error Model (SEM)

In the spatial error model, the error terms of neighboring locations move together. This is when there is spatial interaction in the error terms. It differs from the general nested spatial model with ρ = θ = 0, the general spatial model with ρ = 0 and the spatial durbin error model with θ = 0 constraint (Yerdelen Tatoğlu, 2022: 56).

$$Y = X\beta + u \qquad u = \lambda Wu + \varepsilon \qquad (12)$$

The model is estimated by maximum likelihood (MLE) and generalized moments (GMM).

3.6.7. Spatially Lagged X Model (Model with Spatially Lagged Independent Variable (SLX)

The spatial error model includes independent variables with spatial lags. Since it contains only spatial explanatory variables, it differs from the general nested spatial model with ρ =λ = 0, from the spatial durbin error model with λ = 0 and from the spatial durbin model with ρ = 0 (Yerdelen Tatoğlu, 2022: 57).

$$Y = X\beta + WX\theta + u \qquad (13)$$

The model is estimated by ordinary least squares (OLS) and maximum likelihood (MLE).

3.6.8. Model without Spatial Effects

It is the model that emerges as a result of the tests that there are no spatial effects in the dependent variable, independent variables and error term.

$$Y = X\beta + u \qquad (14)$$

There are no spatial effects in the model despite the presence of unit-sized locations. Therefore, an estimation can be done by ordinary least squares (OLS) or maximum likelihood (MLE).

3.6.9. *Implementation Results*

The dependent variable in this study is the total number of housing sales. The total number of housing sales (LnKSS) refers to the total housing demand in that province. The independent variable is GDP (Thousand TL) (LnGSYH). Data are taken on a provincial basis. The logarithms of the number of housing sales and GDP variables are taken. The spatial weight matrix is constructed according to the neighboring status of the provinces and formed according to the border neighborhood. The model is first estimated with OLS. The regression model is estimated as follows:

$$\ln KSS_i = \beta_0 + \beta_1 LnGSYHi + u_i \quad (15)$$

Table 1: Regression Model

LnKSS	Coefficient	Std.error	t statistics	Probability
LnGSYH	1.06	.515	20.65	0.000
Constant	-3.94	.379	-10.39	0.000
F statistics	426.45			
R^2	0.84			

H_0: Parameters other than the fixed parameter are together equal to zero.
H_1: At least one parameter is different from zero.

As seen in Table 1, the calculated F value is 426.45. Since Fcalculus > Ftable, H_0 hypothesis is rejected. The GDP variable, which is the explanatory variable in the model, is significant in explaining the housing demand. In other words, the model is significant. The R^2 value, which is the significance number, is approximately 84%. The GDP variable, which is the independent variable in the model, explains approximately 84% of the average variability in the housing demand variable.

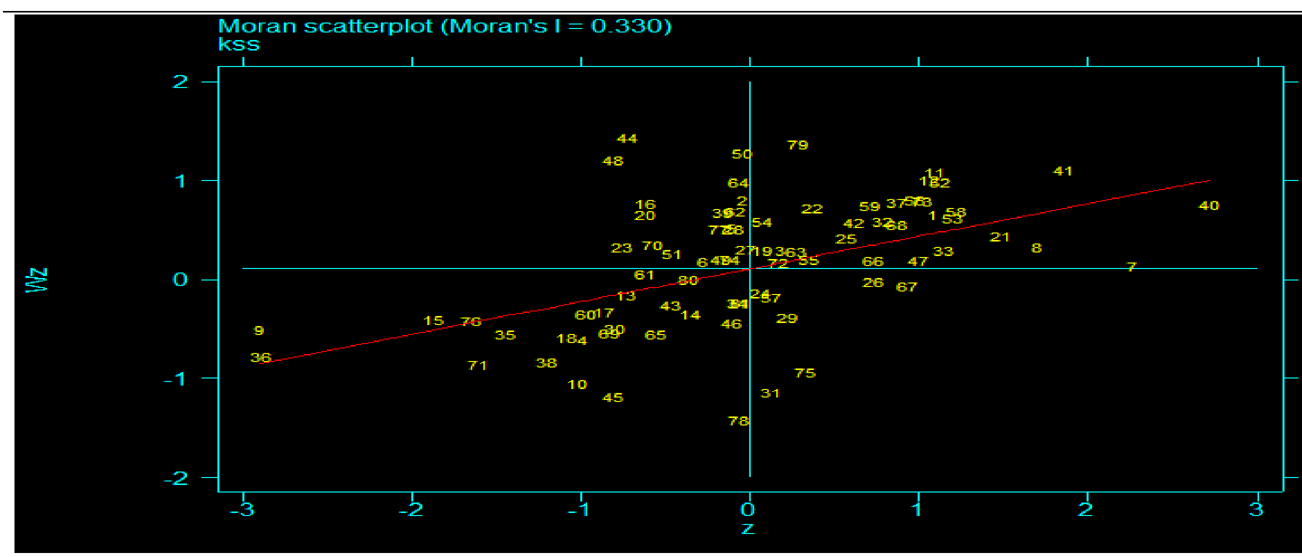
To test the significance of the parameters; the calculated P>ltl values can be checked. The parameters of both variables are significant. The parameter of the constant term is also significant.

Table 2: Spatial Effect Test

	Test Statistics	p-value
Global Moran (MI)	0.33	0.000
Geary C	0.61	0.000
Getis & Ord's G	0.063	0.004
LM lag	10.12	0.001
LM error	10.94	0.001
Robust LM lag	3.72	0.05
Robust LM error	4.54	0.033

The output shows the results of the Global Moran I test statistic. The Moran I value is approximately 0.33%. The provinces of Turkiye are positively correlated with their neighboring provinces by 0.33% for the housing demand variable. According to the P-value, the null hypothesis of no spatial autocorrelation is rejected. It is concluded that there is spatial autocorrelation. In Table 2, separate tests are conducted for the detection of spatial error and spatial lag. According to the LM (Lagrange multiplier) test, the null hypothesis is rejected for both spatial error and spatial autocorrelation. Therefore, it is concluded that there is both spatial autocorrelation and spatial lag. In this case, since it is necessary to look at the robust tests, both the Robust LM test spatial error test and the Robust LM spatial lag test reject the null hypothesis and conclude that there is spatial lag and spatial error.

Figure 1: Moran I Spread Diagram



The output in Figure 1 includes the country name, Moran's I value expected value, standard deviation, Z test statistic and probability values for the Z test statistic. Probability values are calculated for 90%, 95% and 99% confidence levels. For values lower than the confidence levels, the H0 hypothesis that there is no spatial autocorrelation is rejected. Accordingly, it is concluded that there is spatial autocorrelation for Adana, Ağrı, Ardahan, Artvin, Aydın, Balıkesir, Bayburt, Bitlis, Bursa, Erzincan, Gümüşhane, Hakkari, Iğdır, İstanbul, İzmir, Karaman, Kars, Kocaeli, Konya, Manisa, Mersin, Şırnak, Tekirdağ, Tunceli.

Table 3: Local Moran I Statistics Test

RegionName	Ii	E(Ii)	sd(Ii)	z	p-value*
Adana	0645	-0.013	0.388	1.693	0.045
Adıyaman	-0.031	-0.013	0.428	-0.043	0.483
Afyonkarahisar	0.044	-0.013	0.357	0.157	0.438
Ağrı	0.669	-0.013	0.388	1.755	0.040
Aksaray	-0.051	-0.013	0.428	-0.089	0.464
Amasya	-0.036	-0.013	0.482	-0.048	0.481
Ankara	0.181	-0.013	0.357	0.540	0.294
Antalya	0.464	-0.013	0.388	1.227	0.110
Ardahan	1.670	-0.013	0.560	3.006	0.001
Artvin	1.151	-0.013	0.560	2.077	0.019
Aydın	1.133	-0.013	0.482	2.377	0.009
Balıkesir	1.025	-0.013	0.428	2.422	0.008
Bartın	0.159	-0.013	0.560	0.305	0.380
Batman	0.147	-0.013	0.428	0.373	0.355
Bayburt	0.891	-0.013	0.428	2.110	0.017
Bilecik	-0.449	-0.013	0.388	-1.124	0.131
Bingöl	0.342	-0.013	0.388	0.913	0.181
Bitlis	0.706	-0.013	0.428	1.677	0.047
Bolu	0.015	-0.013	0.332	0.084	0.466
Burdur	-0.377	-0.013	0.428	-0.851	0.197
Bursa	0.579	-0.013	0.428	1.382	0.084
Çanakkale	0.248	-0.013	0.560	0.466	0.321
Çankırı	-0.207	-0.013	0.388	-0.501	0.308
Çorum	-0.011	-0.013	0.357	0.005	0.498
Denizli	0.208	-0.013	0.388	0.567	0.286
Diyarbakır	-0.062	-0.013	0.332	-0.150	0.440
Düzce	-0.007	-0.013	0.560	0.009	0.496
Edirne	-0.044	-0.013	0.560	-0.056	0.478
Elazığ	-0.100	-0.013	0.428	-0.204	0.419
Erzincan	0.454	-0.013	0.311	1.500	0.067
Erzurum	-0.152	-0.013	0.311	-0.448	0.327
Eskişehir	0.419	-0.013	0.388	1.111	0.133
Gaziantep	0.278	-0.013	0.388	0.747	0.227
Giresun	0.025	-0.013	0.428	0.087	0.465
Gümüşhane	0.888	-0.013	0.482	1.868	0.031
Hakkari	2.458	-0.013	0.690	3.580	0.000
Hatay	0.634	-0.013	0.560	1.154	0.124
Iğdır	1.097	-0.013	0.690	1.608	0.054
Isparta	-0.103	-0.013	0.482	-0.188	0.425
İstanbul	1.918	-0.013	0.560	3.448	0.000
İzmir	1.952	-0.013	0.560	3.510	0.000
Kahramanmaraş	0.321	-0.013	0.357	0.935	0.175
Karabük	0.153	-0.013	0.428	0.386	0.350
Karaman	-1.009	-0.013	0.560	-1.779	0.038
Kars	1.016	-0.013	0.482	2.135	0.016
Kastamonu	0.056	-0.013	0.428	0.159	0.437
Kayseri	0.132	-0.013	0.388	0.371	0.355
Kilis	-0.940	-0.013	0.982	-0.944	0.172
Kırıkkale	-0.026	-0.013	0.428	-0.032	0.487
Kırklareli	-0.059	-0.013	0.560	-0.083	0.467
Kırşehir	-0.090	-0.013	0.428	-0.182	0.428
Kocaeli	1.042	-0.013	0.428	2.463	0.007
Konya	0.684	-0.013	0.311	2.240	0.013
Kütahya	0.039	-0.013	0.357	0.145	0.442
Malatya	0.053	-0.013	0.388	0.169	0.433
Manisa	0.731	-0.013	0.388	1.915	0.028
Mardin	-0.029	-0.013	0.428	-0.038	0.485
Mersin	0.783	-0.013	0.428	1.857	0.032
Muğla	0.492	-0.013	0.482	1.047	0.148
Muş	0.400	-0.013	0.388	1.063	0.144
Nevşehir	0.003	-0.013	0.428	0.036	0.486
Niğde	-0.053	-0.013	0.388	-0.105	0.458
Ordu	0.062	-0.013	0.482	0.155	0.439
Osmaniye	-0.060	-0.013	0.482	-0.099	0.461
Rize	0.345	-0.013	0.482	0.742	0.229
Sakarya	0.098	-0.013	0.482	0.230	0.409
Samsun	-0.122	-0.013	0.428	-0.255	0.399
Şanlıurfa	0.431	-0.013	0.482	0.920	0.179
Siirt	0.503	-0.013	0.428	1.204	0.114
Sinop	-0.170	-0.013	0.560	-0.282	0.389
Şırnak	1.495	-0.013	0.482	3.128	0.001
Sivas	0.018	-0.013	0.332	0.093	0.463
Tekirdağ	0.760	-0.013	0.482	1.603	0.054
Tokat	-0.017	-0.013	0.428	-0.010	0.496
Trabzon	-0.330	-0.013	0.482	-0.659	0.255
Tunceli	0.803	-0.013	0.560	1.456	0.073
Uşak	-0.084	-0.013	0.482	-0.149	0.441
Van	0.104	-0.013	0.428	0.272	0.393
Yalova	0.378	-0.013	0.690	0.566	0.286
Yozgat	0.020	-0.013	0.332	0.099	0.461
Zonguldak	0.016	-0.013	0.482	0.059	0.476

*1-tail test

In the Moran I scatter diagram shown in the figure, the upper left region is low-high, the upper right region is high-high, the lower left region is low-low and the lower right region is high-low. The region where the observations fall determines the autocorrelation.

Table 4: Summary of Estimation of Spatial Econometric Models

Değişkenler	GNS	SAC	SDEM	SDM	SAR	SEM	SLX
LnGSYH	1.01*	1.02*	1.03*	1.00*	0.99*	1.01*	1.02*
Cons	-3.59**	-4.29*	-5.06*	-2.74*	-4.31*	-3.56*	-4.85*
w1x_LnGSYH	-0.16	-	0.18**	-0.36*	-	-	0.16**
Rho	0.32*	0.16**	0.49*	0.49*	0.22*	-	-
Lambda	0.18	0.35*	-	-	-	0.52*	-
Sigma	0.19*	0.19*	0.19*	0.19*	0.20*	0.19*	0.21*
F	222.24*	449.93*	146.4*	222.49*	443.93*	419.5*	222.5*
Wald	444.49*	449.93*	439.2*	444.98*	443.93*	419.5*	-
R^2	0.85	0.85	0.85	0.85	0.85	0.85	0.85
LR test (rho=0)	5.02*	3.80**	13.99*	14.19*	11.33*	-	-
LR test (Lambda=0)	0.75	4.66*	-	-	-	15.65*	-
LR test (rho+Lambda=0)	14.62*	14.37*	-	-	-	-	-

*, ** and *** indicate significance levels of 1%, 5% and 10% respectively.

The output presents the OLS estimation of the GNS, SAC, SDEM, SDM, SAR, SEM and SLX models. When the GNS model is analyzed from the data in the table, it is seen that the model is significant according to F and Wald tests. The Buse R2 is 85%. GDP and constant term parameters are significant and the effect of GDP variable on housing demand is positive. Each 1% increase in the GDP variable increases housing demand by 1.01%. A 1% increase in the spatially lagged GDP variable decreases housing demand by 0.01%. When the SAC model is analyzed, the Buse R2 value is calculated as approximately 85%. F and Wald tests are significant. The GDP variable and the fixed variable are significant in the model. The effect of GDP variable on housing demand is positive. Each 1% increase in the GDP variable increases housing demand by 1.02%.

When the SDEM model is analyzed, F and Wald tests are significant. Buse R^2 is approximately 85%. The fixed parameter, spatial lagged GDP and GDP variables are significant and the effect of spatial lagged GDP and GDP variables on housing demand is positive, while the effect of the constant term is negative. Each 1% increase in the GDP variable increases housing demand by 1.03%. A 1% increase in spatially lagged GDP increases housing demand by 0.18%. When the data in the SDM model are analyzed, F and Wald tests are significant. The Buse R2 value is approximately 85%. The fixed parameter, spatial lagged GDP and GDP variables are significant and the effect of the GDP variable on housing demand is positive, while the effect of the constant term and spatial lagged GDP is negative. Each 1% increase in the GDP variable increases housing demand by 1%. A 1% increase in spatial lagged GDP decreases housing demand by 0.36%.

When the data in the SAR model are analyzed, F and Wald tests are significant. The Buse R2 value is 85%. The parameters of the constant term and GDP variables are significant. While the effect of GDP on housing demand is positive, the effect of the constant term is negative. Each 1% increase in the GDP variable increases housing demand by 0.99%. When the data in the SEM model are analyzed, F and Wald tests are significant. The Buse R2 value is approximately 85%. The parameters of the constant term and GDP variables are significant. While the effect of GDP on housing demand is positive, the effect of the constant term is negative. Each 1% increase in the GDP variable increases housing demand by 1.01%.

When the data in the SLX model are analyzed, the model is significant according to the F test. The R^2 value is approximately 85%. The parameters of spatial lagged GDP, GDP and the constant term are significant. While the effect of GDP and spatial lagged GDP on the housing demand variable is positive, the effect of the constant term is negative. Each 1% increase in the GDP variable increases housing demand by 1.02%. A 1% increase in spatial lagged GDP increases housing demand by 0.16%.

Table 5: Summary of Estimation of Spatial Econometric Models

Variables	SEM-GMM	SDEM-GMM
LnGSYH	1.02*	1.03*
Cons	-3.63*	-5.02*
w1x_LnGSYH	-	0.18**
Rho	-	-
Lambda	-	-
Sigma	-	-
F	407.32*	211.17*
Wald	407.32*	422.34*
R^2	0.84	0.85
Hausman LM	-	-
Sargan LM	-	-
Basman LM	-	-

*, **, *** indicate significance levels of 1%, 5% and 10% respectively.

GMM estimation results are presented in the output. When the SEM model is analyzed from the data in the table from SEM and SDEM models, it is seen that the model is significant according to F and Wald tests. Buse R2 is 84%. GDP and constant parameters are significant. While the effect of the GDP variable on housing demand is positive, the effect of the constant term variable is negative. Each 1% increase in the GDP variable increases housing demand by 1.02%. When the SDEM model is analyzed, the Buse R2 value is calculated as approximately 85%. F and Wald tests are significant. The parameters of the constant term, GDP and spatially lagged GDP variables are significant. While the effect of GDP and spatial lagged GDP on housing demand is positive, the effect of the constant term is negative. Each 1% increase in the GDP variable increases housing demand by 1.03%. Each 1% increase in the spatially lagged GDP variable increases housing demand by 0.18%.

Table 6: Information Criteria

Variables	SEM	SAR	SAC	SDM
$\bar{R}^2$	0.84	0.85	0.85	0.85
LLF	14.5687	13.9443	16.0349	16.2260
AIC	0.0503	0.0479	0.0474	0.0485
Log AIC	-2.9901	-3.0378	-3.0493	-3.0260
SC	0.0533	0.0509	0.0503	0.0530
Log SC	-2.9310	-2.9787	-2.9901	-2.9373
FPE	0.0497	0.0473	0.0468	0.0479
HQ	0.0515	0.0491	0.0485	0.0503
Rice	0.0503	0.0480	0.0475	0.0486
Shibata	0.0502	0.0479	0.0473	0.0484
GCV	0.0503	0.0480	0.0474	0.0486

Table 6 presents the information criteria for the models. SAR, SEM and SAC models R ̅^2 values were almost all the same. When all other criteria are compared, it is seen that the SAC model has relatively low results in all criteria. When the SAR model is compared with the SDM model, the SAR model is relatively more appropriate. In the model selection criteria, SAC points to the SAC model among SAR and SEM. In the choice between SAR and SDM, it is seen that the SAR model is appropriate. Therefore, the appropriate model is the SAC model.

4. Conclusion

In this study, an empirical analysis was conducted with the help of spatial econometric models on whether economic growth has an impact on the demand in the housing market in all provinces in Turkiye. In this context, GDP was determined as the independent variable using cross-sectional data for the period of 2019. In order to determine the relationship between housing demand and the GDP variable, the series were evaluated separately in all provinces. Data from 81 cities with neighborhood relations between them were used.

In spatial econometric analyses, tests are conducted to determine which model is appropriate to provide information about the presence and type of spatial effect. Moran's I test developed by Moran (1950) is used to test spatial autocorrelation. In this study, the Global Moran I test statistic is approximately 0.33%. It can be said that the provinces of Turkiye are positively correlated with their neighboring provinces at a rate of 0.33% for the housing demand variable. According to the P-value, the null hypothesis that there is no spatial autocorrelation is rejected and it is concluded that there is spatial autocorrelation. In the provincial context, the Local Moran I test is used to determine the relationship between a province and its neighboring provinces. In this study, looking at the Local Moran I values, it is concluded that there is spatial autocorrelation for Adana, Ağrı, Ardahan, Artvin, Aydın, Balıkesir, Bayburt, Bitlis, Bursa, Erzincan, Gümüşhane, Hakkari, Iğdır, İstanbul, İzmir, Karaman, Kars, Kocaeli, Konya, Manisa, Mersin, Şırnak, Tekirdağ, Tunceli.

In the General Nested Spatial Model (GNS), F and Wald tests show that the model is significant. GDP and constant term parameters are significant and the effect of the GDP variable on housing demand is positive. According to this model, each 1% increase in the GDP variable increases housing demand by 1.01%. A 1% increase in the spatially lagged GDP variable decreases housing demand by 0.01%. In the General Spatial Model (SAC), F and Wald tests are significant. In the model, the parameters of the GDP variable and the fixed variable are found to be significant. According to this model, the effect of the GDP variable on housing demand is positive. Each 1% increase in the GDP variable increases the housing demand by 1.02%. In the Spatial Durbin Error Model (SDEM), F and Wald tests are significant. The fixed parameter, spatial lagged GDP and GDP variables are significant and the effect of spatial lagged GDP and GDP variables on housing demand is positive, while the effect of the constant term is negative. According to this model, each 1% increase in the GDP variable increases housing demand by 1.03%. A 1% increase in spatially lagged GDP increases housing demand by 0.18%.

In the Spatial Durbin Model (SDM), F and Wald tests are significant. The fixed parameter, spatial lagged GDP and GDP variables are significant and the effect of the GDP variable on housing demand is positive, while the effect of the constant term and spatial lagged GDP is negative. According to this model, each 1% increase in the GDP variable increases housing demand by 1%. A 1% increase in spatial lagged GDP decreases housing demand by 0.36%. In the Spatial Autoregressive Model (SAR), F and Wald tests are significant. The parameters of the constant term and GDP variables are significant. While the effect of GDP on housing demand is positive, the effect of the constant term is negative. According to this model, each 1% increase in the GDP variable increases housing demand by 0.99%. In the Spatial Error Model (SEM), F and Wald tests are significant. The parameters of the constant term and GDP variables are significant and the effect of GDP on housing demand is positive, while the effect of the constant term is negative. According to this model, each 1% increase in the GDP variable increases housing demand by 1.01%. Spatial Lagged X Model (In the Independent Variable Spatial Lagged Model (SLX), the model is significant according to the F test. The parameters of spatially lagged GDP, GDP and the constant term are significant. The effect of GDP and spatial lagged GDP on the housing demand variable is positive, while the effect of the constant term is negative. According to this model, each 1% increase in the GDP variable increases housing demand by 1.02%. A 1% increase in the spatial lagged GDP increases housing demand by 0.16%.

When the SEM model found with the help of the GMM estimation method is analyzed, it is seen that the model is significant according to the F and Wald tests. The GDP and constant parameters are significant and the effect of the GDP variable on housing demand is positive, while the effect of the constant term variable is negative. According to the SEM model, each 1% increase in the GDP variable increases housing demand by 1.02%. Again, when the SDEM model is analyzed with GMM estimation, F and Wald tests are significant. The parameters of the constant term, GDP and spatial lagged GDP variables are significant in the model. While the effect of GDP and spatial lagged GDP on housing demand is positive, the effect of the constant term is negative. Each 1% increase in the GDP variable increases housing demand by 1.03%. Each 1% increase in the spatially lagged GDP variable increases housing demand by 0.18%.

When the information criteria for all models are analyzed, SAR, SEM and SAC $\bar{R}^2$ values are almost the same. When all other criteria are compared, it is seen that the SAC model has relatively low results in all criteria. When the SAR model is compared with the SDM model, the SAR model is relatively more appropriate. In the model selection criteria, SAC points to the SAC model among SAR and SEM. In the choice between SAR and SDM, it is seen that the SAR model is appropriate. Therefore, it is decided that the appropriate model is the SAC model.

As a result of the research, the GDP variable is found to be a significant and positively effective parameter in all models. The spatially lagged GDP parameter is also found to be significant in models where spatial lags are taken into account, negatively effective in SDM and GNS models, and positively effective in SDEM, SLX and SDEM-GMM models.

Since the determinants of housing demand in all provinces of Turkiye are positively correlated with their neighboring provinces, the analysis reveals that the shocks or effects of the variables also affect the housing demand in other provinces. In this context, Adana, Ağrı, Ardahan, Artvin, Aydın, Balıkesir, Bayburt, Bitlis, Bursa, Erzincan, Gümüşhane, Hakkari, Iğdır, İstanbul, İzmir, Karaman, Kars, Kocaeli, Konya, Manisa, Mersin, Şırnak, Tekirdağ, Tunceli have the highest impact.

References

Alagidede P., & Mensah, J.O. (2016). Construction, Institutions and Economic Growth in Subsaharan Africa. *ERSA Working Paper* 622 (July 11, 2016).

Bayrak, İ. C., & Telatar, O. M. (2021). İnşaat Sektörü ve Ekonomik Büyüme İlişkisi: Türkiye Ekonomisi Üzerine Ampirik Bir Analiz. *Gümüşhane Üniversitesi Sosyal Bilimler Dergisi, 12 (3),* 1283-1297.

Bocutoğlu, E., & Ertürk, Z. (1992). Supply and Demand Analysis in Housing Market: A Case Study in Turkey as a Developing Country. *Management Quality and Economics*, 203-210.

Canbay, Ş., & Mercan, D. (2020). Türkiye'de Konut Fiyatları, Büyüme ve Makroekonomik Değişkenler Arasındaki İlişkinin Ekonometrik Analizi. *Journal of Management and Economics Research, 18 (1),* 176-200.

Chang T., & Nieh, C.C. (2004). A Note on Testing the Causal Link Between Construction Activity and Economic Growth in Taiwan. *Journal of Asian Economics, 15,* 591-598.

Degen, K., & Fischer, A. M. (2010). Immigration and Swiss House Prices. *Swiss National Bank Working Papers*.

Dornbusch, R., & Fischer, S. (1994), *Macro Economics*, McGraw-Hill Inc., İstanbul: Literatür Yayıncılık.

Elhorst, J.P. (2014). Linear Spatial Dependence Models for Cross-Section Data, Spatial Econometrics Chapter2, Springer Berlin Heidelberg, 5-36.

Gelfand, J. E. (1966). The Credit Elasticity of Lower-middle Income Housing Demand. *Land Economics*, *42(4),* 464-472.

Hatipoğlu, Ü., & Tanrıvermiş, H. (2017). Türkiye'de Arz ve Talep Açısından Konut Yatırım Tercihlerini Etkileyen Faktörlerin Değerlendirilmesi. *Bankacılar Dergisi, 100,* 49-75.

Karadaş, H. A., & Salihoglu, E. (2020). Seçili Makroekonomik Değişkenlerin Konut Fiyatlarına Etkisi: Türkiye Örneği. *Ekonomik ve Sosyal Araştırmalar Dergisi*, *16(1),* 63-80.

Kıral, G., & Çelik, C. (2018). Panel Veri Analizi ve Kümeleme Yöntemi ile Türkiye'de Konut Talebinin İncelenmesi. *Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi, 32(4)* , 1009-1026 .

Lebe, F., & Yiğit, B. (2009). *Analysis of The Short and Long-Run Housing Demand in Turkey*. In The 7th International Symposium of The Romanian Regional Science Association, 2-13.

Lopes, J., Ruddock, L., & Ribeiro, F. L. (2002). Investment in Construction and Economic Growth in Developing Countries. *Building Research & Information, 30(3),* 152-159.

Manski, C.F. (1993). Identification of Endogenous Social Effects:The Reflection Problem. *The Review of Economic Studies, 60(3),* 531-542.

Mussa, A., Nwaogu, U. G., & Pozo, S. (2017). Immigration and Housing: A Spatial Econometric Analysis. *Journal of Housing Economics*, 13-25.

Öztürk, N., & Fitöz, E. (2009). Türkiye'de Konut Piyasasının Belirleyicileri: Ampirik Bir Uygulama. *ZKÜ Sosyal Bilimler Dergisi*, *5(10*), 21–46.

Rivero, S. S. (2008). Immigration And House Prices In Spain. *Regional Economy Working Paper*.

Sabyasachi, T. (2019). Macroeconomic Determinants of Housing Prices: A Cross Country Level Analysis. *MPRA Paper No. 98089*. University Library of Munich, German.

Trofimov, I. D., Aris, N. M., & Xuan, D. C. D. (2018). Macroeconomic and Demographic Determinants of Residential Property Prices in Malaysia. *Zagreb International Review of Economics & Business, 21(2*), 71-96.

Uysal, D., & Yiğit, M. (2016). Türkiye'de Konut Talebinin Belirleyicileri (1970-2015): Ampirik Bir Çalışma. *Selçuk Üniversitesi Sosyal Bilimler Meslek Yüksek Okulu Dergisi*, *19(1),* 185-209.

Yardımcı, M. C. (2021). Türkiye'de Konut Satışları ve Ekonomik Büyüme Arasındaki İlişkinin Analizi. *Ekonomi İşletme Siyaset ve Uluslararası İlişkiler Dergisi, 7 (2),* 380-391.

Yerdelen Tatoğlu, F. (2022). *Mekansal ekonometri*. İstanbul: Beta yayınevi.

Yetgin, F. (2007). Avrupa Birliği ve Türkiye Konut Politikaları Üzerine Bir Inceleme. *Marmara Üniversitesi İİBF Dergisi, 13(2),* 311-330.