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On the Effect of Change in Age Structure (Population Ageing) on Housing Price in Iran

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ABSTRACT

Housing is a substantial part of the economy with a significant role in GDP, investment and employment. The growth of this sector will result in prosperity of other sectors of the economy because of its many backward and forward linkages. The recent fluctuations in Iran's housing price have transmitted to the whole economy and turned to a big challenge. It has been argued in the literature that the demographic factors are also affecting housing price, besides economic forces. The aim of this study is to investigate the impact of changing demographic factors (population aging and population growth rate) alongside macroeconomic variables on housing price in Iran. Using an ARDL model and data for 1973-2018, we find that population growth rate, real per capita income and real construction costs have positive impact on housing price both in short and long run while real price of gold coin and population ageing have negative effect, of course with weaker effect in the short run. Since the model is in logarithmic form, the coefficients become elasticities and comparable to each other. So, the most significant and effective factors in determining housing price, are population ageing, population growth rate, real construction costs, real gold price and real per capita income respectively.

1. Introduction

Housing is one of the most significant sectors of Iran's economy due to its large share of investment, employment, and production. This sector also plays

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a superior role in the mobilization and usage of production factors of the country. Because of its strong backward and forward linkages with other economic sectors, not only it affects the activities and developments of other sectors but also being affected by them. We can consider the housing sector as a driving force as well as a leading sector of the country; its prosperity flourishes other sectors, and its recession causes their stagnations. These features make housing such a crucial sector so that its progress and growth is regarded as one of the most important goals of the economic policy (Salmani, 2016). So, by observing housing fluctuations, one can predict future economic outlook of the country and by identifying the factors affecting housing prices, policy makers can figure out how to manage the economy better (Salmani, 2016: Mehregan and Tartar, 2014). This is why determining micro and macroeconomic factors driving supply and demand sides of housing, becomes very vital to economic policy making. Of course, since housing supply is relatively inelastic, the market demand would be responsible for most of the housing price changes.

Housing market in Iran has gone through many ups and downs in recent years, which are the reflection of macroeconomic developments as well as shifts in demand and supply of the market itself. Although during boom times housing price increases dominantly, but in the bust times it remains stable or decreases very slowly (of course with a great impact on housing market as well as whole economy).

One of the most important and often ignored factors is the demographic characteristics such as aging. The ageing feature of population has only been considered in a few studies and for a limited countries, but now it is taken as a pervasive phenomenon in the whole world. The ageing of population is caused by the process of demographic transition (which is of course not the same for different countries in its severity and depth) and depends on the stage of their population transition. Iran is in the final stage of demographic transition and its mortality and fertility levels are approaching each other (Zarghami and Mirzaei, 2015). It seems that in the coming years, in addition to the risk of population decline, the housing sector in Iran may face another risk, because of rise in population ageing ratio.

This study aims at identifying the factors affecting housing prices in Iran's economy with emphasis on demographic changes (such as age structure) both in the short and long run. The structure of this paper is as follows; the next section (section 2), reviews briefly the theoretical basis and empirical evidences of this research. In the third section the proposed research model will be introduced and justified, followed by model estimation, using the Autoregressive Distributed Lag (ARDL) method with Iran's annual data for 1973-2018. Last section is devoted to the interpretation of results and some policy recommendations.

2. Review of literature

2-1. Theoretical Foundations

People reside in houses and housing is constructed in locations people live in. So, there is a close relationship between population and housing; a more populated area, the more densely constructed dwellings. Housing is a special durable consumer good with a potency for repair and renovation. It is also an asset which can be used as a proper way of keeping household savings' purchasing power intact, a good and competitive substitute for other forms of assets (at least in the economies like Iran with a long history of rising housing prices). Housing is a special good because of its non-homogeneity nature, so we cannot find not even any two units with exactly the same features or specifications. This non-homogeneity nature is the result of differences in plenty of features such as its location in city, size, map and interior design, materials used, age and many more (each one with diversified quality and specification itself). Therefore its market and its price determining factors are more complex. Since its construction is a very time consuming process, any desired changes in housing supply should be targeted, planned and started quite some time before. By comparing the great number of existing second-hand homes with the number of newly built ones, one can conclude that the stock of housing is relatively stable and most of housing price changes are attributable to market demand.

Housing is basically demanded by households due to the reasons mostly related to family formation. But the motivation of people to demand for

housing is not the same; some buy it for their own residence (consuming its services) and some as an asset. Because of its strong and well suited second-hand market and rentable potency, housing price changes are also subject to the tendency of asset holders (in order to remain in the market), beside its production cost and market demand condition. Economic theory suggests that housing price is affected at least by three demographic factors; population growth rate (birth and death rates), out or in-migration and life expectancy, in addition to usual economic factors. Obviously a higher natural population growth rate (positive birth rate-death rate differentials) and migration will increase both the size and structure of adult population (main demanders of housing), resulting in higher demand for housing services. These two demographic factors, alongside with income and preferences of the adult population are the main reasons of shifts in total demand for housing services. It has been justified and accepted in the literature that the optimal route for consumption of housing services is based on a life cycle trend (Flavin and Yamashita, 2002), therefore any changes in the size and age distribution of the population causes large and predictable changes in housing prices (Mankiw and Weil, 1989). That is based on the law of demand-supply and also the usual and accepted assumption of limited long-term elasticity of housing supply, an increase (a decrease) in population size (for any reason) leads to higher (lower) housing price over time (Levin et al., 2009). People's demand for housing services, (which is different and mostly independent from demand for housing itself) is low during their school years, increases by entering the labor market, then peaks with family formation and decreases at the retirement age. Housing price changes due to population jump without any changes in other effective factors are called "size effect". This is the firsy channel of demographic effect on housing price.

It is very reasonable and usual for adult population to smooth out their use of housing services throughout their life cycle: buying private housing at younger age, of course if they can afford. But in case of loan restrictions and/or other financial frictions, the households may face some problems. Consequently, in periods of financial ability, they would buy their private housing and sell when necessary (in case of illness or substituting with a more

proper or beneficiary asset) or death. Thus, life cycle theory predicts the negative effect of ageing on housing price, i.e., housing prices should fall when the share of population at retirement age is high. This can be called the "age structure effect" or "age distribution effect", which is expected to act independently of the size effect (Takáts, 2012). The impact of ageing on the demand for housing as an investment (a durable good) is the second effective channel of demographic factors on housing price. In models that address the saving behavior with a life-cycle approach, young people buy a durable good (as a capital in order to protect their purchasing power and getting prepared for retirement time), and some of them sell or rent their houses at retirement age and move to a more proper area or even a foreign country (Henderson and Ioannides, 1983: Kraft and Munk, 2011). Likewise, a steady growth in the retired population ratio, reduces housing investment demand. Any price changes resulting from change in retired ratio again depends on the price elasticity of the housing supply. However, the nature of ageing effect on housing demand as an investment is self-reinforcing. Housing owners may anticipate future price declines due to more sellers than buyers and act accordingly, which then increases the cost of housing (as a capital) ownership and in turn reduces its investment demand and the current price (Hiller and Lerbs, 2016). Note that any changes in people's life expectancy will also shift housing demand directly and also through changes in size and age structure of adult population, retirement postponing, migration behavior and decision to stay or leave the asset market of housing.

The 2 channels mentioned above have no direct effect on construction costs of residential buildings, mostly because of high mobility of construction workers as well as most other inputs of construction process. There is a third channel that affects the price of urban housing i.e., negative population growth rate and outmigration. But the negative population growth rate or outmigration followed by lower density of households in cities would decrease demand for land (as the essential input of housing construction of residential buildings) and therefore reduce the price of every square meter of land for housing, since lots of proper housing land are left useless. This is a new phenomenon and would be more visible if the speed of population reduction and outmigration

is relatively high. In these cases usually and typically, urban planners restrict zoning rules to control the amount of land available for housing construction and to stabilize land prices (Mayer and Somerville, 2000). Besides the effective factors of housing price mentioned above, two other factors are also expressed in the literature, namely intra-sectoral and inter-sectoral elements. The usual intra-sectoral factor is constructing cost as a proxy fur supply side of the market, with positive expectation effect, while the alternative asset market (i.e, gold market) competing with housing market as an alternative investment is taken as intra-sectoral factor. The higher return in competing market, the lower demand for housing is expected (Mousavi and Droudian, 2015)

The effective factors of house price level may be classified into two groups: intra-sectoral & inter-sectoral factors of housing market. From intra-sectoral factors, the construction cost was included in the analysis as a proxy of supply variable with positive expected effect. From the inter-sectoral factors, the role of alternative asset markets was significant given the extent of housing demand as an investment. The higher return on investment in competing markets, we expect less demand for house. Hence, return on gold is considered as a variable with probable negative effect on the price of house (Mousavi & Doroudian, 2015).

2-2. Empirical evidence

Mankiw and Weil (1989) were the first researchers to investigate the possible effects of demographic changes on housing demand and prices, considering housings demand as a function of age, in addition to the usual effective factors. They used the United States cross-section data in 1970 and found that housing demand was very low for young people under the age of 20, high for those aged 20-35, and low again for older groups. They stated that the US peak demand for housing in the 1980s was due to the population explosion and predicted that people who were born in that decade would be retired in 2007. This meant that the real price of housing would fall by 47%. But these results were criticized by many. Goodman (1990) concluded that the explanatory power of the model is significantly increased by adding demographic variables to the model and claimed that age and race are also important. Usually we

expect that the older households are home owners and demand for both rent a house or buying it is inversely related to age. Household size is also important but has a smaller impact on the housing demand. Peek and Wilcox (1991) attributed changes in the housing price index mostly to the post-tax interest rates and construction costs. They stated that demographic variables are important but not as much as insisted on by Mankiw nd Weil (1989). Krainer (2005) provided some evidence on reluctance of the people over the age of 65 to buy a home, even if can afford. Levin et al. (2009) criticized Mankiw and Weil's use of cross-sectional data for forecasting, on the grounds of neglecting housing supply changes through time and failure to control other important variables in housing prices. Ohtake and Shintani (1996) examined the mechanism of the Japanese housing market in the light of demographic changes. They concluded that the supply of housing in Japan is price elastic in the long run, and the demographic changes affect the (existing) housing stock without any effect on price. However, demographic factors affect housing prices through the short-term adjustment process of the Japanese housing market. Krainer (2005) provides some evidence on reluctance of the people over the age of 65 to buy a home, even if can afford. Takats (2012) used the data for 22 advanced economies to examine the effects of aging on housing price. His panel data regression model showed that one percent increase in per capita income and in population size will lead to 1.88 and 1.05 percent increase in the real price of housing, respectively. In contrast, one percent increase in the elderly dependency rate (population over 65 years divided by the population at working age of 20-64 years) would lower housing prices by 68%. His results showed that in the next 40 years, housing prices will fall annually by 2.5% for South Korea and 0.8% on the average for countries considered. Algieri (2013) analyzed the main promoters of real housing prices in five main countries of the European Union, plus United States and United Kingdom using an intangible component model. This technique enabled him to explain price changes that are not due to economic factors of real income, long-term interest rates, stock prices and inflation rate, but are due to the significant effects of unseen factors such as structural changes in market or in people's preferences (as the invisible, hidden or

intangible components). The results showed that per capita income elasticity and demographic changes are the main factors explaining changes in the real price of housing. Meanwhile, the stock market had a positive relationship with housing prices, which showed the predominance of wealth effect to substitution effect. Hiller and Lerbs (2016) examined how the age distribution of urban population affects housing price growth in 87 German cities. Their results indicated that the population ageing has the most significant effect on the real selling price of single-unit apartments and houses. They also showed that rent growth was positively related to the increase in the dependency ratio and may be an indication of this fact that demand for residences that provide only housing services were increasing relatively. Zheng (2017) using data for 31 provinces in China, concluded that the ratio of population in working age had a positive effect on housing prices, firstly due to the very large population of young people at marriage age and secondly due to the high-income population in this age. Also, while the ratio of elderly population has a negative effect on housing prices, the ratio of young population has significantly positive effect. He justifies this finding mainly by the fact that as time passes and the working age group become elderly retired people, housing demand and price pressures decrease. Also, when young population reach working age, they cannot quickly demand housing. Therefore he recommends population growth policies to promote housing demand stability. Park et al. (2017) examined the dynamic effects of population aging on housing prices in 6 metropolises and 7 provinces of South Korea in the period 1990-2014 using panel data. Their results showed that any increases in both production and growth rate of per capita income by 1 percent, housing prices will rise by about 0.3 percent. Although the population growth rate in the regression was meaningless, with a 1% increase in the dependency ratio, housing prices fall by about 0.7%. Therefore, the researchers concluded that it is necessary to pay attention to the effect of population aging for housing-related predictions. They also stated that the relation between housing prices and aging variables and/or economic variables can change with change in households' preferences, financial institutions, and so on. Zeng et al. (2019) examined the effect of population structure and household savings on housing prices in

China, using data from 35 large and medium-sized cities. They concluded that the child dependency ratio has a significant negative effect on housing prices, while the elderly dependency ratio has a positive effect. Also, they find a very remarkable positive relationship between household savings and housing price. While the effect of population aging on housing prices varies at different levels of household savings. Thus, population aging affects housing prices through household savings. Releasing the older generation's savings can gradually stave off rising housing prices. Population aging reduces risk in the long run. Zhanget al. (2020) using panel data from 2005 to 2017, they examined the role of divorce in the relationship between aging and housing demands. The results showed that regardless of the moderating effect of divorce, the aging population has a significant effect on housing demands and the divorce rates do not generally increase housing demands, but there are differences in the significance levels of the impact of the number of residential and regional transactions. Considering the moderating effect, the aging population has a clear effect on housing demands, but because the divorce rate has a debilitating role, the promoting effect gradually decreases.

In Iran, Samimi et al. (2007) studied only the effect of economic variables on the housing price index using ARDL method with quarterly data during 1994-2005 period. Their results showed that the inflation rate, per capita household income, stock price index, money supply, price index of construction services and number of completed buildings affect the behavior of real housing price. Suri et al. (2012) used the VAR model with quarterly data from 1991 to 2006 to investigate the relationship between interest rates on bank loans and housing price. Their results indicated that as the interest rate of bank loans decreases, the households' demand for housing would increase, while liquidity and per capita income have positive effects on housing price. Mousavi and Dorudian (2015) attempted to identify factors causing housing price in city of Tehran to fluctuate, by using the structural time series method and Kalman filter algorithm with quarterly data from 1991 to 2009. Their results show that real interest rates, per capita completed residential buildings, and the return on alternative assets have negative effect on housing prices, while the construction cost has a positive effect. Their

policy recommendation for controlling housing market fluctuations is to strengthen the supply of housing and control its construction costs. Ghaderi and Izadi (2016) studied the effect of economic and social factors on housing price in Iran using OLS method and annual data from 1971 to 2012. Their findings indicated that the loans granted by bank Maskan, urbanization rate, unemployment rate, yearly rent rate, housing tax, per capita income and material price index have positive effect housing price while GDP, number of issued building permits and government expenditures have negative effect.

3. Data and Model

As mentioned before, the goal of present research is mainly to evaluate the effect of population aging on housing price in Iran. So, based on the theoretical foundations and empirical evidences reviewed briefly above, we specify the research model as follows:

$$P_H = f\ (P_A,\ Cost, Y, Age, Pop) \quad (1)$$

where P_H, denotes housing price index, P_A asset price index, $Cost$ construction cost, Y gross domestic product or income, Age the age structure of the country and Pop population growth rate. Since the time series data for housing price index is not available for the whole period (1973-2018), we have no other choice except to use another indicator as a proxy. The Statistical Center of Iran has prepared and implemented the housing price survey plan since 1993, but there exists no data for the years before. Of course the heterogeneity nature of housing and the overtime evolution of its construction method such as size, materials and facilities, map, interior design as well as its location and environmental status has added to the complexity of housing price calculation in a proper way. The common approach to resolve this is by defining a standard housing, as was proposed by Muth (1960) and used repeatedly afterwards. In this method, a more frequent, common or usual housing built with specific type of materials is taken as the standard and other types of housing with different kind and quality of materials are evaluated according to the standard one (finding its equivalence) through their price differentials (Muth: 1960, Aghaei: 1997). Unfortunately, the detailed,

extensive and reliable data needed for calculating the housing price index for all urban areas of the country is not available. So this is why most domestic applied researchers used a suitable substitute instead. The developments of social behavior in recent years such as urbanization rapid growth and high migration rate have made the problem even worse.

A very common index to be used in the studies of this kind is called the Housing Price Index, which is a component of the Consumer Price Index (CPI). This index includes three factors; "rent of non-private residential housing", "rental equivalence of owner occupied houses" and "maintenance and repair services". Thus, this index represents the annual cost of renting a house for a household on one hand and at the same time the potential annual income of this asset for its owner on the other hand. The calculation's method of "rental equivalence of owner occupied houses" or for short "private housing rent" has chanced through time: from 1982 and after the revision of CPI index, its changes was not calculated directly, but instead it was adjusted the same as CPI index, and again since 1990 (based on some studies and past experiences) it has been adjusted the same as "non-private housing rent" (Hemmati 2007). These changes in its calculation process make it inconsistent as a time series data, especially when there is not enough detailed information to calculate or at least make it consistent. The heavy and growing weight of "private housing rent" of 20.92 compare to the other two factors 7.51 and 1.71 (according to the statistics published by Central Bank of Iran (CBI) for 2016), emphasizes on the dominant role of private housing rent in calculation of "housing price index", therefore making it less reliable. So we had no other choice except to use a substitute, i.e., "non-private housing rent", as many other researchers. This substitution, despite its weaknesses, make the calculations more reliable and acts as a good indicator or proxy for housing price.

P_A, is the real (based on the 2004 prices) price of old design gold coin and considered as the price of a common asset (a suitable substitute for what most households buy with their savings in order to maintain the value of its purchasing power).

Cost is defined as the real construction cost index, and represents the average cost of constructing one square meter of completed buildings in all

cities of the country. These costs include map design, engineer supervision, building permit, building materials, tools and equipment, labor wages, architect's fees, central installation (heating-cooling, gas, electricity, water and sewage), excluding land price (cost of buying land). As mentioned above, quality and type of materials, facilities and equipment used in different residential units are among the factors making the nature of buildings heterogeneous and also complicating the measurement of its construction cost. Since there is a very high correlation between materials used and equipment and facilities installed in any building, we focus on the cost of materials and reduce the measurement complication of cost, without losing much. For example, in a residential building made with clay and bricks, less expensive facilities would be installed. But in the more luxurious buildings, more expensive facilities and equipment (with more costly usage) such as central heating system, swimming pool would be installed. This approach also opens the road to homogenizing housing units by defining standard building, which innovatively was proposed by Muth (1960) and used repeatedly afterwards. Therefore, the construction cost of a standard housing in each period in Iran is measured and used. The standard building for the period of 1973 to 2006 is defined as the one built with bricks and beam, and for 2007 and after, as the one built with reinforced concrete.

Age is the index of country's population ageing and is defined as the ratio of population over 60 years to working age population (20-60 years) a most common used indicator.

Y or income is defined as real (based on the 2004 prices) per capita GDP.

Pop denotes the country's population growth rate.

The economic data are taken from CBI and the Statistics Center of Iran (SCI), and the data for demographic variables from SCI. As we know demographic data are gathered only in census years, and SCI estimates them for other times, using a spectrum population projection software in a specific procedure. With this published time series data, the population aging is calculated based on the definition given above.

The time domain of the present study is from 1973 to 2018. The regression function is in logarithmic form of (all variables are in logarithm), so each

coefficient becomes elasticity of housing price to the corresponding explanatory variable.

4. Model estimation

4-1. Preliminary Tests

a) Unit Root Test: As we know, the reliability of time series data (variables) should be evaluated before making statistical inferences (which are based on the standard asymptotic theory) and using the results of estimation process. This is done with the use of KPSS unit root test. The results of this test for the variables under consideration (both at level and first difference) are presented in the following two tables, respectively. According to the results, we can conclude that some variables are I (0) while others are I (1), in fact there is a combination of I (0) and I (1) variables. Fortunately, there is no I(2) variable and a stationary and reliable relation between variables can be found with a maximum of one difference.

Table 1. KPSS Unit Root Test for Variables

Variable	Type of Test	
	With y-intercept	With y-intercept and trend line
P_H	0.49	0.11*
Y	.019*	0.19
P_A	.028*	0.11*
Cost	0.20*	0.18
Age	0.11*	0.08*
Pop	0.71	0.09*
Critical value (5 percent)	**0.463**	**0.14**

* Indicates the stability of variable

Table 2. KPSS Unit Root Test for First Difference of Data

Variable	Test Type	
	With y-intercept	With y-intercept and trend line
P_H	0.12*	0..07*
Y	0.23*	0.07*
P_A	0.14*	0.13*
Cost	0.09*	0.08*
Age	0.36*	0.13*
Pop	0.10*	0.10*
Critical value (5 percent)	**0.46**	**0.14**

* Indicates the stability of variable

b) Long-run relationship test: Now we use the Band Co-integration Test presented by Pesaran et al. (2001) to ensure that there is a stable long-term relationship between the variables. In this test the null hypothesis is "the absence of a long-term stable relationship between dependent and explanatory variables" and the boundary distribution of the test depends on the degree of integration of variables, i.e. I(1) or I(0). When the explanatory variables are a combination of I(1) and I(0) processes (instead of a usual critical point in most statistical tests), an asymptotic domain (an area with a lower and an upper point) or a bound is specified to separate the acceptance zone of the null hypothesis. If the calculated test statistic is greater than the upper extreme critical values, the null hypothesis is rejected (the existence of a stable long-term relationship between the variables is justified) and if the test statistic is less than the lower extreme, the null hypothesis cannot be rejected (there is no long-run relation between them). If the test statistic falls in within the band (between the two extremes), it is not possible to draw a definite conclusion from the test and other steps should be taken[1]. The results of this test are presented in following table (table 3):

Table 3. Cointegration Test Results

1. These steps are fully explained in the text-books.

Significance Level	95 Percent		99 Percent	
Lower and Upper Extreme	I (1)	I (0)	I (1)	I (0)
Critical values	3.34	2.14	4.21	2.82
Band test F statistics	14.23			
N=45, K=5, No y-intercept and trend line				

The results shown above indicate that there is a significant co-integration relationship between variables. Since Auto Regressive Distributed Lag (ARDL) is used as one of the most appropriate econometric method for estimating the proposed model of this study, the next step would be to select its appropriate and optimal specification, based on the method proposed by Pesaran and Shin (1998). Since the value of band test statistic is higher than the upper extreme of the test with 99% confidence, the null hypothesis of the test "there is no stable long-term relationship" cannot be accepted. Being confident that the regression is not false, the next step is to estimate both the long-run and short-run dynamic model. We use Schwartz-Bayesian criterion to determine the optimal lag in the estimated model. After taking all these steps, we come up with the following regression function as the optimal regression one:

$$P_H = f(P_H(-1), P_A, Cost, Y, Y(-1), Age, Pop, D) \quad (2)$$

Where D is a dummy variable with value one for two years of 1979 and 1981, a year after two special events (victory of Islamic revolution and start of imposed war) that had a significant effect on housing price. The best results are obtained when regression is without y-intercept and time trend. The accuracy of the estimated model and its structural consistency should be evaluated using usual diagnosis tests. For this purpose, the Breusch-Godfrey Serial Correlation, White Heteroscedasticity Test, Jarque-Bera Test and Ramsey RESET Test are used and the results are shown in the table 4, below:

Table 4. Regression Diagnostic Tests Results

Type	Test Statistic	Probability
Serial correlation	0.08	0.99
Heteroscedasticity	0.68	0.70
Normality	0.60	0.73
Ramsey Reset	2.57	0.11

The results presented above shows that the estimated regression satisfies classical assumptions (lack of serial correlation, homoscedasticity and normality of residuals) and based on the Ramsey Reset Test we cannot reject the correctness of the subordinate form. Furthermore, to evaluate the structural consistency of the model, we use CUSUM and CUSUMSQ tests, their graphs are shown in Figure 1.

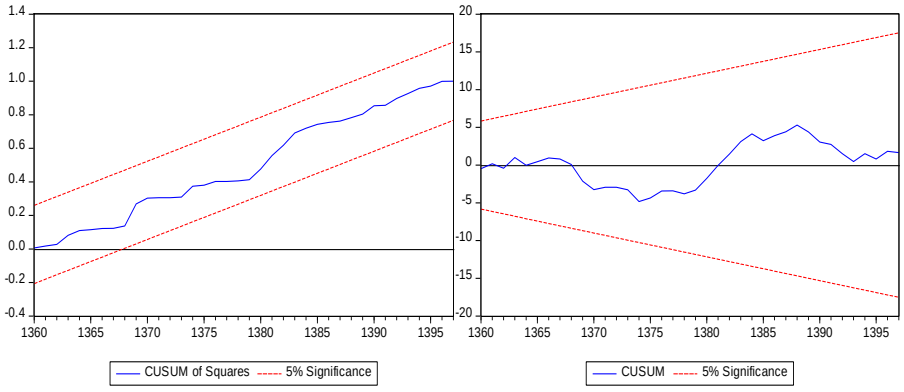

Figure 1. CUSUM and CUSUMSQ Structural Consistency Tests

Therefore, based on the test results presented above, we conclude that the estimated regression confirms the structural stability of the coefficients in the period under study, i.e., it is correctly specified and can be used as a proper regression.

4-2. Long-rum results

The long-run estimated coefficients are shown in table 5:

Table 5. Long-run Coefficients

Explanatory variables	Y	Cost	P_A	Pop	Age
Coefficient value	0.15	0.23	-0.18	0.41	-.090
T statistic	5.55	5.58	-3.76	8.72	-6.55
Probability	0.0000	0.0000	0.0006	0.0000	0.0000

As it is obvious all the coefficients are significantly different from zero in the long-term, the regression as a whole is also significantly meaningful and gives a very good fit to the data. Now we can interpreter the results long run as follows:

a) One percent increase in per capita income (on the average) will lead to 0.15% percent rise in the housing prices. The positive income effect indicates an increase in demand for housing services as well as demand for housing as a valuable wealth (or household investment), resulting in an increase in housing prices, obviously an expected result. Since usually, when income increases, people get more inclined to pay more for housing commodity (to buy or rent more).

b) One percent increase in the cost of housing construction (on the average), will increase the housing price by 0.23 %. Although its positive sign was expected (any increase in the production costs will lead to higher housing price), but being less than one, indicates that suppliers are not able to transfer all the increase in production costs to buyers. One reason might be the existence of large stock of housing.

c) One percent increase in the price of substitute assets (here gold coin price) will result in a 0.18 % reduction of housing price. The negative sign of the coefficient (which was expected) indicates that these are substitute assets; households buy them to safeguard the purchasing power of their savings. Therefore, an increase in the price of one asset (gold coin here) will

motivate some of households to enter to gold coin market and demand less housing (because it may not be a good way of using their savings) or even sell their houses to exploit the opportunity of rising gold coin price. Also, changes in the asset (gold coin) price can be seen as a reflector of changes in market interest rates (i.e., the user costs of capital). So the expecting negative sign indicates the negative effect of interest rates on investment and in turn on housing price.

d) One percent increase in the rate of population growth (on the average) will increase the housing price by 0.41%. Its positive sign is quite reasonable and expected, since population growth and more profoundly higher population growth rates will increase demand for housing services (need more housing services) which with supply of housing being fairly inelastic, the price of housing increases; the size effect as mentioned before.

e) One percent increase in population ageing on the average, will decline housing price by 0.90%. The negative effect of ageing population index on housing price is in accordance with economic theory and insists on the age structure (or distribution) effect of population; older people have less motivations to by housing. Therefore, if all other effective variables remain constant or at least stable, as population of the country gets older (population ageing), the demand for housing services and housing as an investment would decrease and eventually housing prices will fall. Lack of rapid adjustment of housing stock also leads to greater sensitivity of housing prices.

4-3. Short-run results

As it is usual, in order to derive the short-run relationship between variables, the so called “error correction model or equation” is used (adding the long-run regression residual to the regression function). The results of estimating error correction model are shown in table 6.

Table 6. Error Correction Equation (Short-Term Relationship)

Explanatory variables	Y	Cost	P_A	Pop	Age	Dum	Error Correction
Coefficient value	0.65	0.17	-0.05	0.26	-0.43	-0.21	-0.60
T statistic	5.98	4.27	-1.52	3.94	-1.48	-4.43	-7.29
Probability	0.0000	0.0001	0.1360	0.0003	0.1464	0.0001	0.0000
R^2=0.81, $\bar{R}^2 = 0.79$, D-W=1.97, Jaque-Bera Statistic=0.37, Ramsey Statistic=.92							

These results indicate that the error correction model is correctly specified and gives a good fit to the short-run fluctuations of housing price in Iran. All of the coefficients are significantly different from zero at 5% level, except age index (which is significant at 10% level, noting that it is a one-sided test)., so the results are reliable and can be interpreted:

a) The estimated coefficient of error correction term is equal to -0.60, its sign is in accordance with the econometric principles and its magnitude shows a fast convergence of short-run equation towards long-run equilibrium (60% of the model imbalances is corrected each period), another words it is an indication of fast response of housing price to changes in explanatory factors or fast reaction of housing market to any disequilibrium.

b) One percent increase in per capita income (on the average) increases the housing price by 0.65 percent in the short-term. This is much bigger than its long-run counterpart and shows higher sensitivity of housing price to per capita income in the short run relative to the long-run (the income effect of housing demand (for its services or as an asset) in the short term is greater. Of course the stricter inelasticity of housing supply in the short term can be the main cause of this phenomenon.

c) One percent increase in the cost of housing construction (on the average) will lead to 0.17% rise in the housing price. The construction cost effect in the short term is slightly less than its long-run effect which means an

increase in construction cost can be less transferred to housing price in the short run.

d) One percent increase in the price of assets (gold coin) decreases the price of housing by 0.05 percent (significant at the 90% confidence level).

d) One percent increase in population growth rate on the average, increases housing prices by 0.26 percent, although quite smaller than its long-run counterpart, but still is very effective and tangible for households.

e) One percent increase in the ageing index on the average, decreases the housing price by 0.43 percent (being significant less than 8% level). Development of population ageing (or structural changes in population) is a long-run process and in the short-run is not very much noticeable. So we should not have expected to see a distinguished changes in housing price in the short-run.

5. Conclusion and policy recommendations

The main goal of this research was to evaluate the effect of population aging on housing price. Based on the literature review, we come up with a model in which 5 variables of per capita income, asset price, construction cost in urban areas population aging and population growth rate as the explanatory variables of housing price. An ARDL model was used with 1973-2018data.

Since model is in logarithmic form, the coefficients become elasticities and comparable to each other. The estimated long-run relationship show that population aging, population growth rate, real construction costs, real gold prices and real per capita income are the most important determinants of housing prices, respectively. However in the short run, real per capita income, population growth rates, and real construction costs are the most important determinants of housing prices respectively. Population growth rates, real construction costs, and real per capita income have positive effect on housing price, while population ageing and the real price of gold coin (asset) have negative effect as expected.

The effects of demographic variables on housing price is an important issue for homeowners, investors and policymakers. Decreasing trend of Iran's population growth rate, will confront Iran in the coming years, with the risk of high elderly population ratio in addition to the risk of population decline. Our findings have consistency with life cycle theory. The two factors of population growth rate (size effect) and population aging (structure effect) had the great impact on housing prices in the period under review. These two factors have different heterogeneous effects on the housing market. If government implements a population policy today to increase the population growth rate, the size effect will be felt much sooner in the housing market than the impact of population structure (with a lag of at least twenty years). More importantly, in addition to population growth rate, migration and mortality rate also affect the distribution effect. According to the theoretical foundations, changes in the age structure of the population affect the demand for investment in the housing sector and any changes in housing price due to this factor, depends on the price elasticity of housing supply. Therefore, it is necessary for the government decision makers in housing sector to consider these two demographic factors very deeply.

Also, since both per capita income elasticity and construction cost elasticity are positive and less than one, we can conclude that government policies for increasing per capita income and at the same time lowering construction cost, will eventually lead to prosperity of housing market and lower housing price in the long term due to the bigger elasticity of construction cost.

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