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Original Research Article

# Extracting Key Economic Indicators Affecting Housing Prices in the Metropolises of Iran Using the Fuzzy Delphi Method*

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## Abstract

**Problem statement:** One of the questions for construction industry stakeholders and the public, as the primary beneficiaries of housing in Iran's metropolises, is how housing prices will change in the future. In other words, when and with what intensity will periods of housing recession and boom occur? Answering these questions requires a future-oriented perspective on housing and an understanding of the relationship between housing prices and the country's macroeconomic indicators.

**Research objective:** This study aims to extract the most crucial macroeconomic indicators affecting housing prices in the country's metropolises to foster thinking and research on future housing prices and understand the cycles of housing recession and boom. This study hopes to contribute to real estate development companies, design and construction firms, investors, users, and industry stakeholders make better and more effective decisions for their businesses and lives. This approach reveals and clarifies potential risks and dangers in the future housing market, enabling better examination and responsiveness for the mentioned audience.

**Research method:** Based on the steps of the Fuzzy Delphi method, all macroeconomic indicators related to housing prices were initially extracted through a review of library resources and previous research. Then, through expert surveys and screening of each indicator's scores and comparison of their acquired values, the most critical economic indicators affecting housing prices were determined.

**Conclusion:** The study's key indicators, in order of significance, are "inflation," "exchange rate," "residential land value," "construction costs," and "liquidity." The extracted indicators and their order indicate that the "investment" aspect of housing in Iran's metropolises is more important than the "supply" and "demand" aspects.

**Keywords:** *Housing Prices, Recession and Boom Periods, Economic Indicators, Construction Industry, Fuzzy Delphi Method.*

## Introduction

The subject of housing prices and their fluctuations over time is a fundamental issue for stakeholders in this field in Iran. Given the significant investment value of housing, this topic is also important for small-scale investors and the general public. According to the Ministry of Roads and Urban Development, the proportion of net housing costs to total urban household expenses in 2023 was 36%.

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This figure, along with the private sector's investment of 1,445. 4 trillion rials in new urban buildings in the summer of 2022, highlights the substantial impact and importance of housing in the national economy and the interconnectedness of these factors (Ministry of Roads and Urban Development, 2024).

To better understand the economic relationships influencing housing prices, it is first necessary to identify the main impacting indicators. Once these indicators are identified and monitored, a comprehensive and informed perspective on potential future housing changes can be developed based on scientific insights. This study aims to identify the most critical economic indicators affecting housing prices in Iran's metropolises. The Fuzzy Delphi Method was employed for this purpose, and after reviewing the literature and previous research and conducting expert surveys, the key economic indicators were identified.

## Literature Review

One of the indicators less frequently addressed in domestic research for its impact on housing prices is the unemployment rate. One study has pointed to a positive correlation between unemployment rates and housing price increases (Zarepour, 2006), a finding also introduced in several international studies and examined in this research (Vaidynathan et al., 2023).

The mortgage loans indicator has been included in several domestic studies. Variables such as bank credit facilities and subsidies have a more significant role in predicting the dependent variable (sustainable housing in Kermanshah city) compared to other variables (Darabi et al., 2022). However, mortgage loans and their amounts have been mentioned in only one international study (Liu & Ma, 2021).

Interest rate is also another indicator that has been studied. In one domestic study focusing on Tehran, Granger causality between bank interest rates and housing prices was not confirmed (Sabbaq Kermani et al. 2010). However, another study found its effect on housing prices to be negative (Mousavi & Doroodian, 2015). Internationally, some researchers have found interest rates to be non-impactful (Cohen & Karpaviciute, 2017; Tripathi, 2020; Johnstone & Watuwa, 2007), while others have found them to be less impactful (Adams & Fuss, 2010; Liu & Ma, 2021), impactful (Abelson et al., 2005; Algieri, 2013), or the most impactful indicator (Xu & Tang, 2014).

Household income indicator has been mentioned in some sources (Kishor & Marfatia, 2017). One researcher, considering household expenditure's impact on purchasing power, argued that the income-to-housing price ratio alone is not a suitable indicator for determining housing affordability (Case study: Urban areas of Iran in 2014). However, in a study carried out in Beijing and Shanghai, China, researchers found a two-way relationship between housing prices and household income (Shen et al., 2005).

Some domestic sources have found a relationship between gold or coin prices and housing prices, which has not been explored in any international research. One article noted a short-term, two-way relationship between these factors (Sabbaq Kermani et al., 2010), while another article determined this relationship in the long term, alongside several other factors, as determinants of housing price levels (Asgari & Almasi, 2011). Some researchers have included this indicator alongside stock and foreign exchange prices, referring to them as alternative asset returns and describing them as negatively correlated with housing prices (Mousavi & Doroodian, 2015).

Some researchers have concluded that rental rates, alongside several other indicators, are among the most significant factors affecting housing prices (Ghaderi & Izady, 2016).

The stock market index is more commonly discussed in domestic research. Among international studies, only one has addressed this indicator, citing gross domestic product (GDP) alongside the stock market as a Granger cause of housing prices in Shanghai (Shen et al., 2005). In domestic research, this factor has been described as negatively related to housing prices (Doroodian, 2008), with some considering it impactful in the short term (Asgari & Almasi, 2011). The stock market index also impacts housing prices in various regions of Tehran (Motevaseli et al., 2010).

In a study conducted in Kermanshah, researchers pointed out the role of the foreign exchange rate indicator (Soheili et al., 2014). Some researchers found a positive relationship with housing prices (Naji Meidani et al., 2010), while others identified a negative relationship in the short and long term (Khiabani, 2003), and some recognized it as one of the most influential indicators in Iran's housing price pattern (Nemati et al., 2020). This indicator has also been identified as an influential factor in some international studies (Zhang et al., 2012).

Another indicator is the housing starts, particularly for residential buildings, which represent the level of housing construction. One researcher, in a university thesis, pointed to its negative correlation with prices (Zarepour, 2006). The housing starts, with a positive coefficient, explain changes in investment in urban residential units (Agheli Kohneshahri, 2007).

The impact of urbanization rates and urban population on housing prices in cities has been significant in both domestic and international research (Abbasinejad & Yari, 2008; Nemati et al., 2020).

Many studies emphasize the positive effect of construction costs on housing prices (Ghaderi et al., 2011; Doroodian, 2008; Mousavi & Doroodian, 2015; Nasrollahi, et al., 2009; Ghoreyshi, 2006). Some articles assess the impact of construction costs as short-term (Asgari & Almasi, 2011). In some research, residential land value is identified as more important than other cost factors (Soheili et al., 2014). One researcher highlighted the reciprocal and positive relationship between land and housing prices (Doroodian, 2008). Another study, a case study of Isfahan from 1992 to 2004, found a direct relationship between household income growth (GNP per capita) and land price growth. They also identified the reduction in urban land per capita as one of the factors driving land price increases (Sameti & Moeini, 2007). Two other researchers also deemed this factor the most influential in increasing housing prices, observing a long-term relationship between them (Asgari & Almasi, 2011). However, in international studies, only one research in China mentioned this factor as significant (Liu & Ma, 2021).

Another factor in increasing construction costs is inflation. However, findings from a study covering 1973 to 2005 showed that the impact of inflation rates on housing price growth was insignificant during the reviewed period (Abbasinejad & Yari, 2008). This factor is also observed in international research. For example, an article indicated a long-term relationship between inflation rates and housing prices (Vui Kiong & Binti Aralas, 2019).

Gross Domestic Product (GDP) has been influential in some domestic and international research, with some studies finding a positive relationship (Naji Meidani et al., 2010; Khiabani, 2003; Xu & Tang, 2014; Tripathi, 2020; Zulkarnain & Nawi, 2024; Hossain & Latif, 2009) and others a negative one (Ghaderi & Izady, 2016; Zarepour, 2006; Nasrollahi et al., 2009; Ghoreyshi, 2006). However, some researchers have concluded that this indicator does not significantly impact housing prices (Liu & Ma, 2021).

A factor observed only in domestic studies is the price of oil. Several domestic studies have indicated the impact of oil sales and prices on housing prices. In the long term, this indicator is positively correlated with oil revenue (Ghoreyshi, 2006).

Liquidity also affects housing prices in various regions of Tehran (Motevaseli et al., 2010). Between 2006 and 2008, the sharp increase in liquidity volume caused inflation, leading to inflationary expectations and subsequently to an increase in expected inflation. This factor ultimately resulted in a gradual and nonlinear increase in housing prices (Panahi et al., 2018). Additionally, liquidity has had significant effects on housing price fluctuations (Doroodian, 2008). The relationship between this indicator and housing prices is positive (Mousavi & Doroodian, 2015).

Factors such as average household expenditures, long-term deposit interest rates, real housing prices in the previous period, loan repayment periods, urban land per capita, housing taxes, government spending on housing, macroprudential policies, housing credit, and broad money are mentioned in only a few articles (one or two studies) (Ghaderi,

2017; Asgari & Chegeni, 2007; Nasrollahi et al., 2009; Sameti & Moeini, 2007; Zarepour, 2006; Cohen & Karpaviciute, 2017; Tripathi, 2020; Vogiazas & Alexiou, 2017; Egert & Mihaljek, 2007). To ensure the comprehensiveness of the literature and indicators, real estate pricing models were also reviewed. These studies examined the impact of the following variables on property prices, variables such as area, number of rooms, architectural style, year of construction, amenities (elevator, parking, storage), proximity to the metro, shopping centers, distance from traffic, noise pollution, and security (Moradi & Mesgari, 2022; Souri & Moniri Javid, 2011; Rosales & Hernandez, 2021). Ultimately, no other economic indicators related to the topic were found in similar studies.

It is noteworthy that the economic indicators in this research are defined and refined based on the logic of the World Bank's "Economics and Development" indicators (World Bank, 2024). Other variables, such as government policies, international relations, political developments, etc., can also impact housing prices through their effects on the country's macroeconomic variables. However, secondary causal relationships were not considered in this study. Examining how and to what extent these factors affect the economy and, consequently, housing prices, despite their importance, is left to other studies.

Conclusively, Table 1 presents a list of indicators related to housing prices. Indicators mentioned in only one or two articles, such as loan repayment periods, urban land per capita, housing taxes, and government spending on housing, were removed from the list. Sixteen influential economic indicators, including "Unemployment Rate," "Mortgage Loans," "Interest Rate," "Household Income," "Gold Coin Price," "Rental Rates," "Stock Market Index," "Exchange Rate," "Housing Starts," "Urban Population Rate," "Residential Land Value," "Construction Costs," "Inflation," "Gross Domestic Product (GDP)," "Oil Prices," and "Liquidity," were confirmed after review and expert surveys.

## Research Methodology

This applied research aims to identify key indicators in the housing sector of Iran's metropolitan areas, defined as cities with populations exceeding 500,000 (Supreme Council of Urban Planning and Architecture of Iran, 2009). The research philosophy is "Critical Realism," with an "Abductive" approach to theoretical development. The methodology is quantitative, where expert opinions are collected qualitatively and analyzed using the Fuzzy Delphi Method. The study is cross-sectional and does not require periodic repetition. Initial library studies were followed by expert interviews and surveys, which were ultimately analyzed using the Fuzzy Delphi technique. The questionnaire included 16 Likert-scale questions and one descriptive question for feedback. The relationship between linguistic terms and Fuzzy Delphi numbers is presented in Table 2 (Mirsepassi et al., 2010).

- **Subjects of the study**

The study subjects consisted of 34 experts, including university professors in economics or management and professionals in related fields such as construction and urban planning. These individuals typically hold managerial positions in investment and real estate development companies in Iran's metropolitan areas and possess a comprehensive understanding of the housing market (Table 3). The sampling was done non-randomly, using the convenience sampling method, and in some cases, the snowball method was employed. Regarding the number and adequacy of the expert population, to ensure sufficient diversity and complete coverage of topics in the Delphi method, a sample size of 15 to 30 people is generally recommended (Okoli & Pawlowski, 2004). Some sources suggest that there should be more than 32 usable responses (Hassangholipour et al., 2014). On the other hand, increasing the number of experts beyond the optimal level may complicate the research processes and data collection and analysis, making the consensus-reaching process more complex and time-consuming (Delbecq et al., 1975; Linstone & Turoff, 2002).

Table 1. Macroeconomic indicators influencing housing prices and their sources. Source: Authors.

| Indicators/Sources | Unemployment Rate | Mortgage Loans | Interest Rate | Household Income | Gold Coin Price | Rent Rate | Stock Market Index | Exchange Rate | Housing Starts | Urban Population Rate | Residential Land Value | Construction Cost | Inflation | Gross Domestic Product (GDP) | Oil Price | Liquidity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Panahi et al., 2017 | - | * | * | - | * | - | * | - | - | * | - | * | * | - | - | * |
| Khiabani, 2003 | - | - | - | - | - | - | * | * | - | - | - | - | - | * | - | * |
| Darabi et al., 2022 | - | * | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Doroodian, 2008 | - | - | * | - | * | - | - | * | * | - | * | * | - | - | * | * |
| Zarepour, 2006 | * | * | - | * | - | * | - | - | * | * | - | * | - | * | - | - |
| Sameti & Moeini, 2007 | - | - | - | - | - | - | - | - | - | - | * | - | - | * | - | - |
| Soheili et al., 2014 | - | * | - | * | - | | * | * | - | - | * | * | - | - | - | - |
| Sabbaq Kermani et al., 2010 | - | - | * | * | * | - | - | - | * | - | * | * | - | - | - | - |
| Agheli Kohneshahri, 2007 | - | - | - | - | - | - | * | - | * | - | - | * | - | - | - | - |
| Abbasinejad & Yari, 2008 | - | * | - | - | - | - | - | - | - | * | - | - | - | - | - | * |
| Asgari & Almasi, 2011 | - | - | * | - | * | - | * | | * | * | * | * | - | - | * | - |
| Ghaderi & Izady, 2016 | - | - | - | * | - | * | - | - | - | * | - | * | - | * | - | - |
| Ghaderi et al., 2011 | - | - | - | * | - | - | * | * | - | - | - | * | - | - | - | * |
| Ghaderi, 2017 | - | - | * | | - | - | - | - | - | - | - | - | - | - | - | - |
| Ghoreyshi, 2006 | - | - | - | - | * | - | - | - | - | - | - | * | - | * | * | - |
| Motevaseli et al., 2010 | - | - | - | - | - | | * | - | - | - | - | - | - | - | - | * |
| Mousavi & Doroodian, 2015 | - | - | * | | * | - | * | * | * | - | - | * | - | - | - | * |
| Naji Meidani et al., 2010 | - | - | - | - | - | - | - | * | - | - | - | - | * | * | - | * |
| Nasrollahi et al., 2009 | - | - | * | - | - | - | - | - | - | - | - | * | - | * | * | - |
| Nemati et al., 2020 | * | - | - | * | - | - | - | * | - | * | - | * | - | - | * | * |
| Abelson et al., 2005 | - | - | * | * | - | - | * | - | - | - | - | - | * | - | - | - |
| Adams & Fuss, 2010 | - | - | * | - | - | - | - | - | - | - | - | * | - | * | - | - |
| Algieri, 2013 | - | - | * | * | - | - | * | - | - | - | - | - | * | - | - | - |
| Cohen & Karpaviciute, 2017 | * | - | - | - | - | - | - | - | - | - | - | - | - | * | - | - |
| Egert & Mihaljek, 2007 | - | - | * | - | - | - | - | - | - | * | - | - | - | * | - | - |
| Hossain & Latif, 2009 | - | - | - | - | - | - | - | - | - | - | - | - | * | * | - | - |
| Johnstone & Watuwa, 2007 | * | - | - | * | - | - | - | - | * | * | - | - | - | - | - | - |
| Kishor & Marfatia, 2017 | - | - | * | * | - | - | - | - | - | - | - | - | - | - | - | - |
| Liu & Ma, 2021 | * | * | - | * | - | - | - | - | - | - | * | - | - | - | - | - |
| Shen et al., 2005 | - | - | - | * | - | - | * | | * | - | - | - | - | * | - | - |
| Tripathi, 2020 | - | - | - | * | - | * | - | * | - | * | - | - | * | * | - | * |
| Vaidynathan et al., 2023 | * | - | * | - | - | - | - | - | - | - | - | - | * | * | - | -- |
| Vogiazas & Alexiou, 2017 | - | - | - | - | - | - | - | * | - | - | - | - | - | * | - | - |
| Vui Kiong & Binti Aralas, 2019 | - | - | * | - | - | - | - | * | * | * | - | - | * | * | - | - |
| Xu & Tang, 2014 | * | - | * | * | - | - | - | - | - | - | - | * | | * | - | * |
| Zhang et al., 2012 | - | - | * | - | - | - | - | * | - | - | - | * | - | - | - | * |
| Zulkarnain & Nawi, 2024 | * | - | - | - | - | - | - | - | - | - | - | - | - | * | - | - |

Table 2. Linguistic expressions and fuzzy Delphi numbers. Source: Mirsepassi et al., 2010.

| Linguistic Phrase | Triangular Fuzzy Numbers |
|---|---|
| Very Low | 25.0, 0, 0 |
| Low | 0.50, 0.25/ 0 |
| Medium | 75.0, 50.0, 25.0 |
| High | 1, 75.0, 50.0 |
| Very High | 1, 1, 75.0 |

Considering all these points, the opinions of 34 experts with a suitable diversity of specialties were used to cover various aspects of the topic.

- **Research process phases**

First step: The results of previous research were examined and the main economic indicators affecting housing prices in Iran's metropolitan areas were extracted (Table 1).

Second step: A questionnaire was designed to gather expert opinions from the fields of economics, management, and housing to rank the extracted indicators.

Third step: The indicators were evaluated using the Fuzzy Delphi Method and the key influencing indicators were identified.

## Discussion

The screening of indicators is based on the scores received from experts, comparing each indicator's value with a threshold value of S. The threshold value, set at 0. 7 in this research, is determined through the researcher's subjective inference (Rahdari & Nasr, 2017). To find the value of each indicator, the triangular fuzzy numbers of the expert opinions are calculated, followed by the fuzzy average for the opinions of the n respondents. The fuzzy number τ for the indicators is calculated using the following relations (Rahdari & Nasr, 2017; Seyfoddin Asl et al., 2016).

To interpret the results, the scores are first fuzzified according to the scale in Table 2 and Equation 1. Then, using Equation 2 to 4, the fuzzy averages of the scores are calculated. Finally, the fuzzy averages are defuzzified into crisp numbers (Equation 5), determining the final score for each indicator. Indicators with a score above the threshold of 0. 7 are confirmed and finalized. The fuzzy Delphi calculation results are shown in Table 4.

The ranking of economic indicators based on final scores is displayed in Fig. 1. The key indicators influencing housing prices in Iranian metropolises, in order of importance, are inflation, exchange rates, residential land value, construction costs, and liquidity. Confirmed indicators are shown in dark gray, while rejected ones are in light gray. The results are consistent with previous research and were validated by experts, eliminating the need for a second round of surveys.

## Conclusion

This study, using the fuzzy Delphi method, has identified and analyzed economic indicators affecting housing prices in Iran's major cities, leading to a deeper understanding and providing a new perspective on their impacts. The focus on Iran's unique economic conditions and the housing market in major cities adds innovation to the research, with input from experts in various fields lending credibility to the results. Additionally, the fuzzy Delphi method, with its ability to collect and analyze experts' opinions and create consensus on complex issues, introduces a new methodology in this type of research, especially since most previous studies have relied on statistical methods and correlation analyses.

In terms of application, the results of this study can assist economic policymakers in developing and implementing effective strategies for controlling inflation and exchange rates. Furthermore, the findings can be enlightening for decision-makers and

Eq. (1) $$\tilde{\tau}_{ij} = (a_{ij}, b_{ij}, c_{ij}), \quad i = 1,2,\dots,n \quad j = 1,2,\dots,m$$

Eq. (2) $$b_j = \sum \frac{b_{ij}}{n}$$

Eq. (3) $$c_j = \sum \frac{c_{ij}}{n}$$

Eq. (4) $$c_j = \sum \frac{c_{ij}}{n}$$

Eq. (5) $$a_j = \sum \frac{a_{ij}}{n}$$

Table 3. Descriptive frequency distribution of experts. Source: Authors.

| Category | Subcategory | Frequency | Percentage (out of 100%) |
|---|---|---|---|
| Field of Study | Economics | 3 | 9 |
| | Management | 16 | 47 |
| | Engineering (Architecture, Civil, Urban Planning) | 15 | 44 |
| Education Level | Bachelor's | 6 | 18 |
| | Master's | 21 | 62 |
| | Doctorate | 7 | 20 |
| Occupation Type | University Professor | 3 | 9 |
| | Professional Specialist | 31 | 91 |
| Work Experience | 5 to 10 years | 4 | 12 |
| | 11 to 15 years | 9 | 26 |
| | 16 to 20 years | 7 | 21 |
| | 21 to 25 years | 5 | 15 |
| | 26 years and above | 9 | 26 |

stakeholders in the housing market of the country's major cities, including investment and construction companies, helping them to adopt appropriate monetary policies for managing liquidity and their businesses in the current unstable economic environment.

Regarding the research findings, three main aspects can be identified: "capital," "supply," and "demand." The "inflation" and "exchange rate" indices are capital aspects and have been identified as the key factors influencing housing prices. These indices, in addition to increasing construction costs, play a significant role in preserving capital value in inflationary conditions. Given the economic and currency fluctuations in Iran, the capital aspect is the most crucial, and these two indices are vital in investors' decision-making and determining housing prices in Iran's metropolises. Therefore, controlling inflation and exchange rates can lead to economic stability, reduce competition for investment in the housing market, and prevent negative impacts on this market.

The "residential land value" and "construction cost" indices are supply aspects. These indices indicate the costs associated with providing and developing housing units and directly impact construction costs and the final housing price. An increase in land prices and construction costs can lead to higher housing prices and impose more economic pressure on buyers and renters. Proper planning to provide ready-to-build land and control construction costs can improve the housing supply and reduce price fluctuations.

The "liquidity" index is a demand aspect. Increased liquidity, especially during economic downturns, can lead to higher demand for housing and rising prices. In this regard, policymakers can control liquidity through appropriate tax and monetary policies and prevent price bubbles in the housing market.

Finally, it should be noted that the capital generated from economic activities in the country is striving to preserve its value under the current inflationary conditions. Therefore, the greater importance of the capital aspect in housing, as found in this study, means that investors view investing in housing as a desirable way to preserve their capital value in the current inflationary conditions. Hence, the value of capital attracted to the housing

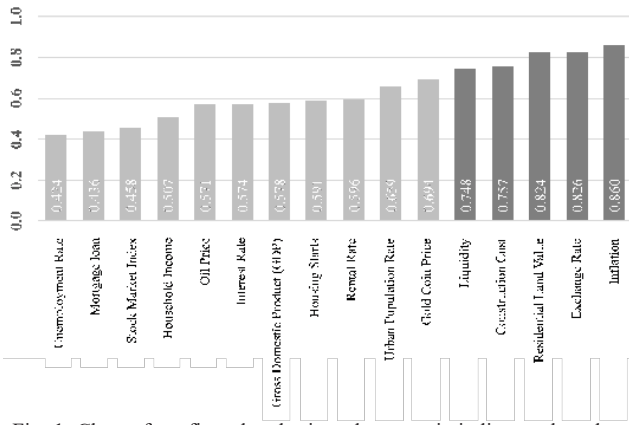


Fig. 1. Chart of confirmed and rejected economic indicators based on non-fuzzy scores and threshold value. Source: Authors.

Table 4. Fuzzy Delphi results. Source: Authors.

| Row | Index Title | Fuzzy Score | Non-Fuzzy Score | Status |
|---|---|---|---|---|
| 1 | Unemployment Rate | 0.206,0.412,0.654 | 0.424 | Rejected |
| 2 | Mortgage Loan | 0.206,0.426,0.676 | 0.436 | Rejected |
| 3 | Interest Rate | 0.331,0.574,0.816 | 0.574 | Rejected |
| 4 | Household Income | 0.279,0.507,0.735 | 0.507 | Rejected |
| 5 | Gold Coin Price | 0.463,0.713,0.904 | 0.694 | Rejected |
| 6 | Rental Rate | 0.353,0.603,0.831 | 0.596 | Rejected |
| 7 | Stock Market Index | 0.213,0.456,0.706 | 0.458 | Rejected |
| 8 | Exchange Rate | 0.632,0.882,0.963 | 0.826 | confirmed |
| 9 | Housing Starts | 0.346,0.596,0.831 | 0.591 | Rejected |
| 10 | Urban Population Rate | 0.426,0.669,0.882 | 0.659 | Rejected |
| 11 | Residential Land Value | 0.618,0.868,0.985 | 0.824 | confirmed |
| 12 | Construction Cost | 0.544,0.794,0.934 | 0.757 | confirmed |
| 13 | Inflation | 0.669,0.919,0.993 | 0.860 | confirmed |
| 14 | Gross Domestic Product (GDP) | 0.338,0.581,0.816 | 0.578 | Rejected |
| 15 | Oil Price | 0.324,0.574,0.816 | 0.571 | Rejected |
| 16 | Liquidity | 0.529,0.772,0.941 | 0.748 | confirmed |

sector is often correlated with capital indices such as exchange rates and inflation and will be evaluated accordingly. Thus, the primary issue in controlling housing prices in the metropolises and major cities of the country is ensuring economic stability, with supply and demand factors being of secondary importance, although these factors are also dynamically influenced by the country's economic stability.

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## Conflict of Interest

The authors declare no conflicts of interest in this research.

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