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DRIVING FORCES OF HOUSING PRICES IN TÜRKİYE: A NONLINEAR ARDL ANALYSIS

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ABSTRACT

The study aims to examine the effects of the industrial production index, consumer price index, consumer confidence index, real effective exchange rate, and loan interest rate variables on the housing price index. Monthly data between 2010:01-2024:05 is used in the study and the NARDL method is used. When the long-term coefficients are examined; it is seen that positive shocks in the industrial production index have a positive effect on the housing price index and negative shocks have a negative effect on the housing price index. It is seen that positive changes in the consumer price index have a positive effect on the housing price index and negative changes have a negative effect. Increases in the consumer confidence index have a positive effect on the housing price index. An increase in the real effective exchange rate causes a decrease in the housing price index in the long term. Finally, both positive and negative changes in housing loan interest rates increase the housing price index.

Keywords: *Housing Price Determinants, Nonlinear ARDL, Türkiye.*

Jel Codes: *E31, C82, R31.*

1. INTRODUCTION

The housing market, which constitutes one of the essential sub-markets of the construction sector, also plays a vital role in economic development due to its strong connections with other sectors of the economy. Considering the direct and indirect effects on different sectors, the share of the construction sector in the Turkish economy reaches 30% (INTES, 2024).

Housing is one of the critical asset categories and, despite its generally illiquid and highly leveraged structure, it constitutes the most significant component of household wealth. The housing market plays an important role in the transmission of monetary policy and in shaping socio-economic variables. These features make housing one of the most preferred sectors by policymakers (Coskun et al., 2020). In developing countries like Türkiye, households generally tend to hold their wealth in the form of housing rather than financial assets. Therefore, the housing market can be the mainstay of economic crises and speculative movements. While the importance of the housing sector in the global

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economy is increasing, studies on the determinants of housing prices in the Turkish economy have also attracted considerable attention in recent years (Akpolat, 2022; Akça, 2023; Akyol-Özcan, 2023).

One of the most concrete examples of how the housing sector can affect the entire economic system occurred in the US in 2008. The rise in housing prices in the 2000s increased the demand for housing and banks facilitated loans. This encouraged investors to buy more homes and caused prices to rise even more. However, housing prices became overvalued and demand began to shrink due to the market mechanism. When the decline in demand was combined with the non-payment of loans, the mortgage system collapsed, financial companies began to go bankrupt, and the crisis quickly spread to Europe. This crisis revealed how the housing market and the financial system are deeply interconnected and how a collapse in one sector can have global effects.

The housing price index is created to monitor price changes in the housing market and covers the entire country. When calculating the index, the housing values in the valuation reports prepared during the applications made to commercial banks that provide loans with individual housing loan requests are used (TCMB, 2024). According to the CBRT report published in May 2024, the housing price index, which increased by 45.0 percent compared to the same month of the previous year, decreased by 14.9 percent in real terms during the same period. It is seen that there has been a significant increase in the index, especially since 2020, and that this trend continues. It would not be wrong to say that the recent increase in housing prices is caused by the combination of both demand-related and cost-related effects. The demand for housing has increased with urbanization and population growth. In addition, the increase in housing purchases caused prices to rise. In addition, the increase in construction materials and labor costs has increased housing prices. The increases in housing prices in Türkiye have raised the question of what the potential risks are regarding the housing market and when prices will stop increasing.

The Turkish economy grew by 4.5% in 2023 compared to the previous year. This rate was 5.7% in the first quarter of 2024. The construction sector was the fastest-growing sector with 7.8% in 2023 and 11.1% in the first quarter of 2024. Considering the share of the construction sector in the Turkish economy, examining the housing market, which is the most important sub-market of the construction sector, is critical to understanding many important areas such as the general state of the economy, investment opportunities, policy-making, financial access, and social impacts.

This study examines the factors influencing the housing price index in a developing economy like Türkiye, where the housing market exhibits unique characteristics. It evaluates the impact of variables such as the industrial production index, consumer price index, consumer confidence index, real effective exchange rate, and housing loan interest rate on the Turkish housing market.

There is an interaction between the industrial production index, which is chosen as an indicator of growth, and the housing price index. Changes in industrial production can affect housing prices through economic growth, income levels, and investment conditions. High industrial production

generally indicates economic growth and an increase in the labor force. Since the increase in the industrial production index represents an increase in economic activity, it increases the demand for housing and housing prices in the long run. (Adams and Füss, 2010, Karadaş and Salihoğlu, 2020). Economic growth can increase people's incomes and stimulate housing demand. On the other hand, when industrial production increases, the production of construction materials and other related products also increases. This can affect construction sector activity and housing supply.

Changes in inflation rates have a direct impact on the housing sector, which is affected by many inputs. While housing prices increase in periods of high inflation, the opposite effect occurs in periods of low inflation. High inflation also negatively affects the housing supply (İslamoğlu and Nazlıoğlu, 2019).

The consumer confidence index can directly affect the housing price index; high consumer confidence can increase economic optimism and housing demand along with spending, leading to higher housing prices (Yıldız-Contuk, 2021). High confidence can also encourage housing purchases by facilitating access to credit. On the other hand, low consumer confidence can lead to restrictions on spending due to economic uncertainty, reduced credit use, and thus lower housing demand, leading to lower housing prices. This interaction directly shapes the demand and price dynamics in the housing market.

Exchange rates are an important factor affecting the real estate sector, especially in countries that are trying to attract foreign investors. Changes in exchange rates directly affect housing prices determined in foreign currencies, which can cause prices to increase or decrease for foreign buyers. In addition, the costs of imported construction materials and equipment change depending on exchange rates, which can affect the total sales prices of real estate units. Therefore, in an economic environment where the exchange rate rises, the cost of purchased materials will increase, directly increasing housing costs (Özcan and Başaran-Tormuş, 2018). In summary, exchange rate fluctuations affect both foreign investors' purchasing decisions and construction costs, shaping the current situation and future decisions in the real estate sector.

Finally, loan interest rates can affect the housing market through many channels. Interest rates higher than asset yields affect credit preferences and consumers may be limited in their use of credit. In addition, high mortgage debt and variable-rate financing conditions can also affect housing demand and put pressure on housing prices. Loan options that allow long-term payments for housing purchases and the levels of interest rates applied affect the amount of housing demand. In periods of contraction in the housing sector, offering mortgage loan options with attractive interest rates can increase the amount of housing demand (Karadaş and Salihoğlu, 2020).

To analyze the determinants of the housing price index in Türkiye, monthly data between 2010:01-2024:05 are used. Methodologically, firstly, the stationarity properties of the series were

investigated using Augmented Dickey-Fuller, Phillips-Perron, and Lee & Strazicich tests. The cointegration relationship between the variables was determined using the Bounds test approach. Then, the short- and long-term relationship between the variables was determined using the NARDL method.

The rest of the article is organized as follows. The next section summarizes the literature on the housing market in Türkiye. Section 3 discusses the data and methodology, while Section 4 summarizes the empirical findings. The last section includes the conclusions.

2. LITERATURE REVIEW

The literature generally examines the housing market under two main headings: housing supply and demand determinants and housing price determinants. In addition to basic determinants such as interest rates, inflation, and GDP, more specific macroeconomic determinants such as housing loan volume, money supply, stock market index, exchange rate, unemployment rate, and construction costs are mostly used as housing price determinants.

The international literature on the subject is quite extensive (Capozza (2002); Zietz et al. (2008); Adams and Füss (2010); Katrakilidis and Trachanas (2012); Pillaiyan (2015); Zandi et al. (2015); Cohen and Karpavičiūtė (2017); Wang et al. (2017); Tan et al. (2018); Mohan et al. (2019); Raza et al. (2023); Abasimi et al. (2023)). Although the number of studies conducted on Türkiye has increased recently, it is still considered a subject that needs investigation.

Durkaya and Yamak (2004) examined housing demand in Türkiye between 1964-1997 and found a positive and strong relationship between housing demand and per capita income. Badurlar (2008) examined the relationship between housing prices and GDP, money supply, exchange rate, and short-term interest rates in Türkiye using data from 1990 to 2006. The study found a bidirectional causality between housing prices and both exchange rates and interest rates while also identifying a unidirectional causality from money supply and GDP to housing prices. They also stated that in the long term, there is a positive relationship between exchange rate, GDP, and housing prices in the long term and a negative relationship between interest rates, money supply, and housing prices.

Akkaş and Sayılgan (2015) investigated the relationship between housing prices and housing loan interest rates in Türkiye. Their findings showed a unidirectional causality from housing loan interest rates to housing prices, suggesting that rising housing loan interest rates eventually resulted in a delayed decrease in housing prices.

Karamelikli (2016) analyzed the relationship between housing prices in Türkiye and macroeconomic variables such as inflation, real domestic product, unemployment, and interest rates using the NARDL model. Contrary to common findings in the literature, the study found that interest rates have a negative impact on housing prices. Additionally, both nominal interest rates and inflation

negatively affected housing prices, with inflation having a more significant impact than nominal interest rates. This led to the conclusion that the real interest rate is expected to be positive in the long run.

Canbay and Kırca (2019) tested the Granger causality between housing sales and housing loan interest rates in Türkiye. According to the asymmetric Granger causality test results, the study found reverse causality between housing loan interest rates and housing sales. Specifically, positive shocks in housing loan interest rates lead to negative shocks in housing sales, indicating a Granger causal relationship between rising interest rates and falling housing sales.

Gebesoglu (2019) examined the relationship between housing price index dynamics and GDP, exchange rate, interest rate, and BIST 100 Index return in Türkiye and concluded that the increase in BIST 100 index returns caused the housing price to decrease. She also concluded that since the lagged effect of exchange rates on housing prices leads to macroeconomic fluctuations, measures to balance exchange rate changes help eliminate housing price imbalances.

Karadaş and Salihoğlu (2020) investigated the macroeconomic factors affecting the change in housing prices in Türkiye. According to the results of the ARDL cointegration test, the industrial production index affects housing prices positively, while housing loan interest rates, housing loan volume, consumer price index, and real exchange rate affect housing prices negatively.

Eryüzlü and Ekici (2020) analyzed the relations between the housing sector and the exchange rate in the Turkish economy using econometric methods. Negative shocks in the real effective exchange rate cause negative shocks in both the housing and new housing price index.

Çetin (2021) examined multiple factors affecting housing prices in Türkiye, including the weighted average interest rate on housing loans, total housing loans within the banking sector, the real effective exchange rate based on CPI, the industrial production index, the wholesale price index for construction materials, the consumer price index, and the real rent index. The study concluded that the consumer price index and industrial production index negatively influence housing prices. In contrast, the housing loan interest rate and the wholesale price index for construction materials have a positive impact on housing prices.

Akpolat (2022) employed the NARDL method to analyze the impact of real effective exchange rates, real mortgage rates, real construction cost index real M2 money supply, and housing sales on housing prices. He found that the exchange rate has a positive and symmetric effect on housing prices. Additionally, negative changes in the money supply have a larger impact on housing prices than positive changes. The study also revealed that negative changes in construction costs and housing sales figures increase housing prices, whereas fluctuations in loan interest rates tend to decrease housing prices.

Shinwar and Özdemir (2022) explored the relationship between various macroeconomic indicators and housing prices in Türkiye. They discovered that increases in the industrial production

index and the consumer price index negatively affected the housing price index in the short term. Additionally, they found no causal relationship between the consumer price index (CPI) or industrial production index and the housing price index. The study concluded that there was only a one-way causality from the housing price index to the consumer price index.

Akça (2023) examined the short- and long-term effects of inflation, exchange rates, the industrial production index, housing interest rates, total housing loans, and housing volume on housing inflation in Türkiye, considering multiple structural breaks. The study found that, in the short term, housing interest rates most influence housing prices, the real exchange rate, housing volume, and total housing loans. In the long term, the most significant influences on housing prices are total housing loans, housing volume, and housing interest rates.

Aydın (2023) investigated the causal relationships between various macroeconomic variables in Türkiye, such as the housing price index, wholesale price index for construction materials, consumer price index, dollar exchange rate, housing loan interest rates, and industrial production index. Utilizing the Toda-Yamamoto causality test, the study identified bidirectional Granger causality between the housing price index and the construction materials wholesale price index and between the consumer price index and the dollar exchange rate. Furthermore, a unidirectional Granger causality was found between the housing price index and the housing loan interest rate.

Akyol Özcan (2023) examined the effects of housing loan interest rates, exchange rates, and CPI variables on the housing price index. According to the long-term results of NARDL, there is a linear relationship between the housing loan interest rate and the housing price index, an asymmetric relationship between the CPI and the housing price index, while the exchange rate has no effect.

In addition to all these studies, there are also regional studies conducted for Türkiye (Paksoy et al. 2014; Zeren and Ergüzel, 2015; Erdem and Yamak, 2018; İslamoğlu and Nazlıoğlu, 2019; Korkmaz 2019; Sağlam and Abdioğlu, 2020; Aydın et al., 2021).

3. DATA AND METHODOLOGY

In this part of the study, the variables used in the study and the econometric method will be included. As determinants of the housing price index (*hpi*), industrial production index (*ipi*) is used as an indicator of growth, consumer price index (*cpi*), consumer confidence index (*cci*), real exchange rate (*rex*), housing loan interest rate (*int*) data. Table 1 shows the given explanations and their sources.

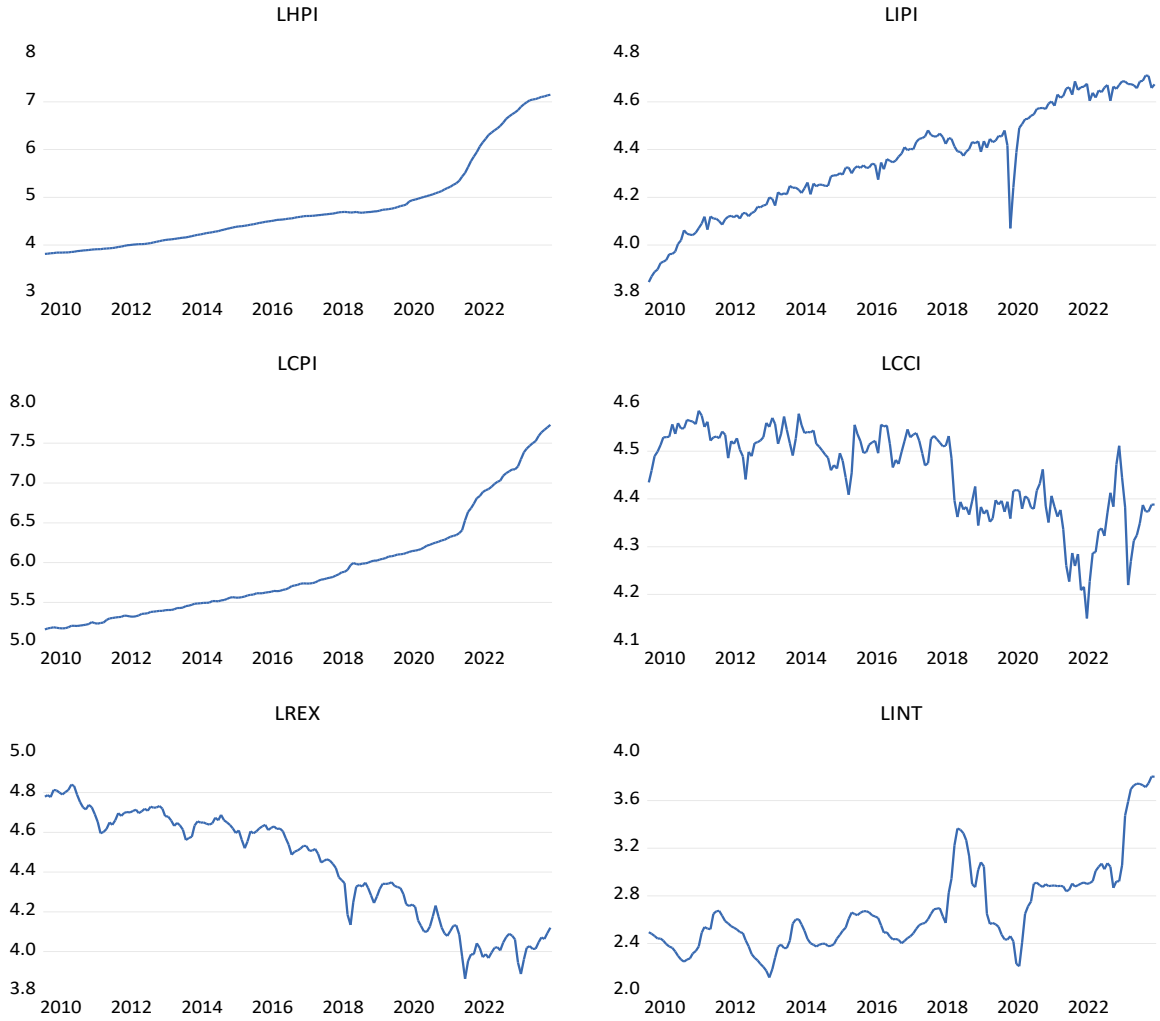
Table 1. Variables Used in the Analysis

Symbol	Variable name	Data source
hpi	Housing price index	CBRT
ipi	Industrial production index	TURKSTAT
cpi	Consumer price index	TURKSTAT

cci	Consumer confidence index	TURKSTAT
rex	Real exchange rate	CBRT
int	Housing loan interest rate	CBRT

For this purpose, monthly data between 2010:01- 2024:05 are used. All variables were cleared of any seasonal effects and included in the model by taking their logarithms. Each variable is shown in Graph 1.

Graph 1. The Trend of The Series



The housing price index (*lhpi*), which has been showing a continuous increase trend since 2010, allows us to produce important results about the real estate market, which is a market that needs to be examined. As can be seen in the graph, all variables except *lrex* and *lcci* have an increasing trend. In particular, the breaks seen in lint and *lipi* in 2020 and in *lcci* in 2022 are remarkable. For this reason, the unit root test, which takes into account structural breaks, should also be used when performing unit root tests in the continuation of the study.

In the study, firstly the relevant literature was examined and in line with these studies, the following model was established to estimate the determinants of the housing price index:

$$lhpi = \beta_0 + \beta_1 lipi + \beta_2 lcpi + \beta_3 lcci + \beta_4 lrex + \beta_5 lint + \varepsilon_t \quad (1)$$

where β_0 is the constant term, ε_t is the error term of the model.

The Autoregressive Distributed Lag (ARDL) model, developed by Pesaran et al. (2001), substantially contributed to econometric analysis. In this model, the dependent variable must be first-order stationary (I(1)), while the explanatory variables can be either first-order stationary (I(1)) or level stationary (I(0)). This flexibility allows the ARDL model to analyze regression and cointegration relationships among variables of differing stationarity orders.

Shin et al. (2014) extended the ARDL model introduced by Pesaran et al. (2001) to develop the NARDL model. This extension enables the analysis of the separate effects of positive and negative shocks in explanatory variables on the dependent variable. The NARDL model helps determine whether positive and negative shocks have different impacts on the dependent variable, allowing for a clearer understanding of which type of shock is more influential.

Based on the above arguments, the NARDL model is preferred for at least three reasons. First, it enables modelling the potential cointegration relationship between the housing price index and selected variables. Second, it accommodates both linear and nonlinear cointegration testing. Third, it differentiates between short-term and long-term effects of independent variables on the dependent variable. Although a nonlinear threshold Vector Error Correction Model (VECM) can also test these phenomena, it may face convergence issues due to the larger number of parameters compared to the NARDL model (Van Hoang et al., 2016). As mentioned before, it should be noted that the dependent variable should be stationary in the first difference (I(1)). In addition, the NARDL model can be applied when all variables are stationary in the first difference.

With y_t as the dependent variable, x_t as the independent variable and u_t as the deviations from the long-run equilibrium, the asymmetric relationship can be presented as follows:

$$y_t = \delta^+ x_t^+ + \delta^- x_t^- + u_t \quad (2)$$

where δ^+ and δ^- are log-run coefficients of positive and negative changes in x_t, respectively. The positive and negative partial sums of the dependent variable are given in equation 3:

$$x^+ = \sum_{i=1}^{t} \Delta x_t^+ = \sum_{i=1}^{t} \max(\Delta x_i, 0), \qquad x^- = \sum_{i=1}^{t} \Delta x_t^- = \sum_{i=1}^{t} \min(\Delta x_i, 0) \quad (3)$$

Based on equation 3, the NARDL model is presented as follows:

$$\Delta y_t = \theta_0 + \theta_1 y_{t-1} + \delta^+ x_{t-1}^+ + \delta^- x_{t-1}^- + \sum_{i=1}^{p} \gamma_i \Delta y_{t-i} + \sum_{i=0}^{q} \rho_i^+ x_{t-i}^+ + \sum_{i=0}^{q} \rho_i^- x_{t-i}^{+-} + u_t \quad (4)$$

The model can be summarized as follows:

$$\Delta y_t = \theta_0 + \theta y_{t-1} + \delta^+ x_{t-1}^+ + \delta^- x_{t-1}^- + \sum_{i=1}^{p} \gamma_i \Delta y_{t-i} + \sum_{i=0}^{q} (\rho_i \Delta x_{t-i}) + u_t \qquad (5)$$

Within the NARDL framework, the asymmetric reactions of the dependent variable to positive and negative shifts in the independent variable are represented as positive and negative dynamic multipliers. These multipliers correspond to unit changes in x^+ (positive shocks) and x^- (negative shocks) respectively. Specifically, they are expressed as follows:

$$m_k^+ = \sum_{l=0}^{k} \frac{\emptyset y_{t+l}}{\emptyset x_t^+} \; and \qquad m_k^- = \sum_{l=0}^{k} \frac{\emptyset y_{t+l}}{\emptyset x_t^-} \; with \; k = 0,1,2 \ldots \qquad (6)$$

where, $k \to \infty, m_k^+ \to L^+, and \; m_k^- \to L^-$ by constuction. Based on the estimated multipliers, after a change affecting the system, dynamic adjustments can be observed from the initial balance to the new balance among the system variables. As mentioned before, the model is made with the natural logarithm of all the variables and the analysis results are presented in the next section.

4. EMPIRICAL RESULTS

Both ARDL and NARDL bounds test approaches give meaningful and consistent results even if the variables are stationary at different levels. However, the stationarity of the variables at the I(2) level is not accepted. For this reason, the stationarity levels of the variables must be determined before the analysis. The stationarity levels of the variables were determined through the Augmented Dickey-Fuller (ADF) unit root tests by Dickey and Fuller (1979), the Phillips-Perron (PP) unit root tests by Phillips and Perron (1988), and the structural break unit root test developed by Lee and Strazicich (2004). In this context, the ADF, PP, and Lee and Strazicich unit root test results for the variables are given in Table 2.

Table 2. ADF, PP, and Lee & Strazicich Unit Root Tests Results

With Constant					
Test	**ADF**	**PP**	**Lee & Strazicich LM Test**		
Variables	**Test Statistics**	**Test Statistics**	**Test Statistics**	**Critical Value**	**Break**
lkfe	0.4915 (0.9860)	3.4849 (1.0000)	-2.6591	-4.0283	2021M11
Δlkfe	-2.3536 (0.1567)	-2.7402 (0.0694)*	-3.6710	-3.4290**	2020M03
lrex	-0.8892 (0.7898)	-0.7612 (0.8270)	-2.5337	-4.0283	2018M07
Δlrex	-10.6820 (0.0000)***	-9.4417 (0.0000)***	-10.1590	-4.0277***	2014M08
lint	-1.3385 (0.6111)	0.2265 (0.9736)	-3.2555	-4.0283	2020M09
Δlint	-8.0334 (0.0000)***	-7.5035 (0.0000)***	-7.8028	-4.0277***	2021M09

lipi	-1.8876 (0.3376)	-1.8498 (0.3555)	-3.6515	-4.0283	2020M02
Δlipi	-10.2776 (0.0000)***	-21.1539 (0.0000)***	-10.5448	-4.0277***	2011M12
ltge	-2.4194 (0.1379)	-2.2388 (0.1935)	-2.5742	-4.0283	2019M04
Δltge	-13.2632 (0.0000)***	-15.7139 (0.0000)***	-9.2779	-4.0277***	2011M06
ltufe	-4.4743 (1.0000)	7.0083 (1.0000)	-4.0982	-4.0277***	2020M08
Δltufe	-3.7276 (0.0045)***	-5.8487 (0.0000)***	-	-	-
With Constant and Trend					
Test	**ADF**	**PP**	**Lee & Strazicich LM Test**		
Variables	**Test Statistics**	**Test Statistics**	**Test Statistics**	**Critical Value**	**Break**
kfe	-1.3282 (0.8774)	0.5209 (0.9993)	-4.4685	-4.7581	2019M10
Δkfe	-1.7638 (0.0739)*	-3.1497 (0.0984)*	-4.8530	-4.6577***	2021M07
lrex	-2.7562 (0.2158)	-2.6763 (0.2478)	-5.8140	-6.4650	2016M10
Δlrex	-10.6502 (0.0000)***	-9.3690 (0.0000)***	-10.0249	-4.6636***	2013M09
lint	-2.9979 (0.1359)	-1.8851 (0.6580)	-4.5243	-4.6814	2021M04
Δlint	-8.0851 (0.0000)***	-7.4115 (0.0000)***	-6.1317	-4.7775***	2018M03
lipi	-5.2202 (0.0001)***	-5.0010 (0.0003)***	-4.0932	-4.7705	2018M11
Δlipi	-	-	-10.4971	-4.5902***	2012M07
ltge	-4.4044 (0.0028)***	-4.3638 (0.0032)***	-4.2632	-4.7717	2018M10
Δltge	-	-	-9.7827	-4.7775***	2016M12
ltufe	1.7868 (1.0000)	2.8890 (1.0000)	-7.4881	-4.6463***	2021M09
Δltufe	-7.3376 (0.0000)***	-7.2814 (0.0000)***	-	-	-

**, **, and * indicates statistically significance at 1%, 5% and 10% respectiely. Δ is the difference operator.
(): Contains the probability value (p) in parentheses.

Unit root tests were applied for both constant and with constant and trend. When the ADF and PP test results are evaluated together, it is seen that all the variables are not stationary at the I(0) level. In this case, the H_0 "series has a unit root" hypothesis for the variables that cannot be rejected at the I(0) level. When the difference operation is applied to the non-stationary variables, the variables become stationary at the I(1) level. In Lee & Strazicich unit root test, which considers structural breaks, the main hypothesis is that the variables are not stationary with a single break. According to this test, the series became stationary at the first difference.

After determining the stationarity levels of the series, it is necessary to investigate whether there is a cointegration relationship between the variables. According to the NARDL bounds test, the F bounds

test is applied to the created model to investigate whether there is a cointegration relationship between the variables. The test statistics results are given in Table 3.

Table 3. Bounds Test Result for Cointegration in the Specified NARDL Model

F-statistics	Significance Level	Critical Value	
		I(0)	I(1)
30.1891***	10% 5% 1%	2.220 2.500 3.070	3.170 3.500 4.230
*** (%1), ** (%5), * (%10) indicates rejection of H_0 hypothesis at significance level. For the cointegration test, H_0: There is no cointegration.			

The null hypothesis (H_0) of the F-statistic obtained as a result of the NARDL bounds test is that there is no cointegration between the series. Therefore, the null hypothesis must be rejected for there to be cointegration between the series. If the value of the F-statistic is less than the lower limit value at the given significance level, the null hypothesis cannot be rejected. If the value of the F-statistic falls between the lower and upper limit values, a decision cannot be made about the null hypothesis at that significance value. If the value of the F-statistic exceeds the upper critical value, the null hypothesis is rejected at that significance level. This indicates that there is a long-term relationship between the series. As can be seen from the table, the value of the F-statistic (30.1891) is greater than the upper limit value of the 1% significance level (4.230). Therefore, the H_0 hypothesis is rejected, in other words, it is concluded that there is a long-term relationship between the series. As a result, long-term coefficients can be used to examine the degree and direction of the effect of the variables.

Based on the information above, the NARDL model used in this study is as follows:

$$\Delta lhpi_t = \theta_0 + \theta lhpi_{t-1} + \delta_1^+ lipi_{t-1}^+ + \delta_1^- lipi_{t-1}^- + \delta_2^+ lcpi_{t-1}^+ + \delta_2^- lcpi_{t-1}^- + \delta_3^+ lcci_{t-1}^+ + \delta_3^- lcci_{t-1}^- + \delta_4^+ lrex_{t-1}^+ + \delta_4^- lrex_{t-1}^- + \delta_5^+ lint_{t-1}^+ + \delta_5^- lint_{t-1}^- + \sum_{i=1}^{p} \gamma_i \Delta lhpi_{t-i} + \sum_{i=0}^{q} (\rho_{1,i}^+ \Delta lipi_{t-i}^+ + \rho_{1,i}^- \Delta lipi_{t-i}^- + \rho_{2,i}^+ \Delta lcpi_{t-i}^+ + \rho_{2,i}^- \Delta lcpi_{t-i}^- + \rho_{3,i}^+ \Delta lcci_{t-i}^+ + \rho_{3,i}^- \Delta lcci_{t-i}^- + \rho_{4,i}^+ \Delta lrex_{t-i}^+ + \rho_{4,i}^- \Delta lrex_{t-i}^- + \rho_{5,i}^+ \Delta lint_{t-i}^+ + \rho_{5,i}^- \Delta lint_{t-i}^-) + u_t \quad (7)$$

Akaike Information Criteria was used to select the lags for the NARDL model. The best (smallest) Akaike information criteria value is calculated for NARDL (1,2,2,1,0,2) (Appendix-1). The lags in question were created according to the order in Equation 7 with their positive and negative components for all variables. NARDL short- and long-term findings are given in Table 4.

Table 4. NARDL (1,2,2,1,0,2) Model Results

Short-run coefficients ***Dependent variable ΔLHPI***			
Variable	***Coefficient***	***t-Statistic***	***Prob.***
$LHPI$ (-1)	0.042559	0.0017	0.0017***
$LIPI^{+}$(-1)	0.091156	3.580345	0.0005***
$LIPI^{-}$(-1)	-0.096197	3.227896	0.0015***
$LCPI^{+}$(-1)	-0.068902	-2.978092	0.0034***
$LCPI^{-}$(-1)	0.572955	3.656647	0.0004***
$LCCI^{+}$(-1)	-0.169533	-8.350201	0.0000***
$LCCI^{-}$(-1)	0.025949	1.024772	0.3072
$LREX^{+}$	0.155876	4.483422	0.0000***
$LREX^{-}$	-0.083628	-4.830702	0.0000***
$LINT^{+}$(-1)	-0.034157	-4.890486	0.0000***
$LINT^{-}$(-1)	-0.032536	-5.317825	0.0000***
$\Delta LIPI^{+}$	0.089712	1.629726	0.1053
$\Delta LIPI^{-}$	0.022395	0.849344	0.3971
$\Delta LIPI^{+}$(-1)	0.004186	0.103740	0.9175
$\Delta LIPI^{-}$(-1)	-0.161126	-4.033850	0.0001***
$\Delta LCPI^{+}$	0.169246	2.753483	0.0067***
$\Delta LCPI^{-}$	0.348071	0.864468	0.3888
$\Delta LCPI^{+}$(-1)	0.379748	6.225603	0.0000***
$\Delta LCPI^{-}$(-1)	-0.415297	-1.053497	0.2939
$\Delta LCCI^{+}$	-0.068474	-1.480753	0.1409
$\Delta LCCI^{-}$	0.024650	0.548333	0.5843
$\Delta LINT^{+}$	-0.033606	-2.028745	0.0443**
$\Delta LINT^{-}$	-0.043756	-2.250361	0.0259**
$\Delta LINT^{+}$(-1)	-0.027445	-1.713875	0.0887*
$\Delta LINT^{-}$(-1)	0.051190	2.814830	0.0056***
ECT (-1)	-0.033606	-2.028745	0.0443**
Long-run coefficients			
$LIPI^{+}$	2.141879	-2.084062	0.0388**
$LIPI^{-}$	-2.260324	-2.287080	0.0235**
$LCPI^{+}$	1.618987	7.228719	0.0000***
$LCPI^{-}$	-13.46262	-2.080817	0.0391**
$LCCI^{+}$	3.983478	3.041735	0.0028***
$LCCI^{-}$	-0.609712	-0.984694	0.3263
$LREX^{+}$	-3.662592	-2.394128	0.0178**
$LREX^{-}$	1.964988	3.197917	0.0017***
$LINT^{+}$	0.802582	2.161646	0.0321**
$LINT^{-}$	0.764485	3.106786	0.0022***
Diagnostic tests	***Test statistic***	***Prob.***	

Serial correlation LM test	1.1835	0.3092
Breusch-Pagan-Godfrey heteroscedasticity test	1.2667	0.2035
CUSUM	Stable (Appendix-2)	
***, **, and * refer to statistically significance at 1%, 5% and 10% respectiely.		

Table 4 shows both long-run and short-run results. It is seen that the long-run coefficients are positive for *lipi* increases and negative for its decreases. There is a directional relationship between the two variables. The long-run coefficient of $lipi^+$is 2.14 ($p<0.05$). This means that a 1% increase in the industrial production index (*lipi*) leads to a 2.14% increase in the housing price index. Industrial production is considered an indicator of economic growth. Increasing industrial production indicates that general economic activity increases, and thus, housing demand increases. This may cause housing prices to increase in the long-run. The long-run coefficient of $lipi^-$ is -2.26 ($p<0.05$). That is, when the industrial production index decreases, housing prices also decrease by 2.26%. Negative effects indicate that negative changes in industrial production may indicate economic recessions or crises, which may negatively affect housing demand and lead to a decrease in prices. Similar to the long-term findings, the short-term findings also prove a linear relationship. The analysis result is identical to the comments of Durkaya and Yamak (2004), Zandi et al. (2015), and Karadaş and Salihoğlu (2020).

When the long-term coefficients for *lcpi* are examined, it is seen that $lcpi^+$has a positive and statistically significant effect on the lhpi variable at 1% significance level. In other words, as the consumer price index increases, the housing price index also increases. When we look at the negative components, it is seen that $lcpi^-$has a negative and statistically significant effect on the *lhpi* variable at 1% significance level. The most important conclusion to be drawn from here is that inflationary pressures in the country also cause inflation in housing prices. Inflation can increase housing prices because material and labor costs also increase, which pushes housing prices up. The negative effect is quite high and significant (-13.46262 ($p<0.05$)). This shows that when inflation reaches a certain level, especially in high inflation periods, it can lead to a decrease in purchasing power, and, thus, a decrease in housing demand. This situation can cause housing prices to fall in the long term. When we look at the short-term findings, it is seen that the effects of $lcpi^-$are insignificant. The lagged values of $lcpi^+$support the long-term results. The negative effect findings are identical to the results of Çetin (2021).

When the long-term coefficients of the consumer confidence index (*lcci*) are examined, it is observed that the variable $lcci^+$has a positive effect on *lhpi* and $lcci^-$ has a negative effect, but the negative effect is not significant. As confidence increases in an economy, households can more easily invest and increase their expenditures. With the increase in the consumer confidence index, there will be an increase in household housing demand, and the increasing housing demand will cause prices to increase. In the short-term results, the lagged values of both the positive and negative components do

not have any significant effect. The increase or decrease in the short-term consumer confidence index does not affect the housing market.

As the real effective exchange rate decreases, the national currency depreciates, while an increase in the real exchange rate indicates appreciation of the national currency. When the real effective exchange rate ($lrex^{+}$) rises, it means that foreign prices are increasing relative to domestic prices, which tends to decrease the housing price index in the long term. According to the analysis, positive shocks in the real effective exchange rate negatively affect the housing price index. Conversely, negative shocks ($lrex^{-}$) lead to an increase in housing prices. The effect of positive shocks is more pronounced than negative shocks. The real appreciation of the national currency can be interpreted as decreasing the housing demand of the domestic people in particular and decreasing housing prices due to insufficient demand. Long-term decreases in the real effective exchange rate have an increasing effect on the housing price index. Short-term findings are consistent with the long-term findings. The results are interpreted as the real exchange rate is an important variable in determining housing prices, as in Eryüzlü and Ekici (2020).

When we examine the long-term effects of the last explanatory variable, the housing loan interest rate (*lint*), it is seen that increases in interest rates ($lint^{+}$) and decreases ($lint^{-}$)increase housing prices. A 1% increase in $lint^{+}$increases the housing price index by 0.8%, while a 1% decrease in $lint^{-}$ increases the housing price index by 0.76%. High housing loan interest rates make housing loans more costly. This can negatively affect housing demand and keep housing prices under pressure in the long run. Low interest rates make housing loans more attractive and increase housing demand. This can cause housing prices to increase in the long run. The fact that increases or decreases in loan interest rates have a decreasing effect on prices is identical to the results of Akpolat (2022).

4. CONCLUSION

The housing market has become an important factor in determining both economic growth and shaping the economic and social well-being of households, especially in developing countries. Population growth, urban migration, and industrialization have led to an increase in housing demand in housing markets. However, developments in the financial system can also indirectly affect housing demand and create a risk of housing price increases.

This study aims to advance the existing literature by analyzing the factors influencing the housing price index. It utilizes data on the housing price index and selected macroeconomic variables from January 2010 to May 2024. Initially, standard unit root and cointegration tests were conducted, including Augmented Dickey-Fuller (1979), Phillips-Perron (1988), and Lee-Strazicich (2004) tests, to assess the stationarity of the series. Following this, a cointegration relationship between the series was identified. Short- and long-term cointegration findings were interpreted using NARDL models, which allow examining the relationships between stationary variables of different degrees.

The industrial production index has an asymmetric effect on the housing price index, and the effects of positive changes ($lipi^+$) and negative changes ($lipi^-$) of the variable differ. When the long-term coefficients are examined, it is seen that positive shocks of the industrial production index have a positive effect on the housing price index, and negative shocks of the industrial production index have a negative effect on the housing price index. It is seen that positive changes ($lcpi^+$) of the consumer price index have a positive effect on the housing price index, while negative changes ($lcpi^-$) have a negative effect. Given that the largest impact comes from a decrease in the consumer price index, it can be concluded that policies aimed at reducing inflation will also significantly influence the housing price index. When we look at the long-term coefficients of the consumer confidence index, the variable $lcci^+$has a positive and significant effect on the housing price index, while the negative effect of $lcci^-$ is observed, but the negative effect is not significant. It can be concluded that the increase in confidence in the economy will increase the household housing demand and cause housing prices to increase. An increase in the real effective exchange rate ($lrex^+$)causes the housing price index to fall in the long run. Positive shocks in the real effective exchange rate have a negative effect on the housing price index. Conversely, negative shocks ($lrex^-$)cause housing prices to rise. Both positive and negative changes in the last explanatory variable, housing loan interest rates, increase the housing price index. High housing loan interest rates make loans more expensive and reduce housing demand, thus suppressing prices. Low interest rates make loans more attractive and increase demand, and this may cause prices to rise.

In general, macroeconomic indicators such as inflation and consumer confidence play an important role in determining long-term trends in housing prices. High inflation can generally cause housing prices to increase, but very high inflation can reduce demand by creating economic uncertainty. When consumer confidence is high, housing demand increases and prices rise. Increased industrial production can support economic growth, which in turn increases housing demand. On the other hand, the exchange rate affects costs, especially in the construction sector, which depends on imported materials. An increase in the exchange rate can increase costs, while a decrease in the exchange rate can decrease costs and increase housing demand. Interest rates affect credit costs, affecting housing demand and prices.

It is known that variables such as industrial production, consumer confidence, inflation and exchange rates shape housing markets in developing economies such as Türkiye. The impact of increasing demand and exchange rate changes on costs during periods of economic growth constitute the basic basis of these results. As a result, long-term impacts are often influenced by persistent and large-scale changes in economic conditions. These impacts can lead to significant changes in the housing market, and understanding these changes is critical to determining market trends and policies.

In the context of the Turkish economy, policymakers should develop new policies to reduce price increases in housing markets and especially consider the economy's long-term dynamics. In this context, anti-inflation policies may have a stabilizing effect on the housing market. The Central Bank's

implementation of tight monetary policies to control inflation can stabilize prices and prevent excessive price increases in the housing market. The tight stance targeting price stability in monetary policy should be maintained and fiscal discipline should be maintained. In addition, supply can be increased by alleviating the pressure of increasing construction costs with subsidies for the construction sector. While housing loan interest rates are being reduced, incentives should also be increased on the supply side so that this policy does not create excess demand. For future research, it is recommended that regional and city-level studies be conducted first. In particular, the dynamics of the Istanbul housing market be examined separately. In addition, other developing economies, such as Türkiye, can be examined, and comparisons can be made about the structure of their economies.

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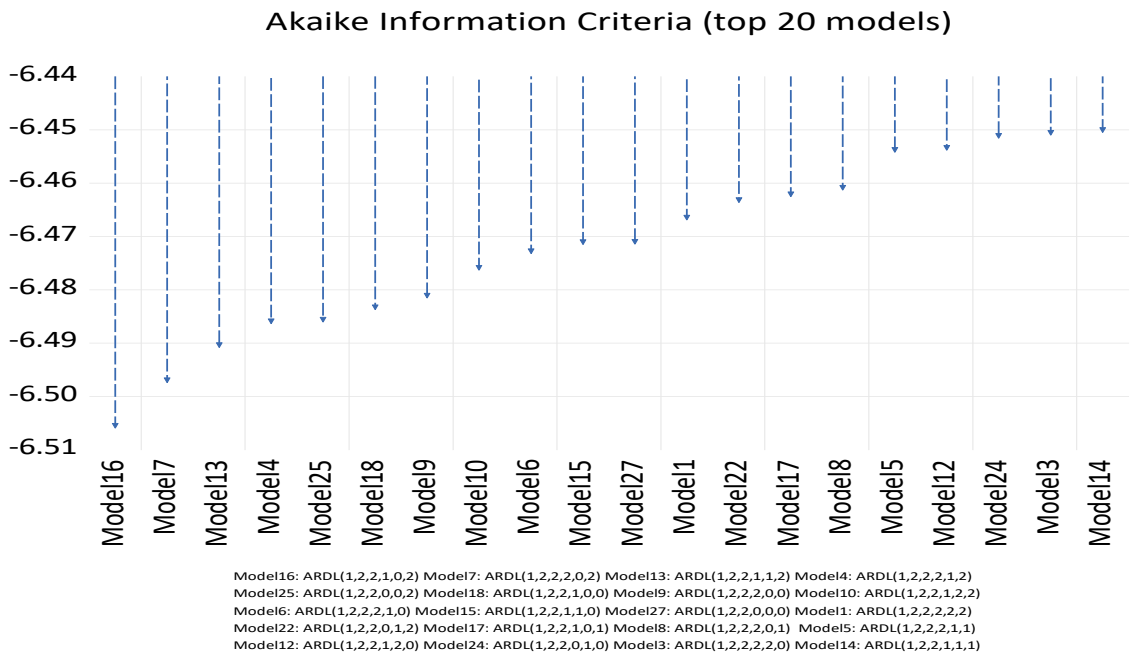
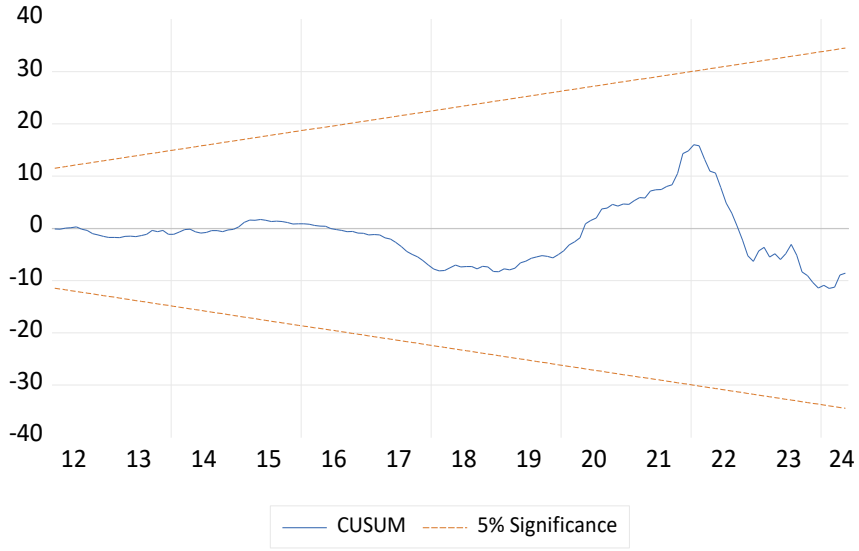
Appendix-1



Appendix-2



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