Effect of Divorce on Urban Housing Costs Applying Spatial Autocorrelation Model: a case study of Iran

Esmaiel Abounoori
Professor of Econometric & Social Statistics,
Department of Economics, Semnan University, Semnan-Iran
Esmaiel.abounoori@semnan.ac.ir
Tel: +989111112176
ORCID: 0000-0003-4168-7163

Hossein Abdoh Tabrizi
Visiting Professor of Finance
Sharif University, Tehran-Iran
abdoh@abdoh.net
Tel: +989121140679

Nooshin Mahmoodi
Ph.D Student of Economics,
Department of Economics, Semnan University, Semnan-Iran
n.mahmoodi@semnan.ac.ir
Tel: +393881489745

Abstract:

In addition to traditional factors, demographic changes also depend on factors such as marriage and divorce. Yet only a small number of researchers investigated the impact of divorce on housing costs. The aim of this paper is to estimate the effect of divorce on housing costs in Iran. Doing so, we have applied a fixed Panel Spatial Autocorrelation model using the data from a set of Iranian provinces over the period of 2006-2014. The results indicate that a one-percent point rise in the divorce increases directly and indirectly house rental index by about 1.05% point. The outcomes also show that household size has a negative and significant effect, but the per capita gross domestic product and the population have positive and significant effects on the house rental index. On average, a one-percent point increase in the house rental index of any other provinces will increase the house rental index in a province by about 0.34 percentage point.

Keywords: Housing, Divorce, Spatial Econometrics, Iran

JEL classification: O18, J10, C21

1. Introduction

With the growth of cities, the need for shelter and housing has become the main concern of their inhabitants, this challenge that grows with increasing housing price and rental rate every year. In Iran over the last years, housing prices and rents have been going up. When a good has a market, its supply and demand status to be used for investigation and planning is accessible. Since housing is a nonmarket good whose information is not directly available, the investigation into factors affecting the demand for housing is a way to make accurate predictions and planning(Walks and August 2008). For example, population structure is a highly important factor, which affects the demand for housing. Studies conducted by the Ministry of Roads and Urban Development for need assessment and classification of housing applicants showed that the annual population growth rate in Iran increased approximately 4% in the first half of the 1980s to approximately 2% in [the first half of] the 1990s, and to approximately 1% in the first half of the 2000s. In contrast, the number of household growth rate increased. In Iran, the annual number of household growth rate increased from 2.51 from 1985-1995 to 2.89% by the end of 2010. The inverse relationship between the rates of population growth and the number of household growth was developed from three decades ago. Although the rate of population growth reduced during 2010-2016 from 1.29% to 1.24%, the household size increased by 14% in the same period. A thorough investigation into Iran's population shows that in recent years, 'lifestyle change' has exacerbated this inverse relationship. Lifestyle change along with such factors as 'divorce' that reduced 'household size' and this reduction practically neutralizes the effect of reduced rate of population growth. Typically, urban planners estimate the demand for housing based on the rates of population growth and marriage. Meanwhile, changes in the population structure of Iran is highly significant and affects the housing demand not only in terms of the number of housing units but also their type and characteristics.

Divorce is among the most important factors, which are less addressed in urban and housing planning. Therefore, this study investigated the effect of divorce on the rental rate. Since the increase in divorce rate has become more prominent in recent years, its effect on house demand between 2006 -2014 was used in 30 provinces.

It is worth noting that due to the spatial nature of housing, two issues often arise: (I) spatial dependence between observations, and (ii) spatial heterogeneity in relationships that are modeled. As a result, the use of a spatial econometric model is needed (LeSage 1999). In this paper, the first issue was considered. In this regard, the current study used the spatial econometrics employing panel data.

2. Literature review

Typically, the effect of changes in population growth on demand for housing has been addressed based on the age range and [mean] age of the populations. Mankiw and N.Weil (1989) used census data in the USA to show that the age range dramatically affects the demand for housing. Based on their work, many other studies investigated the effect of age range on the demand for housing; however, the majority of them focused on young adults aged 20-49 years old, as they accounted for the majority of newly formed households.

A study by Essafi and Simon (2015)investigated the effect of changes in population structure on the real estate market in France between 2000-2013. Results suggested that the prices in this markets are significantly and positively affected by population and GPD. It is worth noting that population changes have a greater impact than GDP changes in the housing price.

Moreover, real estate prices had an inverse relationship with aging-ratio of people over 60 years to active population. Among these studies, there is another one that is conducted in Chongqing between 2003 and 2012. It showed that the rate of population bring-up and sex ratio, in particular, had a negative impact on the housing price. In general, it can be concluded that the population structure affects the housing price (Gao and He, 2014).

According to the reports by Turunen, Ohlsson-Wijk, and Andersson (2017), in addition to traditional factors, changes in population structure also depend on such factors as marriage and divorce in the last decade. Hlaváček and Komárek (2011)have expressed that higher divorce rate causes property price growth because more divorces change one household into two, in result the demand of it will be raised. But little research has been directly addressing the effect of divorce on demand for housing and rental rate or housing cost.

A study has been published by Denmark National Bank shows that in many OECD countries, increasing home ownership, urban extension and demographic changes such as a higher divorce rate motivate housing market (Dam and Rasmussen 2014)

Fischer(2015) investigates the role of divorce on household consumption and housing decisions by considering life-cycle models. The results showed that divorces reduce the household net worth, and therefore the chance of being a homeowner.

Mikolai and Kulu (2018)studied the effect of marital and non-marital separation on individuals residential and housing trajectories. The results showed that many moving are owing to separation. Remarkable, separated women and men chose different types of houses. Women are presumably moving to terraced houses, whiles separated men equally prefer to move to flats (apartments) and terraced (row) houses.

This study is important in this regard which estimated the effect of divorce on housing directly. As mentioned, the number of research that has been investigated directly the effect of divorce on demand for housing are a few. A lots of disassociate research such as (Phillips and Vanderhoff 1991; Rezazadeh and Outadi 2008; Hasanzadeh and Kianvand 2012; Farzanegan and Gholipour 2016; Fischer 2015; Jia, Wang, and Fan 2018; Mikolai and Kulu 2018;)are about both of these issues (housing and divorce) that shows that they are vital for countries economics or in the inverse direction that means they study the effects of housing on the divorce rate. Housing has always played an important role in the economy because it contributes to GDP in two basic ways, the first one buying a house as investments and the second one buying a house as consumption(Kapinos, Gurley-Calvez, and Kapinos 2016). In the same manner, systematic changes in the demographic structure of the country are all a part of economic development(Kelley et al. 1965). Conventionally, the impact of changing the divorce rate on demographic changes are clear. Consequently, this paper investigated directly the effect of divorce on demand for housing. On the other hand, as we know, any of these issues applied spatial econometrics. It is important hence, there is the dependency between observations, and It comes from the nature of houses. In addition, the rate of divorce significantly grows up in Iran which is the traditional country and it has a notable impact on population structure and therefore on housing.

3. Methodology

Two issues often arise when working with spatial data: (I) spatial dependence between observations, and (ii) spatial heterogeneity in modeled equations(Anselin 1988). It means that the model equations or parameters, along with sample data changes with moving on the coordinate plane. The conventional econometric models ignore these two possibilities (spatial dependence and heterogeneity). This is because they run counter to the conventional econometrics' hypotheses (Gauss–Markov theorem), that the desirable features are ordinary least squares estimators.

Following tests can be used to test out significance hypothesis of spatial dependence between error terms in the model: (I) Moran's I, (ii) likelihood ratio test, (iii) Lagrange coefficient test, and (iv) Wald test(Elhorst 2014).

3.1 Spatial Models

According to Anselin (1988), there are three basic models concerning spatial econometrics, namely the First Order Spatial Lag Model or the First Order Spatial Autoregressive Model (FSAR) or (SAR), Spatial Error Model (SEM), Spatial Durbin Error Model (SDEM) (Anselin 1988). but these Spatial Model can be extended that you can see some of the most commonly considered in the literature in table1 (Cook, Hays, and Franzese 2015). In the SAR, the spatial effects are distributed only through the dependent variable. In the SEM, the main path of spatial distribution is through the error term. In the SDM, the spatial distribution is through both the dependent and independent variables.

Tabele1: Spatial Econometric Models (taken from Cook, Hays, and Franzese, 2015)

Name	Structure	Restrictions
General Nesting Spatial Model (GESM)	$y = \rho Wy + X\beta + WX\theta + u$ $u = \lambda Wu + \varepsilon$	none
Spatial Durbin Error Model (SDEM)	$y = X\beta + WX\theta + u$ $u = \lambda Wu + \varepsilon$	$\rho = 0$
Spatial Autocorrelation Model (SAC)	$y = \rho Wy + X\beta + u$ $u = \lambda Wu + \varepsilon$	$\theta = 0$
Spatial Durbin Model (SDM)	$y = \rho Wy + X\beta + WX\theta + u$	$\lambda = 0$
Spatial Autoregressive (SAR)	$y = \rho Wy + X\beta + u$	$\lambda = \theta = 0$
Spatially Lagged X's (SLX)	$y = X\beta + WX\theta + u$	$\rho = \lambda = 0$
Spatial Error Model (SEM)	$y = X\beta + u$ $u = \lambda Wu + \varepsilon$	$\rho = \theta = 0$ $\lambda = -\rho\beta$

For panel data, a full model with all types of spatial effects can be written as:

$$y_{it} = \rho \sum_{j=1}^{N} w_{ij} y_{jt} + \beta_0 + X_{it}\beta + \theta \sum_{j=1}^{N} w_{ij} X_{jt} + u_{it}$$
$$u_{it} = \lambda \sum_{j=1}^{N} w_{ij} u_{jt} + \varepsilon_{it} \quad (1)$$

Here i indexes cross-section of economic units and t indexes time periods y_{it} is the output of the i unit at the time t, whereas X_{it} is a ($1 \times K$) input vector of the i unit at the time t. β is the ($K \times 1$) parameter vector to be estimated, and u_{it} it is an *i.i.d.* disturbance for *i* and *t* with zero mean and variance σ_ε^2 where w_{ij} is a known non-negative element of the ($N \times N$) spatial weights matrix, W. Briefly, the Wald tests are applied to select the optimal model (Elhorst 2014).

3.2 Data

In this section, we applied annual dataset from 30 provinces of Iran for the period 2006 - 2014. As a measure of housing costs, we use the Index of Rental for Housing in urban areas

(HRI) (2011=100), which were collected from Central Bank of Iran. In addition to HRI, the household size (HS), the Natural Rate of Population (NRP), the population (POP), the Real Gross Regional Product per capita (PCGRP) and the Investment in House Building (IHB) were selected as control variables. The Percentage of Ratio of Divorce to Population(PRDP) in the year was applied as independent variables. The percentage of the ratio of divorce to population, birth, and death were collected from the National Organization for Civil Registration of Iran. The gross regional product per capita, the population and the number of the household of each province were prepared from Statistical Center of Iran. Fig 1 and Fig. 2 show the spatial distribution of the percentage divorce ratio to population corresponding to different years in each province.

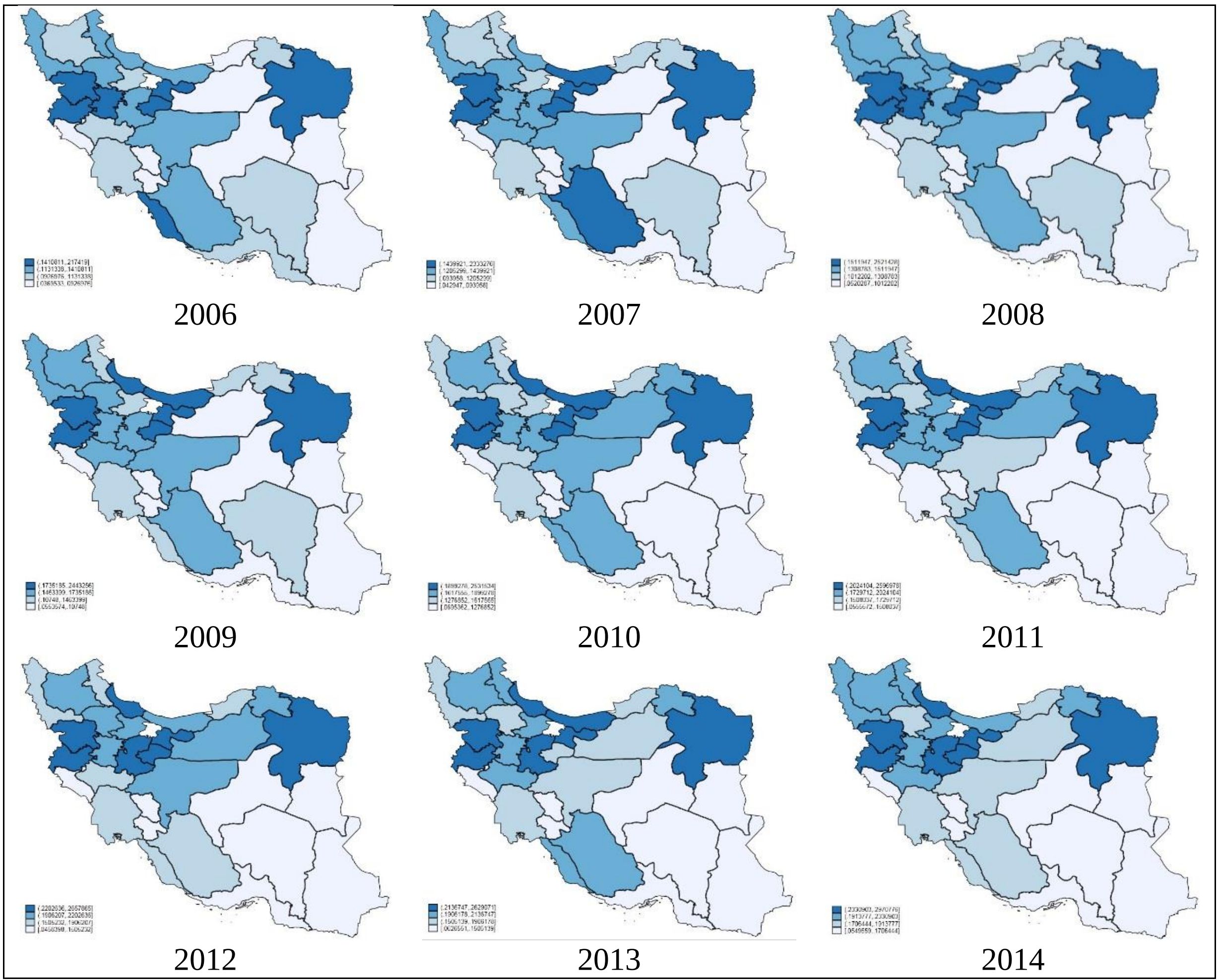

Fig.1.The spatial distribution of the percentage divorce ratio to population
Source: It is drown by the STATA 15.

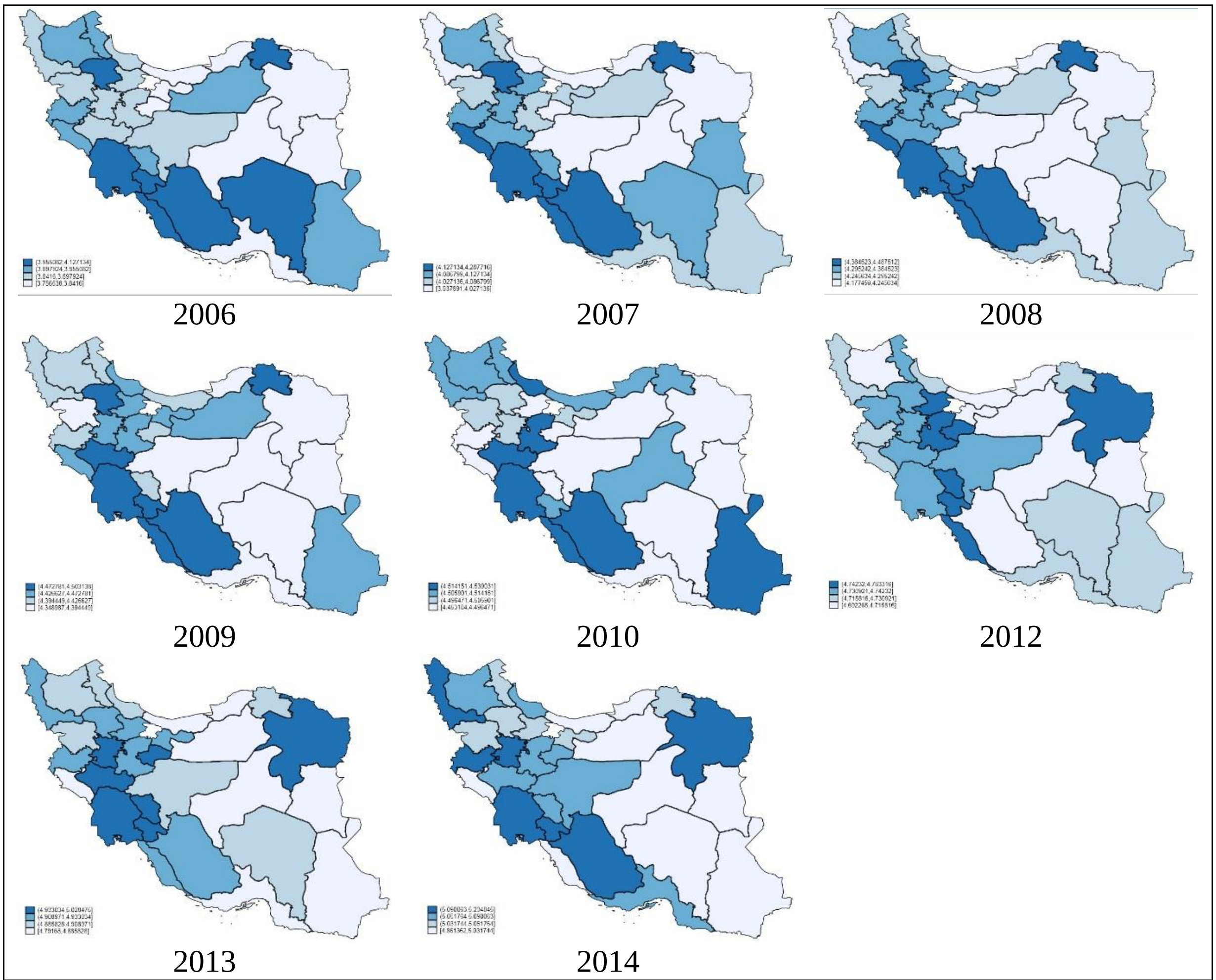

Fig.2.The spatial distribution of the natural logarithm of house rent index
Source: It is drown by the STATA 15.

Because of the difference in scaling variable, the logarithmic regression form can be helpful in analyzing and measuring the effects of variables so the natural logarithmic of the Index of Rental for Housing in urban areas (LHRI), The percentage of ratio of divorce to population(lPRDP), the household size in year(LHS), the Natural Rate of Population (LNRP), the population (LPOP), the real gross domestic product per capita(LPCGRP) and the investment in housing building (LIHB) was applied in this research. Table 2 summarizes the descriptive statistic of the variables.

Table 2. Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
HRI	96.0033	33.1736	42.80	187.75
PRDP(percentage)	0.1566	0.0534	0.0370	0.2971
IHB (Million Rials)	11.8	24.6	.374465	187
POP(person)	2394509	2265972	545787	1.26e+07
HS (person)	3.762698	0.4214942	2.952103	5.1186
NRP(person)	32044.85	29345.39	2207	146626
PCGRP(Million Rials)	71.9839	58.1114	9.61472	405.6375

In this paper, the inverse of the distance between the provinces was applied for the computation of the weight matrix. The summarizes spatial weights matrix are available in table3. Spectral means that the weighting matrix will be normalized in the way that its largest eigenvalue is 1.

Table 3. Weighting matrix

Type	the inverse of the distance
Normalization	spectral
Dimension	30 × 30
Elements	
Minimum	0
Minimum > 0	0.008185
Mean	0.030765
Max	0.152365

For sure that spatial econometrics is useful for our data, the spatial dependence between error terms in the basic panel least square model was tested(Elhorst 2014). The result showed that spatial autocorrelation was confirmed (see table 4). As you see, positive spatial autocorrelation exists that means high house rent index correlate with high house rent index of neighbors or low one with low neighboring values.

Table 4: Testing Spatial Autocorrelation

Ho: Error has No Spatial Autocorrelation H1: Error has Spatial Autocorrelation	
GLOBAL Moran's I = 0.2957	P-Value > Z(16.655) 0.0000
GLOBAL Geary GC = 0.6821	P-Value > Z(-15.659) 0.0000
GLOBAL Getis-Ords GO = -0.2957	P-Value > Z(-16.655) 0.0000

3.3 Model selection

So for the first step before Wald test, the General Nesting Spatial Model (GNSM) as equation (2) was estimated. And table 5 shows the results of both estimations.

$$LHRI_{it} = \rho\sum_{j=1}^{N} w_{ij} LHRI_{jt} + \beta_0 + PRDP_{it}\beta_1 + LHS\,\beta_2 + LNRP_{it}\beta_3 + LCPGRP_{it}\beta_4$$

$$+LPOP\,\beta_5 + LIHB\,\beta_6 + \theta_0\sum_{j=1}^{N} w_{ij} LHS + \theta_1\sum_{j=1}^{N} w_{ij} LPCGRP_{jt} + \theta_2\sum_{j=1}^{N} w_{ij} LIHB_{jt} + \varepsilon_{it}$$

$$\varepsilon_{it} = \lambda\sum_{j=1}^{N} w_{ij}\varepsilon_{jt} + u_{it} \quad (2)$$

Table5. the General Nesting Spatial Model- fixed effects

Dependent variable: LHRI		
	Coef.	P-value
PRDP	0.7270	0.002 **
LHS	-1.2347	0.000***
LNRP	0.0367	0.021*
LPCGRP	0.1714	0.000***
LIHB	0.0224	0.000***
LPOP	1.1461	0.000***
WD*LHRI	0.5467	0.069*
WD*e.LHRI	0.6866	0.000***
WD*LHS	1.6298	0.151
WD*LPCGRP	0.0769	0.699
WD* LIHB	0.0674	0.154
Variance of ε	0.05	
Wald test of spatial terms:	chi2(4) = 173.26	Prob > chi2 = 0.00

Note: The asterisks *, **, and *** denote significance at the 10, 5, and 1 % levels, respectively.

As described in the previous section, the Wald tests are applied to select the optimal model. The result shows that all the models that are described in table 1, except Spatial Durbin Error Model(SDEM) and Spatial Autocorrelation Model(SAC), was rejected. The results of Wald test for different models are presented in table 6.

Table6. Model selection

H_0	chi2	Degree of freedom	Prob
The model is SDEM.(ρ=0)	3.32	1	0.0685
The model is SAC.(θ=0)	4.45	3	0.2169
The model is SDM.(λ=0)	35.49	1	0.0001
The model is SAR ($\lambda = \theta = 0$)	116.16	4	0.000
The model is SLX($\rho = \lambda = 0$)	128.15	2	0.000
The model is SEM($\rho = \theta = 0$,$\lambda = -\rho\beta$)	960.94	10	0.000

4. Model estimation

Based on the previous discussion, the empirical model must be applied as Spatial Durbin Error Model(SDEM) or Spatial Autocorrelation Model(SAC). In this section, both model estimations are presented.

4.1. SDEM Model

The model SDEM (3) was estimated by Maximum Likelihood approach and Stata 15. The result of Fixed effect and Random effect are reported in table 7.

$$LHRI_{it} = \beta_0 + PRDP_{it}\beta_1 + LHS\,\beta_2 + LNRP_{it}\beta_3 + LPCGRP_{it}\beta_4 + LPOP\,\beta_5$$
$$+ LIHB\,\beta_6 + \theta_0\sum_{j=1}^{N} w_{ij} LHS + \theta_1\sum_{j=1}^{N} w_{ij} LPCGRP_{jt} + \theta_2\sum_{j=1}^{N} w_{ij} LIHB_{jt} + \varepsilon_{it} \quad (3)$$
$$\varepsilon_{it} = \lambda\sum_{j=1}^{N} w_{ij}\varepsilon_{jt} + u_{it}$$

Table 7. the Spatial Durbin Error Model

Dependent variable: LHRI		
Variable	fixed-effect	random- effect
PRDP	0.7156**	0.5001*
LHS	-1.1948***	-0.7920***
LNRP	0.0354*	0.0726***
LPCGRP	0.1736***	0.2310***
LIHB	0.0243***	0.0235***
LPOP	1.0848***	-0.1115**
Cons		5.2392***
WD*LHS	1.2194	-1.1209***
WD*LPCGRP	0.2958	0.2066
LIHB	0.1011*	0.0273
WD*e.LHRI	.8464***	0.8692***
Statistics		
AIC	-722.135	-652.89
BIC	-682.55	-606.11
Wald test of spatial terms	chi2(4) = 388.17***	chi2(4) = 375.36***
Note: The asterisks *, **, and *** denote significance at the 10, 5, and 1 % levels, respectively.		

In this paper, the Hausman test (table 8) was applied based on the difference between the fixed and random effects specification of this model. According to the Hausman test, the fixed effects model could present the relation between the variable better. But for the better view, we reported both models in table 7.

Table 8: Hausman test

H_0: difference in coefficients not systematic
chi2(10) = 29.82
Prob>chi2 = 0.0009

4.2. SAC Model

The estimation result from applying the Spatial Autocorrelation Model (equation 4) and the Hausman test are respectively reported in table 9 and 10. Using Hausman test, the results revealed that the random effect was inconsistent and the fixed effect was more appropriate for the data.

$$LHRI_{it} = \rho\sum_{j=1}^{N} w_{ij} LHRI_{jt} + \beta_0 + PRDP_{it}\beta_1 + LHS\,\beta_2 + LNRP_{it}\beta_3 + LPCGDP_{it}\beta_4$$
$$+ LIHB_{it}\beta_5 + LPOP_{it}\beta_6 + \varepsilon_{it} \quad (4)$$

$$\varepsilon_{it} = \lambda \sum_{j=1}^{N} w_{ij} \varepsilon_{jt} + u_{it}$$

Table 9. The Spatial Autocorrelation Model

Dependent variable: LHRI		
Variable	fixed-effect	random- effect
PRDP	.7158**	.63714*
LHS	-1.1952***	-1.0098***
LNRP	.03730*	.073915***
LPCGRP	.17280***	.268316***
LIHB	.02020***	.022983***
LPOP	1.1681***	-.110337**
Cons		5.26960***
WD*LHRI	.34169***	-.025645
WD*e.LHRI	.74674***	.925073***
Statistics		
AIC	-724.1878	-618.2127
BIC	-691.8020	-578.6301
Wald test of spatial terms	chi2(2) = 166.91***	chi2(2)= 2147.38***

Note: The asterisks *, **, and *** denote significance at the 10, 5, and 1 % levels, respectively.

Table 10: Hausman test

H_0: difference in coefficients is not systematic
chi2(8) = 83.11
Prob>chi2 = 0.00

4.3. Comparing SDEM and SAC model

Comparison helps to determine which model is the best to rely on it. The Hausman test indicated that the fixed effect for SDE model and the SAC model must be chosen. The Akaike information criterion (AIC) or the Bayesian information criterion (BIC) was reported to estimation tables (table 11). Comparing these estimators showed that the SAC model is more reliable. After it, all test and interpretation are based on the SAC fixed effect Model. In addition, there are a lot of fixed feature such as Area, geographical location and neighbors of each province that would not change by the time so it is better to choose the fixed effects.

Table 11. Comparing SDEM and SAC model

Model	df	AIC	BIC
The SDEM random effect	11	-722.135	-682.55
The SAC fixed effect	9	-724.187	-691.80

4.4. Results

The results show that a significant and positive association exists between housing rental index and the percentage of the ratio of divorce to the population in Iran province (see columns 1 of Table 9). The positive impact of divorce on house rent can be explained by increases in demand of house, that means by each divorce one household usually becomes two households. Interestingly, the coefficient of LPRDP shows that a 1% increase in this variable increases house rent index about 1.057% in Iran province. The coefficient WD*LHRI (ρ in equation 4) shows that the housing rental index in a province depends on the housing rental index in the other provinces. On average, a one-percent point increase in the house rental index of any other provinces will increase the house rental index in a province by about 0.34 percentage point. And the coefficient of WD*e.LHRI (λ in equation 4) showed that there is dependence in the disturbance process. It means that some unrecognized variables which have impacted on the housing rental index are existing and there are dependent on each other because of their location.

Table 12. Direct, Indirect and Total effects

	Direct	p-value
PRDP	0.7210	0.002
LHS	-1.2039	0.000
LNRP	0.0375	0.020
LPCGRP	0.1740	0.000
LIHB	0.0203	0.001
LPOP	1.1766	0.000
	Indirect	
PRDP	0.3359	0.003
LHS	-0.5608	0.000
LNRP	0.0175	0.050
LPCGRP	0.0810	0.000
LIHB	0.0094	0.004
LPOP	0.5481	0.000
	Total	
PRDP	1.0570	0.002
LHS	-1.7647	0.000
LNRP	0.0550	0.025
LPCGRP	0.2551	0.000
LIHB	0.0298	0.001
LPOP	1.7248	0.000

Table 12 reports the direct and indirect effects of independent variables on the dependent variable. AS it was said the own-province direct effect of a 1-percentage point increase in the percentage of the ratio of divorce to population is to rise house rent index by 1.05 percentages point in total. The across-province spillover effect of a 1-percentage increase in the percentage of the ratio of divorce to population is increasing house rent index by 0.33 percentage points on average. And in total, it showed that if there was a 1-percentage increase in the percentage of the ratio of divorce to population is to increase house rent index by 0.72 percentages. The own-province direct effect of a 1-percentage enlarge in the household size is to reduce house rent index by 1.2 percentage and the across-province spillover effect of a 1-

percentage increase in it decries house rent index by 0.56 percentage points on average. And in total, it showed that if there was a 1-percentage increase in the household size is to decrees house rent index by 1.7 percentages. The good explanation for it is that the house rent in Iran more dependent to the area of the house not to the number of people that living in the house and on the other hand there is no limitation like other countries for the per capita area for each person in Iran.

The own-province direct effect of a 1-percentage increase in the Natural growth of Population in a province is to increase house rent index by 0.037 percentages. The across-province spillover effect of a 1-percentage increase in the Natural growth of Population is to increase house rent index by 0.017 percentage points on average. And in total, it showed that if there was a 1-percentage increase in it is to increase the house rent index by 0.055 percentages. The impact of the Natural growth of Population is very small so we can ignore it.

The own-province direct effect of a 1-percentage increase in the average per capita income is to increase house rent index by 0.175 percentages. The across-province spillover effect of a 1-percentage increase in the average per capita income is to increase house rent index by 0.081 percentage points on average. And in total, it showed that if there was a 1-percentage increase in the average per capita income is to increase house rent index by 0.25 percentages. Housing is a capital asset in Iran so by increasing in the average per capita income, the demand for buying house raises up so it will cause house price increase therefore in house rent.

In fact, the supply of housing must grow up by increasing investment in housing building and therefore it must cause a decreasing in the price of it. But the impact of investment in housing building in over model becomes so small that we can ignore it. The good explanation for it can be increasing in the housing building investment and increasing in the exchange rate of Rial to Dollar occurred at the same time.

And the last variable is the population, the direct, indirect and total impact of it on the house rental index is equal to 1.17, 0.54 and 1.72. This means if there was a 1-percentage point increase in the population is to increase house rent index by1.72 percentages point.

5. Conclusion

There is several research to investigate the effect of housing costs on divorce. However, it has not been tried out in the opposite way. Nowadays divorcing has been growth in the developed countries and make changes in population structure. So we were applying Iran provinces data over the period of 2006-2014 to examine it. The results suggest that a 1% increase in the divorce increases house rental index about 1.05% in average which is included the direct and indirect effects. The findings also indicate that household size has a negative and significant relationship with house rental index in Iran province and 1 percentage increase in the household size is to decrees house rent index by 1.76 percentages, also if there were 1-percentage increase in the population and the natural growth in population are to increase house rent index by 1.72 and 0.05 percentages, respectively. If there were 1-percentage increase in the per capita income and the investment on housing building are to increase the house rental index by 0.25% and 0.03%.

References:

Anselin, Luc. 1988. *Spatial Econometrics: Methods and Models*.

Cook, Scott J., Jude C. Hays, and Robert J. Franzese. 2015. "Model Specification and Spatial Interdependence." *Working paper*.

Dam, Niels Arne and Hedegaard Rasmussen. 2014. "A MULTI-SPEED HOUSING MARKET." *DANMARKS NATIONALBANK* 43–64.

Elhorst, J. Paul. 2014. *SPRINGER BRIEFS IN REGIONAL SCIENCE Spatial Econometrics From Cross-Sectional Data to Spatial Panels*.

Essafi, Yasmine and Arnaud Simon. 2015. "Housing Market and Demography , Evidence from French Panel Data." *European Real Estate Society 22nd Annual Conference* 107–33.

Farzanegan, Mohammad Reza and Hassan Fereidouni Gholipour. 2016. "Divorce and the Cost of Housing: Evidence from Iran." *Review of Economics of the Household* 14(4):1029–54.

Fischer, Marcel. 2015. "Housing Decisions under Divorce Risk ∗ ."

Hasanzadeh, Ali and Mehran Kianvand. 2012. "The Impact of Macroeconomic Variables on Stock Prices : The Case of Tehran Stock Exchange." *Money and Economy* 6(2):171–90.

Hlaváček, Michal and Luboš Komárek. 2011. "Regional Analysis of Housing Price Bubbles and Their Determinants in the Czech Republic." *Finance a Uver - Czech Journal of Economics and Finance* 61(1):67–91.

Jia, Shijun, Yourong Wang, and Gang-Zhi Fan. 2018. "Home-Purchase Limits and Housing Prices: Evidence from China." *The Journal of Real Estate Finance and Economics* 56(3):386–409.

Kapinos, Pavel, Tami Gurley-Calvez, and Kandice Kapinos. 2016. "(Un)Expected Housing Price Changes: Identifying the Drivers of Small Business Finance." *Journal of Economics and Business* 84:79–94.

Kelley, Allen C. et al. 1965. "DEMAND PATTERNS , DEMOGRAPHIC CHANGE AND ECONOMIC GROWTH." 25:694–703.

Kapoor, M., H. H. Kelejian, and I. R. Prucha. 2007. Panel data models with spatially correlated error components. Journal of Econometrics 140:97-130

Larch M., Walde J. (2008) lag or error? — detecting the nature of spatial correlation. in: preisach c., burkhardt h., schmidt-thieme l., decker r. (eds) data analysis, machine learning and applications. studies in classification, data analysis, and knowledge organization. springer, berlin, heidelberg.

LeSage, James P. 1999. "The Theory and Practice of Spatial Econometrics." *International Journal of Forecasting* 2(2):245–46. Retrieved (http://www.spatial-econometrics.com/html/sbook.pdf).

Mankiw, N. Gregor. and David N.Weil. 1989. "The Baby Boom, The Baby Bust, and The Housing Market." *Regional Science and urban Economics* 19:235–58.

Mikolai, Júlia and Hill Kulu. 2018. "Divorce, Separation, and Housing Changes: A

Multiprocess Analysis of Longitudinal Data from England and Wales.” *Demography* 1–24.

Phillips, Richard A. and James H. Vanderhoff. 1991. “Two-Earner Households and Housing Demand: The Effect of the Wife’s Occupational Choice.” *The Journal of Real Estate Finance and Economics* 4(1):83–91.

Rezazadeh, Razieh and Tahere Outadi. 2008. “A REVIEW OF HOUSING DEMAND CONSIDERING THE CHANGES IN POPULATION STRUCTURE IN THE CASE OF TEHRAN.” *INTERNATIONAL JOURNAL OF ENGINEERING SCIENCE (ENGLISH)* 19(10):139–50.

Turunen, Jani, Sofi Ohlsson-Wijk, and Gunnar Andersson. 2017. “Family Forerunners ? An Overview of Family Demographic Change in Sweden Stockholm.”

Walks, Alan and Martine August. 2008. “The Factors Inhibiting Gentrification in Areas with Little Non-Market Housing: Policy Lessons from the Toronto Experience.” *Urban Studies* 45(12):2594–2625.