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Analysis of the asymmetric effect of air pollution on housing prices in Iran (using the NARDL approach)

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Abstract

Given the expansion of cities in recent decades, it is necessary to address environmental problems such as air pollution and study its impact on the economy. One of the most important sectors of the economy in which the environmental effects are very evident is the housing sector. The importance of housing is such that has always been introduced as one of the main human needs. However, the increase in housing prices in recent years and the high cost of services, in the housing sector, have led to little attention being paid to consumer tastes and preferences, including clean air, in housing construction. Therefore, considering the importance of air and housing pollution, the purpose of this article is the asymmetric analysis of the effect of air pollution on the housing price index in Iran. In this regard, the macroeconomic model was used in which the variables of air pollution index, per capita income, liquidity, consumer price index, interest rate and exchange rate were used as explanatory variables for the dependent variable of the housing rent index. The model was estimated using annual data over a period of time (1996-2017) for the Iranian economy and using the Nonlinear Autoregressive Distributed Lag Method (NARDL). The NARDL technique is able to examine the effect of positive and negative air pollution shocks in the short and long term separately on housing prices. It should be noted that the indicator used to express air pollution is (PM2.5). The results of the estimate indicate the fact that each negative shock of air pollution leads to an increase in rent and each positive shock of air pollution leads to a decrease in rent. Estimates also show that per capita income is the most effective variable on housing prices, while interest rate and liquidity had no significant effect on housing prices.

Keywords: Environment, Air pollution, Housing prices, Non Linear ARDL
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1 Introduction

Housing, after food and clothing, is one of the most basic biological needs of human beings, which is of great importance for the preservation and survival of the individual and society. They need to be suitable for their biological pattern [28]. Especially In Recent In recent years with the increasing population, Trend Regrowth Growth Urban and Formation of New households, This need is felt more than precedent [19]. The experience of economic development in

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various countries has shown that population growth and urbanization in some cases reduce the quality and quantity of environmental resources [17].

Environmental issues arise because natural resources are scarce and human desires are unlimited. Proper use of economics enables human beings to make good use of scarce resources and, in principle, will ensure the survival of the human race and prevent environmental degradation and pollution. Any activity at the macro level must be economically justified. The capacity of ecosystems to accept environmental changes is limited, and although nature itself is capable of coping with change, today it seems that the rate of natural regeneration is not commensurate with the dimensions of degradation and as a result, the process of environmental degradation is irreversibly It is progress [21]. The large scale of this phenomenon was not given enough attention until the 1970s. Since then, humans have gradually realized the dimensions of the problem of pollution, and thus environmental pollution has become one of the most important challenges of human society in the 21st century, and the principles of sustainable development and the adoption of appropriate policies and policies Environment became essential in order to prevent and reduce pollution, waste and damage to the environment [4].

In general, environmental pollution includes: air pollution, water pollution, noise pollution and waste pollution [1]. Among these pollutions, air pollution is one of the most important environmental issues that both developed and industrial countries and developing countries are struggling with today. Air pollution has irreparable consequences: Those exposed to particulate matter are far more likely to die from heart and lung disease [16], as well as limited access to clean air for species. Plant and physical goods have a negative effect [6].

Valuing the pleasures of environmental resources, including clean air, has its own complexities, as most environmental goods are not traded on the market and information is incomplete for them; Hence, it is not possible to easily determine the right price for them. One of the methods of environmental valuation is the stated preference (or direct) method. In this method, the researcher tries to infer environmental values directly by asking people about their preferences for the specified environmental goods or services (such as the contingent valuation method (CVM)). But economists are more inclined to use a method called the revealed preference (or indirect) method. In this method, the researcher inferred information indirectly by observing people's behaviors in real markets [24]. For example, it is true that people in a city do not pay directly for clean air, but generally prefer to live in areas of the city that have clean air. This preference ultimately increases the demand for housing in that area and increases housing prices. Based on this, it can be interpreted that people, by paying more for housing, in practice indirectly pay for cleaner air. Therefore, one of the ways to achieve the value of cleaner air or more environmental resources is to study the price of residential units and the factors affecting it [10]. In order to achieve this goal, it is necessary to discover and study the extent and impact of air pollution on housing prices.

Therefore, in this study, we decided to use the nonlinear ARDL (NARDL) to answer the question: "What is the effect of positive and negative air pollution shocks on housing prices in Iran?"

It should be noted that this research for the first time in Iran using macro variables and the Ardel technique has investigated the effect of air pollution on housing prices.

In this article, after stating the introduction, the research literature and experimental studies are presented in the second part. In the third part, the research method is stated. The fourth part is dedicated to the conclusion.

2 Research literature

2.1 Review of literature from a Theoretical Point of View

A major approach in examining housing prices is to study the factors influencing the behavior of applicants and suppliers. The main goal in relation to housing demand is to consider the demand for housing as an asset. In this approach, the aim is to examine the impact of economic and demographic variables such as housing prices, income, interest rates, rents, population and its structure, etc. on consumer choice or in reverse the demand function to examine the factors affecting housing prices is taken into consideration.

But housing supply studies are far fewer in number than demand studies. De Pascal (1999) mentioned two problems of housing supply the lack of a standard unit for measuring housing services and the lack of information about the supply of existing housing units. Housing price with a time lag, construction wage cost, price of other construction projects and volume of credits (due to capital market inefficiencies) are as effective variables from the supply side to housing price.

Therefore, according to these issues, it can be said that housing prices depend on various factors, the most important of which and how they affect housing prices are as follows:

A. Per capita income: From a theoretical point of view and while other conditions are stable, with the increase in per capita household income due to the normalization of housing goods, the demand for it will increase. This can have several reasons; one is that as incomes increase, households tend to own housing and abandon special rental housing in metropolitan areas where relative housing prices are high, resulting in more household demand for housing. This part of the increase in housing demand is focused on consumer demand for housing. But on the other hand, with the increase in income, the demand for housing as a capital good will also increase. As the ultimate desire to save increases as income increases, it can be expected that households' willingness to invest will increase as savings increase. The housing market is also in front of households as a place that attracts part of the investments of the whole economy. With these interpretations, it is not unreasonable to expect that the increase in the per capita income of households will lead to more investment in the housing market. This investment can change both the housing supply sector (through the construction of new housing by the private sector and indeed households) and the market demand segment (through their purchase of housing as a durable capital good). The total effects of the increase in per capita income will lead to an increase in demand for housing and, consequently, an increase in the price of this product [15].

B. Interest rates: Interest rates affect both sides of the housing market, ie supply and demand. Given that interest rates are the cost of borrowing when interest rates rise, suppliers and homebuyers are discouraged from receiving loans, and as a result, supply and demand for housing will fall. Conversely, when interest rates fall (e.g. due to increased money supply), the user's cost of receiving housing facilities will decrease and housing supply and demand will increase [20].

C. Liquidity: From a theoretical point of view, the growth of money supply and liquidity volume, while increasing the price index, increases housing prices as part of the consumer basket.

D. Inflation: In inflationary conditions, the cost of building a housing unit for builders increases. This increase can be due to two reasons; one is the increase in the cost of construction materials because one of the reasons for the increase in inflation is the increase in the price index of construction materials and services as components of the basket of goods that are included in the calculation of inflation. So when there is inflation, we can be sure that the average price index of construction materials and services has also increased, and this will lead to an increase in the cost of construction and the final price of housing. On the other hand, in the context of inflation, construction workers will demand higher real wages, taking into account real inflation and their inflation expectations. This will also lead to increased production costs and wage inflation in the housing sector. In fact, whether the construction industry is a user or capital-intensive, from a theoretical point of view, rising prices will lead to price increases in this sector [15].

E. Air pollution (as the most important type of environmental pollution): In the context of how this variable affects housing prices, two reactions can be considered:

1. Some sections of society tend to ignore the problems of air pollution in their place of residence. Perhaps part of the reason for this is that these people are more affected by factors such as public facilities in the neighbourhood, proximity to the city center, etc. than pollution [14] so in this case pollution has no effect on housing prices.
2. If people react to the problem of pollution; one of the main causes of the difference in the price of housing units in different areas is related to the difference in environmental benefits. The greater the difference in environmental benefits is greater the difference in housing unit prices. This means that areas that are better than other areas in terms of air quality and green space or other environmental variables, have a kind of rent and find the necessary ground to increase prices, and therefore the price of residential houses in these areas compared to Other areas are considered higher [10].

J. Exchange rate: In general, it can be said that the impact of currency fluctuations in the housing market is divided into two categories: short-term and long-term. In the short run, the effect of these price fluctuations will be inversely related to the increase in housing prices, and in the long run, it will be directly related to the increase in housing prices. In this way, in the short term, with the increase of the exchange rate, the prosperity of the housing market will decrease and this recession will change the ground for the favorableness of this market in favor of the tenants or the mortgage and rent applicants. This is because people are more likely to invest in foreign exchange and make short-term profits, so they may sell their property below current prices. But in the long run, the result will be quite the opposite, because, with the increase in the exchange rate, all goods and equipment related to the building will increase in price due to the increase in the exchange rate. Applicants will be offered.

2.2 Previous Experimental Studies

In [6] authors in a study examined the effect of air pollution on housing prices using the Hedonic pricing method for 19 districts of the Bogata capital. TSP was considered as an indicator of pollution. The results showed that air pollution had a negative effect on housing prices so a 1% increase in particulate matter leads to a decrease in housing prices by 0.1263%. [7] in an article examined the effect of air quality on the housing market in the United States using the Hedonic method during the 1970s. The results show that each microgram of reduction in pollution leads to an increase of 0.4-0.2% in the average price of housing, and the elasticity of housing value to pollutant suspended particles is -0.20 to -0.35. [29] in a study examined the effect of air pollution on the value of Lithuanian property. For this purpose, the SAW technique was considered for two areas, consisting of apartments adjacent to the river and the street. The dependent variables in this study are house prices and other variables used: economic variables (including unemployment rate, per capita foreign direct investment, per capita material investment and an annual turnover of construction companies), social variables (including Average income per job, municipal expenditures for social needs, per capita area and identification of barriers to health care) and environmental variables (including CO2 emissions, municipal costs for measuring and improving water quality, solid waste and Green space per capita). The results showed that pollution had a significant effect on property prices, but this effect varied depending on the location of the property and the distance from the source of pollution. [27] used the Hedonic method to evaluate air quality in Indonesia for 1998. The results of the studies showed that the number of pollutants has a negative effect on the rental rate of housing in different parts of the city. [24] in a study entitled "The Impact of Air Pollution on Housing Value", in order to investigate the value of clean air from the perspective of households living in Tabriz, have used the hedonic pricing method. The results obtained during the period 2005-2006 showed that the rent of residential areas has decreased due to air pollutants. In other words, people care about environmental considerations when choosing a home. [10] in a study with an environmental approach and using the Hedonic pricing method examined the impact of environmental variables such as air pollution and green space per capita on the price of residential houses in Tehran. For this purpose, cross-sectional data from 2004 related to 17 districts of Tehran Municipality were used. The method used was the ordinary least squares method (OLS) and the logarithmic function form. According to the results, all environmental variables such as air pollution in terms of standard pollution index and per capita green space have had the expected and significant effects and air pollution has a negative impact on housing prices. An article, [18] examined the effect of air pollution on housing prices in Madrid. For this purpose, the researchers used the data from the last quarter of 2009 and the Hedonic method to estimate housing prices and then used the two methods of ML and TSLS to assess the effect of pollution on housing prices. The results showed that the decision to buy a house in Madrid does not depend on the air quality of the region, but on business services, communications, income level, economic activities of the region and .... And only in areas with the highest levels of pollution can the dependence of pollution on housing prices be observed. [2] in a study investigating the impact of healthy air on the price of residential houses in Tehran in 2008 using the hedonic method. For this purpose, 300 questionnaires were collected by random classification from different areas of Tehran. The results showed that the coefficients of both variables were negative and equal to 0.135 and 0.112, respectively, which means that the willingness of the final payment for Tehran citizens to reduce air pollution can be estimated between 1120000 to 1350000 Rials per meter of house. [9] investigated the effect of clean air on housing prices in Tehran using the hedonic method. The statistical population was registered mortgage transactions for regions 1 to 8 and regions 13 and 14 in 2010. The results showed that for all the studied areas, except for two areas, housing prices will increase with the improvement of air quality. [5] analyzed the relationship between air quality and the market value of the residential property with the expectation of air quality as one of the factors affecting property prices. The study was conducted in the Petaling and Klang areas of Selangor (Malaysia) during the period 2006-2006 using the Pearson correlation technique. The results showed a positive correlation between air pollution and property prices in both areas. [8] investigated the effect of environmental quality on housing choice and housing prices. For this purpose, they used the hedonic technique and Multiple Linear Regression models (MLR). The research area was the city of Toronto (located in southern Italy, where Europe's largest steel plant is located) and around 2012. The results of the studies showed that improving air quality leads to an increase in property prices. [13] examined the effect of air quality on the housing market in 288 cities in China in 2011. The results showed that a microgram decrease in PM10 concentration (contamination criterion) led to an increase in housing value of 80 yuan (equivalent to $11.67). [3] in an article examined the effect of air pollution in the housing market of Tehran. Using the combined data technique for different neighbourhoods of Tehran, the researchers found that a 30 percent increase in the concentration of nitrogen dioxide in the open air leads to a reduction in housing prices of about 3 to 6 percent. Lower levels of air pollution are associated with higher rental rates, and higher levels of air pollution create a chance for property owners to rent rather than occupy it themselves. [30] in an article examined the dynamic interaction between housing prices and air quality for 30 Chinese provinces during the period 2003-2005 using the Panel Var technique. Researchers have shown that better air quality leads to higher housing prices, and that rapid housing

growth also helps improve air quality. [26] examined the effect of air pollution on housing prices in Auckland, CA. For this purpose, they used a combination of the spatial delay model with an instrumental model for 2020. The results of the study indicate a positive relationship between air pollution and housing prices. In general, the results of most studies indicate the negative effect of air pollution on housing prices.

3 Research Method

The linear models used in economic research are suitable for interpretation and cover some experimental applications. However, the equations of these models are very limited because they do not apply to errors and autocorrelation factors that have a significant effect on approximate estimators and small samples. In this case, the OLS estimator remains perfectly consistent in the following equation, but the approximate distribution is non-Gaussian.

$$y_t = \beta^+ x_t^+ + \beta^- x_t^- + u_t$$

$$\Delta x_t = v_t.$$

Therefore, the hypothesis test cannot be performed in the usual way without removing the autocorrelation and ensuring the accuracy of the model specification. In the linear homogeneity literature, several solutions to these dual problems have been proposed in the field of static regression models [23, 25] and dynamic regression models [22]. Since dynamic models are more important and widely used, naturally using the ARDL model developed by [22] a flexible dynamic framework has been created which shows short asymmetry. Long-term and long-term are in model relationships. For this purpose, the following nonlinear ARDL model (p, q) is considered:

$$y_t = \sum_{j=1}^{p} \varphi_t y_{t-j} + \sum_{j=0}^{q} (\theta_j^+ x_{t-j}^+ + \theta_j^- x_{t-j}^-) + \varepsilon_t \tag{3.1}$$

where x_t is defined as a vector $k \times 1$ of multivariate regression such that $x_t = x_t^+ + x_t^-$, φ_t is an autoregressive parameter, θ_j^+ and θ_j^- parameters with an asymmetric distribution interval and ε_t is a perturbation with the mean is zero and the variance is constant. In this study, we focus on a case in which, in order to distinguish between positive and negative changes in pollution, x_t^- is decomposed into two components x_t and x_t^+ around the zero threshold [12].

Following the work of [22], the above equation can be written as an error correction model as follows:

$$\begin{aligned} \Delta y_t &= \rho y_{t-1} + \theta_j^+ x_{t-j}^+ + \theta_j^- x_{t-j}^- + \sum_{j=1}^{p-1} \gamma_t \Delta y_{t-j} + \sum_{j=0}^{q-1} (\varphi_j^+ \Delta x_{t-j}^+ + \varphi_j^- x_{t-j}^-) + \varepsilon_t \\ &= \rho \xi_{t-1} + \sum_{j=1}^{p-1} \gamma_t \Delta y_{t-j} + \sum_{j=0}^{q-1} (\varphi_j^+ \Delta x_{t-j}^+ + \varphi_j^- x_{t-j}^-) + \varepsilon_t \end{aligned} \tag{3.2}$$

where

$\rho = \sum_{j=1}^{p} \varnothing_j - 1$

$j = 1, ..., p-1,\ \gamma_j = -\sum_{i=j+1}^{p} \varnothing_i$

$\theta^+ = \sum_{j=0}^{q} \theta_j^+$

$\theta^- = \sum_{j=0}^{q} \theta_j^-$

$\varphi_0^+ = \theta_0^+$

$\varphi_0^- = \theta_0^-$

$j = 1, ..., q-1,\ \varphi_j^+ = -\sum_{i=j+1}^{q} \theta_j^+$

$j = 1, ..., q-1,\ \varphi_j^- = -\sum_{i=j+1}^{q} \theta_j^-$

and

$\xi_t = y_t - \beta^+ x_t^+ - \beta^- x_t^-$.

It is a nonlinear error correction component in which $\beta^+ = -\theta^+/\rho$ and $\beta^- = -\theta^-/\rho$ are the corresponding asymmetric long-run parameters.

In order to deal with the possibility of non-zero simultaneous correlation between repressors and residuals in the above equation, we consider the summarized form of the data generation process for Δx_t as follows:

$$\Delta x_t = \sum_{j=1}^{q-1} \Lambda_j \Delta x_{t-j} + v_t \tag{3.3}$$

where $v_t \sim iid(0, \sum v)$ where $\sum v$ is a known positive covariance matrix. Given the focus on conditional modeling, ε_t can be expressed in terms of v_t as follows:

$$\varepsilon_t = \omega v_t + e_t = \left(\Delta x_t - \sum_{j=1}^{q-1} \Lambda_j \Delta x_{t-j} \right) + e_t \tag{3.4}$$

That e_t is not structurally correlated with v_t. By substituting (3.2) in (3.4) and sorting it, we will finally have the conditional nonlinear ECM as follows:

$$\Delta y_t = \rho \xi_{t-1} + \sum_{j=1}^{p-1} \gamma_t \Delta y_{t-j} + \sum_{j=0}^{q-1} (\pi_j^+ \Delta x_{t-j}^+ + \pi_j^- \Delta x_{t-j}^-) + e_t \tag{3.5}$$

where: $\pi_0^+ = \theta_0^+ + \omega$ and $\pi_0^- = \theta_0^- + \omega$ and $\pi_j^+ = \varphi_j^+ - \omega \Lambda_j$ and $\pi_j^- = \varphi_j^- - \omega \Lambda_j$ for is $j = 1, ..., q-1$.

It is clear that weakly endogenous equation (3.5) completely corrects the unstable explanatory variables and the selection of a structure with an appropriate interruption results in the absence of serial residual correlation. This model has the desirable features of a fully modified model and dynamic corrections based on the Autoregressive Distributed Lag Method (ARDL) self-explanatory model, which is related to the work of [22] and [23] in a dynamic parametric framework, respectively. Able to model asymmetric long-term and short-term. In addition, because this model is linear for all variables including $\theta^+, \theta^-, \pi^+, \pi^-$, the reliable estimate of Equation (3.5) is obtained by the ordinary least squares (OLS) method.

4 Purpose of Research and Model Estimation

In this study, the effect of air pollution and some macroeconomic variables on housing prices in Iran has been investigated using the Nonlinear Autoregressive Distributed Lag Method (NARDL). For this purpose, annual statistical data during the period (1996-2017) has been used.

To answer the research question, the following model was designed and used:

$\log RHP_t = \beta_1 + \beta_2 \log API_t + \beta_3 \log Y_t + \beta_4 \log M2_t + \beta_5 \log CPI_t + \beta_6 \log ER_t + \beta_7 IR_t + \varepsilon_t$

In this model:

$\log RHP_t$: Logarithm of rental housing rent index in year t

$\log API_t$: Logarithm of air pollution index in year t

$\log Y_t$: Logarithm of per capita income in year t (fixed price in 2011)

$\log M2_t$: Liquidity in year t (fixed price in 2011)

$\log CPI_t$: Logarithm of consumer price index in year t (fixed price in 2011)

$\log ER_t$: Logarithm Informal exchange rate in year t

IR_t: Interest rate in year t

It is important to note that the indicator for air pollution in this study is SPM. The statistical data, which is a time series, was collected through the CBI Central Bank Information Portal, the Center for Statistics and Energy Balance.

As a first step, the variables used in the model must first be tested for reliability.

As the results of the unit root test in Table 1 show, all the variables studied in this study are $I(0)$ and $I(1)$, and this means that the ARDL method for analyzing the short-term and long-term behavior of the variables of the present study, It is a good method.

Table 1: Results of the generalized Dickey-Fuller test for model variables (With width from origin and no process), (Zero means reliability at the surface and reliability at the first order difference.)

Variable name	**Generalized Dickey Fuller Statistics**	**McKinnon Critical Values**			**Pause**
		1%	5%	10%	
LHPI	−3.607	−3.886	−3.052	−2.666	0
LAPI	−6.775	−3.808	−3.020	−2.650	1
LY	−4.005	−3.808	−3.020	−2.650	1
LM2	−2.961	−3.808	−3.020	−2.650	1
LCPI	−2.770	−3.808	−3.020	−2.650	1
IR	−4.051	−3.808	−3.020	−2.650	1
LER	−2.803	−3.808	−3.020	−2.650	1

The results of the short-term estimation of the Nonlinear Autoregressive Distributed Lag Method (NARDL) are presented in Table 2:

Table 2: Results of self-explanatory pattern estimation with wide nonlinear intervals. The dependent variable of the logarithm of the rental housing index

Dependent Variable: LHPI				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Probe**
LHPI(-1)	0.529	0.095	5.525	0.000
LAPI_NEG	0.111	0.053	2.073	0.060
LAPI_POS	−0.169	0.055	−3.064	0.009
LY	0.460	0.220	2.086	0.058
LM2	−0.113	0.075	−1.507	0.157
LCPI	0.631	0.142	4.435	0.000
LER	0.161	0.063	2.561	0.024
IR	0.002	0.001	1.976	0.071
C	−0.084	0.377	−0.223	0.827
R-Squared: 0.99				
Adjusted R-Squared: 0.99				
Durbin-Watson Stat: 1.60				

The coefficient of determination of the model is 0.99, which indicates the high explanatory power of the model and states that 0.99% of the changes of the dependent variable can be explained through the independent variables of the model. Relevant diagnostic tests have been used to test the classical hypotheses. The results of diagnostic tests are presented in the following table:

Table 3: Model diagnostic test results

Test	
LM Test (Breusch-Godfrey)	F-Statistic 2.357 Prob. F(2,11) 0.140 Obs∗R-squared 6.300 Prob Chi-Squared(2) 0.042
Normality	1.832Jarque-Bera (0.399) Probability
Heteroscedasticity (Breusch_Pagan-Godfrey)	F-Statistic 0.501 Prob.F(8,12) 0.832 Obs∗R-squared 5.265 Prob Chi-Squared(8) 0.728 Scaled explained SS 1.209 Prob Chi-Squared(8) 0.996

The results show that the model has no problems in terms of classical assumptions. That is, there is no self-correlation and heterogeneity of variance, and the distribution of residuals components is normal.

Considering that in examining the existence or non-existence of a long-term relationship, the value of the F statistic (equivalent to 9.399) is higher than the value of I (1) (equivalent to 3.13), so the existence of a long-term relationship is confirmed. The results of the long-run relationship are presented in Table 4:

As can be deduced from Table 4, on the one hand, the negative air pollution index coefficient is positive and significant, and on the other hand, the positive air pollution index coefficient is negative and significant, meaning that

Table 4: Long-term estimation results. The dependent variable of the logarithm of the rental housing index

Dependent Variable: LHPI				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Probe**
LAPI_NEG	0.237	0.098	2.415	0.032
LAPI_POS	−0.360	0.128	−2.803	0.016
LY	0.979	0.374	2.614	0.022
LM2	−0.241	0.148	−1.627	0.129
LCPI	1.342	0.151	8.890	0.000
LER	0.343	0.122	2.809	0.015
IR	0.005	0.002	1.774	0.101
C	−0.179	0.793	−0.225	0.825

decreasing and increasing the level of air pollution leads to increasing And the decrease in housing rent index in Iran; The coefficients also indicate that the effect of increased air pollution on the housing rent index is greater than the reduction of air pollution. The positive per capita income coefficient in the table above indicates an increase of about 10% in the rent index for a 10% increase in per capita income. Of course, according to theoretical principles, the effect of per capita income on rent should be negative, because increasing per capita income will increase demand for housing and reduce demand for rent and thus reduce rent, but due to high inflation and rising housing prices in Iran, especially in recent years, has not seen an increase in per capita income that would ultimately lead to an increase in demand for housing. The logarithm coefficient of liquidity is negative and meaningless, the reason for this can be found in the existence of contracts and rental rate stickiness. The results of the long-run relationship show that there is a positive and significant relationship between the logarithmic variable of the consumer price index and the rent index of housing, ie with a 10% increase in the price index of consumer goods and services, the rent of housing will increase by 13%. An increase in the exchange rate on the one hand with a decrease in demand for housing (due to increased willingness to invest in the foreign exchange market) and on the other hand with an increase in inflation in Iran leads to an increase in demand for rent and consequently an increase in housing rents. The results of the model estimate indicate the insignificant effect of this variable on the housing rent index in the long run during the period under review, but in the short term with increasing interest rates, demand for housing rent and consequently rent will increase.

After long-term estimation, an ECM model is now used to examine how short-term imbalances in the housing rent index are adjusted towards long-term equilibrium. The ECM coefficient (-1) shows that in each period, a few percent of the short-term imbalance of the rent index is adjusted to achieve long-term equilibrium. The model estimates that the error correction component coefficient is -0.470, which means that in each period, 47% of the imbalance in housing prices is adjusted and approaches its long-term trend.

Table 5: Results of estimating ECM. The dependent variable of the logarithm of the rental housing index

Dependent Variable: D(LHPI)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Probe**
C	−0.084	0.013	−6.074	0.000
CointEq(−1)*	−0.470	0.043	−10.911	0.000

5 Conclusion

The literature on housing economics in the 20th and 21st centuries emphasizes the significant role of the housing sector in the performance of the national economy. Housing makes up the bulk of the private sector's net worth. Also, the costs of providing housing, such as rent or mortgage instalments, are the most important part of household expenses. In this regard, for various reasons, price fluctuations and housing investment are considered by economists, policymakers and the private sector. The sharp increase in housing prices and the occurrence of periodic shocks in housing prices in different countries, especially in Iran, is a very widespread and complex phenomenon and beyond a purely limited and intra-sectoral issue, [11].

On the other hand, in recent years, increasing air pollution has become one of the main challenges in the whole world. This challenge not only affects the health and lives of human beings, but also destroys billions of dollars of the

world economy every year, and its volume will multiply by 2060 (OECD studies). Therefore, air quality management is an undeniable process that requires application development and implementation.

Therefore, according to the above, the purpose of this study is to investigate the effect of air pollution and other economic factors affecting housing prices. In order to achieve the above goal of the annual statistics of variables "logarithm Housing rent, logarithm air pollution index, logarithm per capita income, logarithm liquidity, logarithm consumer price index, logarithm exchange rate and interest rate" during the period (1996-1996) Used.

The results of the model estimate show that air pollution has a significant effect on housing rents. Households living in areas with low air pollution pay higher rents for housing, and households living in areas with high air pollution do not use the benefits of the environment.

A practical conclusion from the findings is that although there is virtually no market for environmental benefits such as clean air and it is not traded directly, it is valuable and this value becomes apparent when violated. For example, when some areas are prone to air pollution, people are willing to pay more but enjoy cleaner air. Therefore, these inconsistencies create additional costs in the city, and if a policy is adopted that maintains environmental standards in the city, additional costs will be avoided and rents will be adjusted.

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