



Nonlinear Analysis of Inflation's Impact on Asset Markets (Stocks, Coin, Gold, Housing) Using a Time-Varying Parameter VAR (TVP-VAR) Model

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Highlights

- This study focuses on the nonlinear analysis of the impact of inflation on asset markets (stocks, coin, gold, and housing) in the Iranian economy.
- To identify the effects of inflationary shocks on asset markets, a Time-Varying Parameter Vector Autoregression (TVP-VAR) model is employed.
- It provides a realistic approach to how asset markets respond to inflation in Iran.

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Abstract

Asset markets play a pivotal role in dynamic economies by facilitating resource allocation, preserving wealth value, and shaping expectations about the future. Their fluctuations can exert broad effects on investment behavior and economic growth. In the case of Iran—an economy characterized by chronic inflation and recurrent shocks—understanding the effects of inflation on asset markets such as stocks, coin, gold, and housing is of particular importance. The nature of Iran's economy, marked by diverse shocks and structural changes, renders the relationships between inflation and asset markets both dynamic and nonlinear. The objective of this study is to conduct a dynamic and nonlinear analysis of the impact of inflation on Iran's asset markets and to examine the cross-market spillovers among them. To achieve this, monthly data spanning the period March 2011–February 2025 were collected from reliable sources and analyzed using the Time-Varying Parameter Vector Autoregressive (TVP-VAR) model within the Diebold–Yilmaz connectedness framework. This methodological approach allows for assessing time-varying dynamics in market behavior and the intensity of inflationary effects. The empirical findings reveal that inflation exerts its strongest influence on the gold and coin markets, which act as safe havens against inflationary shocks. The housing market demonstrates a weaker yet statistically significant response, while the stock market exhibits the lowest sensitivity to inflation fluctuations. Moreover, substantial cross-market spillovers are observed during inflationary periods, intensifying under crisis conditions.

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1. Introduction

In dynamic economies, asset markets play a crucial role in resource allocation, wealth preservation, and the formation of economic expectations. The behavior of these markets is influenced by macroeconomic conditions, fundamental variables, and anticipatory factors. Fluctuations in asset markets can have profound implications for investment, savings, and economic growth (Gosselin et al., 2022). Among the major macroeconomic variables, inflation plays a complex and multifaceted role in shaping asset market dynamics. Inflation has consistently attracted the attention of policymakers, researchers, and market participants. In many countries—especially developing economies—sharp fluctuations in the general price level not only reduce household purchasing power but also influence investment patterns, consumer behavior, and monetary and fiscal policy orientations (Olamide et al., 2022).

Iran, as an economy that has long experienced persistently high inflation rates, represents a clear example of how inflation affects both real and nominal economic variables. One of the most significant consequences of inflation in such contexts is the asset-oriented behavioral shift among households and investors (Sadeghi et al., 2023). During inflationary periods, the desire to preserve purchasing power drives liquidity away from the money market toward asset markets such as stocks, coin, gold, and housing (Nikoghadam & Abotorabi, 2019). This reallocation of financial resources not only alters the structure of investment but also affects the efficiency of resource allocation at the macroeconomic level. Therefore, understanding the mechanisms through which inflation influences these markets—and the way each market responds to price fluctuations—is of strategic importance for economic policymakers (Daboh et al., 2024). Furthermore, examining the relationship between inflation and asset markets within a dynamic modeling framework is essential, given the interactive nature of these markets. Inflationary spillover effects often exacerbate volatility across markets (Bernanke & Gertler, 2012). For instance, rising inflation expectations can increase demand for gold and coin markets, which, through the wealth effect, may in turn influence the housing and stock markets. Empirical evidence suggests that in the Iranian economy, these dynamics are particularly complex and sometimes lead to speculative cycles within asset markets (Zarei et al., 2020).

Despite the significance of this topic, a precise understanding of how inflation impacts asset markets has remained challenging. The nonlinear and time-varying nature of this relationship has been largely overlooked in domestic literature. Most existing studies have treated these relationships as static and linear, while Iran's economy has been exposed to numerous inflationary shocks over time. These factors have gradually altered the behavioral patterns of markets, resulting in shifts in both the magnitude and direction of inflation's effects across different periods (Mohammadi & Hosseini, 2023). Hence, employing methodologies capable of capturing such structural dynamics is essential. The present study utilizes a Time-Varying Parameter Vector Autoregressive (TVP-

VAR) model with monthly data covering the period March 2011 to February 2025, aiming to provide a realistic depiction of how Iran's asset markets—namely stocks, coin, gold, and housing—respond to inflation. The main innovation of this research lies in its nonlinear and dynamic approach to the simultaneous analysis of four key asset markets. This approach enables the identification of inflation transmission channels, investor behavioral responses, and the degree of market sensitivity to inflation expectations.

The primary objective of this study is to present a clearer picture of the reaction patterns of different asset markets (stocks, coin, gold, and housing) to inflation in the Iranian economy. Additionally, it seeks to analyze inflation-induced spillovers among these markets and the interconnectedness of economic variables within Iran's financial system. From this perspective, the research aims to identify behavioral shifts across different periods, thereby providing a foundation for more effective liquidity management, investment guidance, and inflation control policies. The findings are expected to offer valuable insights for policymakers, investors, and economic researchers by enhancing their understanding of the complex and dynamic interrelations between inflation and asset markets. Such analysis not only contributes to the scientific comprehension of macroeconomic dynamics but also supports the design of more efficient policy frameworks for managing inflation and directing liquidity toward productive sectors.

The present study is structured systematically, with Section 2 devoted to an in-depth examination of the pertinent literature, focusing on the theoretical foundations related to the phenomenon of inflation and its impacts on asset markets. In this section, both theoretical and empirical studies are reviewed, highlighting the gaps in previous research, and the innovative contribution of the current study in addressing these gaps is discussed. Section 3 focuses on the research methodology, providing detailed insights into econometric modeling using the TVP-VAR framework. This section includes an explanation of the model specifications, the data collection and processing procedures, the presentation of descriptive statistics, the analysis of time-varying impulse responses of the variables under study, and the description of the dynamic spillover and connectedness framework among the studied variables. In Section 4, the implications of these findings for the Iranian economy during periods of inflationary volatility are analyzed. Following this, the results are summarized, and policy recommendations for managing inflationary spillovers are presented. Finally, the limitations of the current study are discussed, and potential avenues for future research are suggested.

2. Literature Review

This section is dedicated to a systematic and comprehensive review of the relevant literature, focusing on the theoretical foundations of the inflation phenomenon and its effects on asset markets. In this section, both theoretical and empirical studies are examined, the existing research gaps in previous studies are

highlighted, and the innovative contribution of the present study in addressing these gaps is discussed and analyzed.

2.1. Theoretical Foundations

Inflation, as one of the fundamental concepts of macroeconomics, represents a sustained and persistent increase in the general price level within an economy. This phenomenon leads to consequences such as the erosion of purchasing power, economic instability, and the exacerbation of income inequality (Zheng et al., 2023). In emerging economies such as Iran, the roots of inflation are often attributed to structural factors including fiscal imbalances, supply-side shocks arising from economic sanctions and oil price fluctuations, as well as excess demand pressures exceeding production capacity (Ahmadian, 2025). From a financial market perspective, high inflation tends to reduce real investment returns, thereby pushing investors toward low-risk and safe-haven assets (Motameni et al., 2019). Empirical evidence indicates that gold and coin often serve as hedges against exchange rate volatility; however, their performance is not constant and varies across different time horizons (Wang & Li, 2022). At the macroeconomic level, persistent inflation may slow economic growth and increase unemployment, as firms face rising production costs while households restrict consumption due to declining purchasing power. Moreover, chronic inflation fuels the formation of inflationary expectations, creating a self-reinforcing cycle of rising prices.

The origins of inflation have been interpreted differently across various economic schools of thought, and its effects on asset markets also manifest in diverse ways. Within the Keynesian framework, emphasis is placed on the role of monetary and fiscal policies—such as government spending increases or liquidity expansion—in stimulating aggregate demand and generating inflation (Keynes, 1937). In contrast, monetarists (Friedman, 1986) attribute inflation primarily to excessive growth in the money supply, which can affect asset markets such as stocks by reducing real returns (Friedman, 1968). Additionally, The fluctuations of inflation over time do not have the same effects on the stock market, and the intensity of this impact varies under different economic conditions. In other words, the stock market's response to inflation changes is dynamic and depends on the type and magnitude of inflationary shocks (Ahmadi et al., 2022). Furthermore, structuralist theories focus on the institutional and structural roots of inflation. These approaches highlight factors such as heavy reliance on oil revenues, institutional inefficiencies, and supply-side shocks—like economic sanctions or disruptions in supply chains—as major causes of persistent inflation (Laudati & Pesaran, 2023). In oil-dependent economies such as Iran, inflation expectations and cyclical supply shocks significantly influence housing prices, where liquidity growth and urban development dynamics exhibit a positive relationship with real estate prices (Moeini et al., 2018). The reduction in oil revenues due to sanctions has constrained foreign exchange supply, thereby intensifying inflationary pressures through exchange rate depreciation (Moeini et

al., 2021). Additionally, noncompetitive market structures and labor market rigidities (such as wage stickiness) amplify the persistence and magnitude of inflation—particularly in asset markets like housing, which are often subject to speculative behavior (Roudari et al., 2023). Contractionary monetary policies, such as interest rate hikes, can dampen demand in asset markets, while expansionary fiscal policies, such as budget deficits, tend to exacerbate inflation and redirect capital toward safe-haven assets like gold and coin (Lagos & Navarro, 2023). Collectively, these perspectives underscore the complexity of inflation–asset market linkages and the necessity for dynamic modeling frameworks to analyze them effectively.

Most existing studies have concentrated on linear relationships, whereas nonlinear interactions among asset markets—stocks, coin, gold, and housing—over extended periods have been relatively underexplored. To analyze such relationships, dynamic models like the Time-Varying Parameter Vector Autoregressive (TVP-VAR) framework are particularly suitable, as they enable the examination of temporal changes in model parameters (Antonakakis et al., 2020). These models are capable of capturing nonlinearities and threshold effects, which are especially relevant for volatile economies like Iran (Pourhosseini et al., 2022). In Iran’s case, persistent inflation has destabilized asset markets and frequently mirrors exchange rate fluctuations, underscoring the importance of adopting nonlinear dynamic approaches to better understand these interactions.

2.2. Empirical Literature

This section reviews and analyzes previous domestic and international studies relevant to the present research, focusing on their theoretical frameworks, methodologies, and key findings, in order to highlight the importance and contribution of the current study.

A review of the existing literature indicates that, although numerous studies have examined the relationships between inflation, macroeconomic variables, and asset markets, gaps remain in the dynamic and nonlinear analysis of these relationships in highly volatile economies such as Iran. Both domestic and international studies emphasize the importance of time-varying models like TVP-VAR for capturing temporal changes, yet few have simultaneously analyzed the interconnected behavior of inflation with multiple asset markets—specifically, stocks, coin, gold, and housing. This study extends the literature by enhancing theoretical perspectives on inflation–asset market interlinkages while simultaneously providing insights with direct implications for policy. Its findings can guide policymakers in managing inflation more effectively, stabilizing asset markets, and enhancing investment efficiency in Iran’s inflation-prone economic environment.

Table 1. Summary of Previous Domestic and International Studies

Authors	Research Background
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Moeini et al. (2018)	The analysis found that land scarcity and cyclical supply negatively impact housing prices in Iranian metropolises (2000–2015). In contrast, monetary expansion and market expectations significantly drive up housing prices in major cities.
Khani et al. (2021)	The findings indicated that gold prices are influenced by both global factors (such as world ounce price and USD value) and domestic factors like liquidity and monetary policy. Liquidity control and inflation management were recognized as crucial stabilizing factors in the gold market.
Aboutorabi et al. (2021)	This study uses a Markov-Switching model to analyze inflation regimes and their interaction with financial development in Iran (1982–2017). Findings show that bank financial access reduces inflation, while inflation undermines financial stability but supports some domestic financial depth aspects.
Mohajeri & Taleblou (2022)	Results indicated that basic metals and investment industries play a central role in volatility spillovers in the Tehran Stock Exchange, with changes in these sectors amplifying fluctuations in other groups.
Ahmadi et al. (2022)	Findings revealed that the effect of inflation on industrial stock indices is not constant over time, varying across inflationary conditions (high vs. low inflation).
Wang & Lee (2022)	Using the TVP-VAR model, it was shown that gold acts as a safe haven against exchange rate risk in certain periods; however, this role is neither stable nor permanent and depends on prevailing economic and political conditions.
Cieslak & Pflueger (2023)	This study highlights the difference between “good” inflation caused by demand shocks and “bad” inflation resulting from supply shocks. It explores how each type of inflation affects asset pricing in financial markets. The findings reveal that demand-driven inflation supports stock performance, while supply-driven inflation lowers equity and bond values.
Younis et al. (2023)	Results demonstrated that during crisis periods (e.g., the global financial crisis), correlations among oil, gold, and global stock markets significantly increase; gold and oil play crucial roles in portfolio diversification and risk mitigation.
Mohammadi & Hosseini (2024)	Findings showed that monetary policy shocks (such as interest rate or liquidity changes) significantly contribute to the formation and amplification of stock price bubbles, with varying intensities across periods.
Attarzadeh et al. (2024)	Analysis of correlations among digital assets, gold, energy, and stocks showed that relationships among these assets are dynamic and time-varying, implying that portfolio management requires flexibility and adaptive strategies.
Almeida et al. (2024)	Using the FCVAR model, results indicated that housing and stocks serve as stronger hedges against inflation in certain periods, while gold’s protective role is not constant and depends on economic conditions.

Xie & Cao (2024)	Findings revealed asymmetric risk transmission between cryptocurrency and financial markets in China; the impact of cryptocurrencies on financial markets was stronger than the reverse, though it declined over time.
Esmailpour & Sharif Bagheri (2025)	Results indicated that in Iranian asset portfolios, gold and the stock index hold the highest optimal weights, though optimal weights in commodity markets vary over time.

Source: Research findings

3. The Study Model

In this study, to analyze the nonlinear impact of inflation on asset markets (including stock, coin, gold, and housing) in the Iranian economy from March 2011 to February 2025, an empirical approach based on the Time-Varying Parameter Vector Autoregression (TVP-VAR) model is employed. This approach is derived from the research of Antonakakis et al. (2020). This method facilitates the examination of dynamic relationships and temporal changes between variables, making it suitable for volatile economies such as Iran, which is influenced by structural shocks like sanctions and currency fluctuations (Pourhosseini et al., 2022). For analyzing these dynamic relationships, the TVP-VAR model is used, offering a significant distinction from classical models. While the classical VAR model assumes parameter stability over time and cannot reflect repeated structural changes in the Iranian economy (such as the 2018 currency shocks), and the SVAR model, despite imposing structural constraints, lacks the necessary flexibility for analyzing temporal dynamics, the TVP-VAR model, through Bayesian estimation using the Markov Chain Monte Carlo (MCMC) method and the Diebold & Yilmaz (2014) framework, allows for the analysis of continuous parameter changes. Additionally, in contrast to the Threshold VAR (TVAR) model, which limits changes to discrete thresholds, the TVP-VAR model comprehensively covers nonlinear and time-varying dynamics in inflation spillovers to asset markets. This model can retain all observations without losing data, as in TVP-VAR, parameters are dynamically updated based on past information. Furthermore, this model shows reduced sensitivity to outlier observations, enhancing stability and the accuracy of estimates in the presence of outliers and extreme fluctuations. These features are key advantages of the TVP-VAR model over traditional models, enabling a more precise and flexible analysis of the relationships between economic variables (Zheng et al., 2023).

Time series data were monthly extracted from reliable statistical sources (such as the Central Bank of Iran, Statistical Center of Iran, the Tehran Stock Exchange, and gold and coin associations). Data processing included statistical tests and model estimation using RStudio software. In the first step, the TVP-VAR model is estimated to obtain time-varying variance-covariance matrices. Next, data processing involves conducting the augmented Dickey-Fuller test to check for stationarity of variables, logarithmic transformation for price variables, and estimation of the model via Bayesian methods using the MCMC technique. The Bayesian Time-Varying Parameter Vector Autoregressive (TVP-VAR)

model was estimated using Markov Chain Monte Carlo (MCMC) sampling within the RStudio environment. Four parallel chains were executed, each consisting of 40,000 iterations, with the first 10,000 iterations discarded as burn-in. Applying a thinning factor of 5, approximately 24,000 posterior draws were retained for inference. The priors were specified as Minnesota priors ($\lambda_1=0.2, \lambda_2=0.5, \lambda_3=1$) for the VAR coefficients and Inverse-Wishart priors for the innovation covariance matrix, while state variances were assigned weakly informative Inverse-Gamma priors. Convergence of the chains was confirmed using the Gelman–Rubin statistic ($R^{\wedge} \leq 1.01$), Effective Sample Size ($ESS > 1000$), and the Geweke diagnostic ($|Z| < 1.96$); the Raftery–Lewis diagnostic also indicated that the chain length was sufficient. Generalized Forecast Error Variance Decomposition (GFEVD) results reveal that the Total Connectedness Index (TCI) increased from 0.11 at the one-month horizon to 0.18 at the twelve-month horizon. The TVP-VAR model, which considers parameters and error variances as time-varying, examines nonlinear relationships through time-varying impulse response analysis and variance decomposition (Antonakakis et al., 2020). This approach represents the primary innovation of the research compared to traditional VAR models.

The Diebold & Yilmaz (2014) connectedness framework, widely adopted for identifying and evaluating spillover effects, is also utilized. This model quantifies both the magnitude and direction of risk spillovers, but its standard rolling-window implementation is insufficient for capturing the time-varying nature of risk transmission. To address this limitation, several extensions have been proposed—one of which involves the optimization of window size using mean squared forecast errors in rolling VAR models (Antonakakis et al., 2020). This approach enhances the tracking and interpretation of the dynamic evolution of risk spillovers.

Accordingly, this research adopts the methodology of Antonakakis et al. (2020). Specifically, we employ a Time-Varying Parameter Vector Autoregressive (TVP-VAR) model combined with an augmented joint connectedness framework to investigate the effects of inflation on asset markets—namely stocks, coin, gold, and housing—in the Iranian economy. In general, the TVP-VAR model is specified as follows, adapted to the specific endogenous variables of this study: inflation (Inf_t), stock market index ($Stock_t$), coin price ($Coin_t$), gold price ($Gold_t$) and housing price ($House_t$). Given that the lag order of 2 was selected based on the Hannan–Quinn Information Criterion (HQIC), the model incorporates two time-varying coefficient matrices ($\beta_{1,t}$) and ($\beta_{2,t}$) allowing for dynamic relationships that capture structural changes in Iran's economy, such as inflationary shocks and exchange rate fluctuations.

The TVP-VAR framework can be mathematically represented as:

$$Y_t = \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \varepsilon_t, \quad \varepsilon_t \sim N(0, S_t) \quad (1)$$

$$vec(\beta_t) = vec(\beta_{t-1}) + u_t, \quad u_t \sim N(0, R_t) \quad (2)$$

Also, the equation matrix is as follows:

$$Y_t = \begin{pmatrix} \pi_t \\ S_t \\ C_t \\ G_t \\ H_t \end{pmatrix}, \quad \beta_t = \begin{pmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \\ \beta_5 \end{pmatrix}$$

where π_t is monthly inflation, $S_t = \Delta \ln(\text{Stock}_t)$, $C_t = \Delta^{\text{dc}} \ln(\text{Coin}_t)$, $G_t = \Delta^{\text{dg}} \ln(\text{Gold}_t)$ and $H_t = \Delta \ln(\text{Housing}_t)$. The differencing orders d_c and d_g are determined by unit-root tests; for this study, coin and gold required second differences.

In these equations, Y_t , Y_{t-1} and Y_{t-2} given the selected lag order of 2 are 5×1 vectors comprising the endogenous variables. The matrices $(\beta_{1,t})$ and $(\beta_{2,t})$ are 5×5 time-varying coefficient matrices, while Σ_t is the 5×5 time-varying variance-covariance matrix for the disturbances ε_t . Additionally, This model allows all parameters—including the coefficients in $\beta_{1,t}$ and $\beta_{2,t}$ as well as cross-series correlations—to vary over time. Furthermore, the variance-covariance matrix Σ_t and the variance-covariance matrices for the parameter-evolution processes are assumed to be time-varying, which permits the capture of nonlinear dynamics in Iran's economy, including heightened sensitivities during inflationary crises.

Based on the presented theoretical framework, the TVP-VAR model is subsequently analyzed to examine the dynamic behavior of forecast errors. For this purpose, the Generalized Forecast Error Variance Decomposition (GFEVD), first introduced by Koop et al. (1996) and extended by Pesaran & Shin (1998), is employed. This approach overcomes the limitations of orthogonalized forecast error variance decomposition, enabling the measurement of the contribution of shocks from each variable without imposing a specific identification scheme (Diebold & Yilmaz, 2014). Moreover, this method facilitates temporal analysis and provides a dynamic perspective on the interconnections among economic variables and their impact on financial markets, serving as an efficient tool to understand interactions in markets characterized by severe volatility and structural changes.

The TVP-VAR representation can be expressed as:

$$Y_H = \sum_{i=1}^T \beta_{it} Y_{t-i} + \varepsilon_t = \sum_{j=0}^{\infty} A_{i,t} \varepsilon_{t+H-j} \quad (3)$$

In this framework, the $gSOTij,t$ index represents the effect of a shock originating from variable j on variable i , defined as:

$$\varphi_{ij,t}^g(H) = \frac{E(Y_{i,t}^2(H)) - E[Y_{i,t}(H) - E(Y_{i,t}(H))]^2}{E(Y_{i,t}^2(H))} = \frac{\sum_{t=1}^{T-1} (e_i' A_{i,t} \Sigma_t e_j)^2}{(e_j' \Sigma_t e_j) \sum_{t=1}^{T-1} (e_i' A_{i,t} \Sigma_t A_{i,t}' e_j)} \quad (4)$$

$$gSOTij,t = \frac{\varphi_{ij,t}^g}{\sum_{j=1}^N \varphi_{ij,t}^g} \quad (5)$$

Here, e_j is 5×1 vector with all elements equal to zero except for the j -th element, which is equal to one. The parameter $\varphi_{ij,t}^g$ indicates the relative reduction

in the H-step-ahead forecast error variance of variable i due to shocks in variable j , and the sum of these values yields the final $gSOT_{ij,t}$.

Using GFEVD, the total directional connectedness index proposed by Diebold & Yilmaz (2014) can be derived and calculated as follows:

$$F_{ij,t}(H) = \sum_{j=1, i \neq j}^5 gSOT_{ij,t}(H) \quad (6)$$

$$F_{ji,t}(H) = \sum_{j=1, i \neq j}^5 gSOT_{ji,t}(H) \quad (7)$$

$$NET_t = F_{ij,t}(H) - F_{ji,t}(H) \quad (8)$$

$$TCL_t = \frac{1}{5} \sum_{i=1}^5 F_{ij,t}(H) = \frac{1}{5} \sum_{i=1}^5 F_{ji,t}(H) \quad (9)$$

$$TOT_t = \varphi_{ij,t}^g(H) - \varphi_{ji,t}^g(H) \quad (10)$$

In other words $\varphi_{ij,t}^g(H)$ represents the effect of a shock in variable j has on variable i over a forecast horizon H . Equation (6) indicates the degree to which shocks originating from variable i are transmitted to other variables, referred to as the direct connectedness of variable i with the rest of the system. Conversely, equation (7) measures the direct impact of other variables on variable i , i.e., the extent to which variable i absorbs shocks and fluctuations from the system. Equation (8) represents the difference between these two effects, defined as the net connectedness of variable i . This index shows whether the variable (e.g., inflation) acts as a net transmitter of shocks to the asset markets (when $NET_t > 0$) or as a net receiver (when $NET_t < 0$).

Another important measure, derived from equation (9), is the Total Connectedness Level (TCL_t), which reflects the average impact of each variable on all others. A relatively high value indicates strong interconnections among variables and thus a high degree of market risk interdependence, whereas a low value reflects weak linkages and transmission between variables. Finally, equation (10) measures the bilateral relationship between variables i and j , representing the difference between the effect of variable i on variable j and the reverse. The sign and magnitude of this difference indicate which variable plays the dominant and more influential role.

3.1. Data and Descriptive Statistics

In this study, the dataset comprises 168 monthly observations spanning from March 2011 to February 2025 for the variables of inflation, stock market index, coin price (Bahar-Azadi), gold price (18-carat), and average housing prices in Tehran province. The data were collected from reputable sources, including the Central Bank of Iran, the Statistical Center of Iran, and the Securities and Exchange Organization, and subsequently processed for analysis. The correlation matrix presented below illustrates the relationships among the study variables.

Table 2. Correlation Matrix of Study Variables

	Inflation	Stock	Housing	Coin	Gold
Inflation	1	0.082	0.215	0.314	0.278
Stock	0.082	1	0.112	0.098	0.105
Housing	0.215	0.112	1	0.452	0.398
Coin	0.314	0.098	0.452	1	0.912
Gold	0.278	0.105	0.398	0.912	1

Source: Research findings

The results indicate that inflation exhibits a positive correlation with coin prices (0.314) and gold prices (0.278), reflecting the role of these assets as safe havens and instruments for preserving purchasing power. This effect is particularly pronounced in the Iranian economic context, characterized by significant inflationary fluctuations. Conversely, the correlations of inflation with the stock market index (0.082) and housing prices (0.215) are relatively weaker, which may reflect the more complex influence of economic policies, market-specific risks, and investor expectations on these markets. Furthermore, the very high correlation between coin and gold prices (0.912) underscores the strong interdependence of these two markets, which is reasonable given that both are intrinsically linked to the value of gold. Housing prices are moderately correlated with coin and gold prices (0.452 and 0.398, respectively), suggesting that inflation impacts construction costs and investment demand in the real estate sector. In contrast, the stock market index shows weak correlations with other variables (approximately 0.1), indicating that the stock market's behavior is less directly tied to physical asset markets and more influenced by macroeconomic factors and investor expectations.

In this part, to examine the nonlinear effects of inflation on asset markets, the stock, coin, gold, and housing variables were logarithmically transformed, and non-stationary variables were differenced to achieve stationarity, making them suitable for statistical analysis using the TVP-VAR model. The descriptive statistics, including mean, median, variance, skewness, standard deviation, kurtosis, and p-values from the Augmented Dickey-Fuller (ADF) test, are presented in Table 3 to evaluate the distribution and stationarity of the variables.

Table 3. Descriptive Statistics of Study Variables

Variable	Mean	Median	Variance	Skewness	Std. Dev.	Kurtosis	p-value
Inflation	0.003	0.0021	0.014	-0.455	0.341	3.507	0.01
Stock	0.028	0.0198	0.013	-0.755	0.124	4.562	0.01
Housing	0.024	0.0148	0.001	-0.421	0.032	3.156	0.02
Coin	0.002	0.0004	0.001	-1.272	0.041	4.234	0.01
Gold	0.003	0.0015	0.006	0.393	0.08	5.891	0.01

Source: Research findings

The descriptive statistics indicate that the average monthly inflation rate from March 2011-February 2025 was 0.3%, with a median of 0.2%. The negative

skewness(-0.455) and moderate kurtosis(3.507) suggest that inflation was generally positive, but occasionally experienced sharp spikes. The housing market exhibited a lower volatility compared to other markets, with an average monthly return of 0.2% and a standard deviation of 0.032. Its negative skewness(-0.421) and moderate kurtosis(3.156) imply that price declines were limited, and its growth followed a gradual and stable trend. In contrast, the stock market showed a higher average monthly return of 2.8%, but the negative skewness (-0.755) and high kurtosis (4.562) indicate the presence of severe declines and abnormal returns during certain periods. Significant differences are also observed in the coin and gold markets. The coin market, with a mean monthly return of 0.2% and a standard deviation of 0.041, was the most volatile among the examined variables. Its high negative skewness (-1.272) and high kurtosis (4.234) reflect its sensitivity to exchange rate shocks and policy decisions. Conversely, the gold market exhibited a more stable behavior, with an average monthly return of 0.3%, positive skewness(0.393), and high kurtosis(5.891), largely following an upward trend. These findings underscore that asset markets do not respond uniformly to inflationary shocks. The coin market is riskier than other asset markets, and the transmission of inflationary shocks occurs more rapidly in this market, whereas housing and gold exhibit smoother and more stable dynamics. Moreover, the p-values for all variables are below 0.05, leading to the rejection of the null hypothesis of a unit root and confirming the stationarity of the series.

The line chart below illustrates the processed economic variable fluctuations—namely inflation, stock market, coin, gold, and housing—over the

period 2011–2025. The chart presents the standardized volatility of each variable over time.

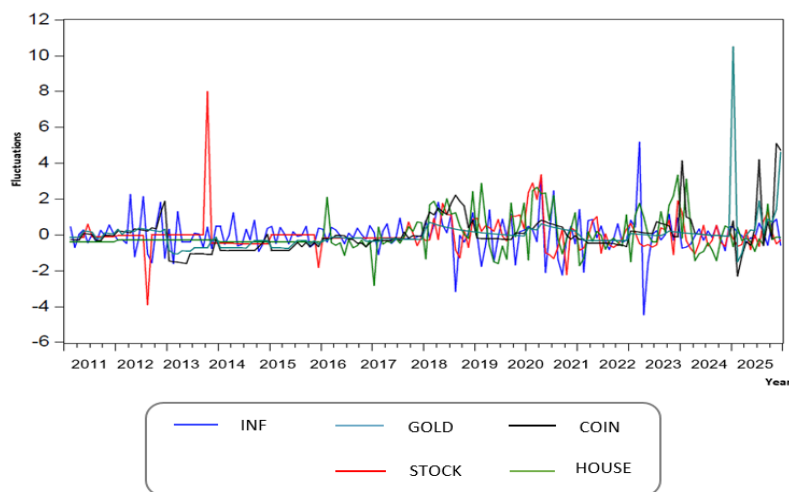


Figure1. Economic Variable Volatility (Inflation, Stock Market, Coin, Gold, House) from 2011 to 2025

Source: Research findings

An examination of Figure1 over the study period indicates that the intensity of volatility across asset markets and the inflation rate has not followed a homogeneous pattern. According to the chart, the stock market and coin market experienced the highest levels of volatility, with significant spikes occurring at certain intervals. This phenomenon was particularly pronounced during the early years of the 2010 and around 2021–2023, coinciding with exchange rate shocks, economic sanctions, and policy instability, which rendered these markets highly risky and volatile. In contrast, the housing market exhibited relatively greater stability, with changes mostly gradual and moderate, reflecting the long-term and lower-risk nature of real estate investments compared to other markets. Additionally, the volatility patterns of inflation and gold indicate that although these variables experienced lower fluctuations than the stock and coin markets, they still demonstrated notable spikes during crisis periods. Specifically, during 2018–2019 and 2022–2023, when Iran's economy faced heightened inflation expectations and severe currency fluctuations, the intensity of changes in these two variables increased significantly.

Overall, the chart suggests that variable volatility rose substantially during economic crises (e.g., 2012 and 2025), with positive peaks (high points) generally exceeding negative troughs. This behavior aligns with events such as exchange rate shocks, international sanctions, and expansionary monetary policies in Iran, including increased money supply, which intensified inflationary pressures and

heightened volatility in asset markets such as coin and gold, commonly regarded as investment safe havens. However, while the stock market and housing experienced relatively lower volatility, they were still affected by shocks during inflationary periods (e.g., 2013).

3.2. Spillover Estimation and Interpretation of Empirical Results

In this section, the effects of inflation on various markets and the transmission of inflationary shocks to asset markets are examined and analyzed. Since the study of the complex and dynamic relationships between economic variables requires precise analysis and appropriate visualizations, the Time-varying Impulse Response to inflation is presented initially. The purpose of this chart is to analyze the responses of different markets, including those for coins, gold, housing, and stocks, to inflationary shocks over time. Specifically, the chart illustrates how the impacts of inflation on these markets evolve over time in response to various inflationary shocks.

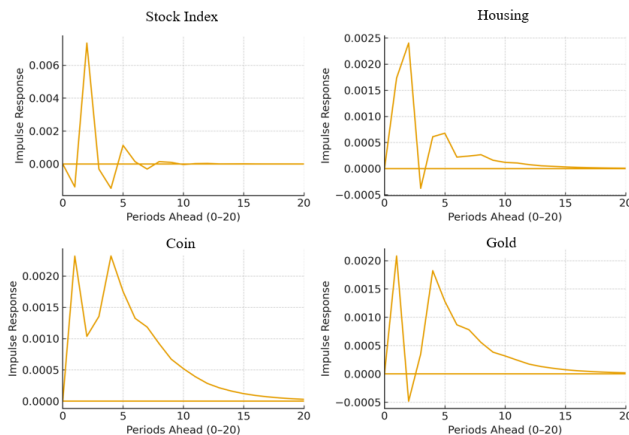


Figure 2. Time-varying Impulse Response to inflation

Source: Research findings

The figure presents the time-varying impulse response to an inflationary shock for four markets—stock index, housing, coin, and gold—over a 20 period horizon. The patterns reveal pronounced heterogeneity across markets. In the stock market, there is a short-lived positive reaction in the very early periods (peaking around period 2) that quickly dissipates and converges toward values close to zero. This behavior is consistent with rapid asset price setting and the swift adjustment of investors' expectations in equity markets. By contrast, the housing market exhibits a weaker and slower response: mild fluctuations appear at the beginning of the horizon and fade more quickly than in other assets, indicating high price stickiness and a gradual adjustment of the price structure in this market. On the other hand, the coin market displays a larger and more

persistent response to the inflation shock, following a hump-shaped profile—reaching a peak within the first few periods and then declining gradually. This pattern underscores the dominant role of speculative and safe-haven channels in shaping the coin market's reaction to inflationary disturbances. The gold market shows a broadly similar trajectory, with the exception of a brief initial negative oscillation, followed by a positive and relatively persistent response that tapers off over time. This behavior is indicative of portfolio reallocation and the role of gold as an inflation hedge over medium horizons. Comparing the four panels indicates that both the amplitude and persistence of responses differ substantially across markets: reactions in the coin and gold markets are stronger and more enduring than those in stocks and housing, whereas the stock market returns to equilibrium more rapidly and the housing market reacts with lower volatility and a slower pace of adjustment.

This section is devoted to examining the estimated spillovers between the inflation variable and asset markets, including the stock market, gold coin, gold, and housing, as well as the interconnections among macroeconomic variables in the Iranian economy, using the Time-Varying Parameter Vector Autoregression (TVP-VAR) model. In the first step, the results of average connectedness or spillovers are presented to identify the role of variables as net shock transmitters (e.g., inflation) and net shock receivers in asset markets. Subsequently, by focusing on the dynamics of connectedness over time, structural changes and potential events that may affect the position and role of each variable are analyzed. Moreover, examining pairwise connectedness allows the identification of patterns of mutual influence among variables and the evolution of these relationships. Time horizons of 1, 3, 6, and 12 months have been employed to analyze variance spillovers, as reported in Table 4. Selecting these horizons enables the assessment of variables' responses to inflationary shocks over the short term (1 month), medium term (3 and 6 months), and long term (12 months). This division has been made considering the length of the time series (168 months) and in line with major economic shocks in Iran, including economic sanctions and exchange rate surges, following the framework proposed by [Antonakakis et al. \(2020\)](#).

To verify the stationarity of the variables, the Augmented Dickey–Fuller (ADF) test was applied. According to the output, inflation, the stock index, and housing became stationary after first differencing, whereas the coin and gold series required second differencing. Next, standard information criteria were computed to select the lag order. The Bayesian Information Criterion (BIC) selects a lag length of 1, whereas the Akaike Information Criterion (AIC) and the Final Prediction Error (FPE)—which typically favor more parameterized specifications—suggest a lag length of 5. Finally, the Hannan–Quinn Information Criterion (HQIC) indicates a lag length of 2. Given the sample size ($n = 168$), a lag order of 2 is adopted as the appropriate specification for the present study.

Table 4. Variance Decomposition and Dynamic Connectedness of Inflation Spillovers to Asset Markets

Variable	Inflation	Gold	Coin	Housing	Stock	To Others	From Others	Total
1								
Inflation	0.93	0.009	0.009	0.02	0.03	0.07	0.07	0.19
Stock	0.03	0.004	0.002	0.04	0.91	0.08	0.09	0.18
Housing	0.01	0.008	0.036	0.84	0.06	0.11	0.07	0.23
Coin	0.02	0.097	0.877	0.003	0.0006	0.12	0.28	0.40
Gold	0.01	0.744	0.237	0.003	0.0007	0.25	0.11	0.37
3								
Inflation	0.91	0.009	0.009	0.04	0.03	0.09	0.11	0.25
Stock	0.04	0.004	0.003	0.04	0.9	0.09	0.13	0.22
Housing	0.03	0.012	0.08	0.7	0.09	0.23	0.12	0.40
Coin	0.03	0.1	0.8	0.03	0.007	0.17	0.42	0.59
Gold	0.01	0.64	0.3	0.01	0.001	0.31	0.12	0.48
6								
Inflation	0.91	0.009	0.009	0.04	0.03	0.09	0.14	0.27
Stock	0.02	0.004	0.003	0.04	0.9	0.06	0.16	0.26
Housing	0.06	0.02	0.114	0.69	0.09	0.3	0.19	0.50
Coin	0.04	0.12	0.728	0.07	0.026	0.27	0.43	0.72
Gold	0.02	0.63	0.32	0.03	0.009	0.38	0.16	0.54
12								
Inflation	0.90	0.009	0.009	0.04	0.03	0.12	0.16	0.27
Stock	0.03	0.004	0.003	0.04	0.9	0.07	0.18	0.27
Housing	0.07	0.024	0.118	0.68	0.1	0.31	0.21	0.52
Coin	0.04	0.123	0.708	0.08	0.03	0.29	0.45	0.74
Gold	0.02	0.6	0.32	0.03	0.01	0.39	0.16	0.55

Source: Research findings

The results of the above table indicate that inflation remains a net transmitter of shocks across all horizons. Specifically, the own-variance share of inflation declines modestly from 0.93 at the one-month horizon to 0.90 at twelve months, while the outgoing spillover rises from 0.07 to 0.12 and the incoming spillover increases from 0.07 to 0.16. Consequently, inflation's total connectedness grows from 0.19 to 0.27. The principal channels through which inflationary spillovers propagate are the coin and housing markets: inflation's contribution to the variance of coin increases from 0.02 to 0.04, and to housing from 0.01 to 0.07 as the horizon lengthens.

In parallel, the bilateral linkage between the coin and gold markets strengthens meaningfully over longer horizons: the share of gold explained by coin rises from 0.237 to 0.32, while the share of coin explained by gold increases from 0.097 to 0.123. Accordingly, both coin and gold evolve into spillover hubs, with their total connectedness rising from (0.40 $\rightarrow$ 0.74) and (0.37 $\rightarrow$ 0.55), respectively. By contrast, the housing market—although self-dominated in the short run (own share 0.84 at one month)—exhibits a pronounced increase in network integration as the horizon extends: incoming spillovers grow from 0.07 to 0.21, and total connectedness from 0.23 to 0.52. The rising contributions from inflation(0.01 $\rightarrow$ 0.07) and coin(0.036 $\rightarrow$ 0.118) to housing variance underscore

the gradual transmission of price shocks to this market over longer horizons. The stock market remains largely driven by idiosyncratic factors (own share ≈ 0.90 at all horizons). Even so, its incoming spillovers increase from 0.09 to 0.18, and total connectedness from 0.18 to 0.27, while inflation's share in explaining stock volatility stays small and relatively stable (≈ 0.02 – 0.03). Taken together, these findings point to a gradual intensification of systemic connectedness as the forecast horizon lengthens and highlight the importance of monitoring and managing inflation-driven spillovers, particularly through the coin and gold markets. Meanwhile, housing's response is slower but steadily increasing, and the stock market remains comparatively more insulated over the period under review.

Figure 3 illustrates the Dynamic Total Connectedness Index (TCI) of volatilities based on the TVP-VAR model for inflation, stock index, coin, gold, and housing variables in the Iranian economy over the period March 2011 to February 2025. The index is calculated using the average variance spillovers derived from the Generalized Forecast Error Variance Decomposition (GFEVD) and was estimated through RStudio software. The Total Connectedness Index (TCI) represents the overall degree of market interdependence over time; thus, an increase in its value indicates intensified volatility spillovers across markets.

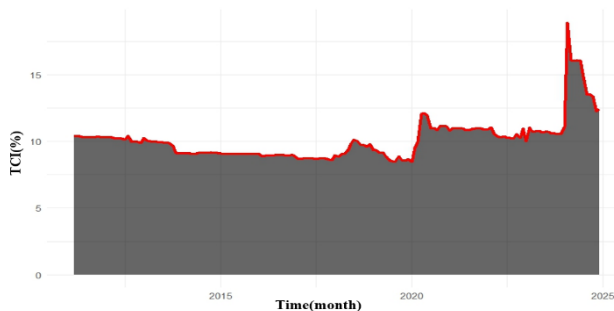


Figure 3. Dynamic Total Connectedness Index of Volatilities

Source: Research findings

The TCI exhibits an upward trend throughout the sample period. This increase is particularly evident during critical phases of Iran's economy, such as 2018 (the exchange rate shock following the U.S. withdrawal from the JCPOA) and 2022–2023, marked by surging inflation driven by exchange rate volatility and fiscal imbalances. According to the results, the TCI rose from around 10% in the early period (2011–2016) to over 15% in the later years (2023–2025). This rising trend suggests a tightening interconnection between asset markets and inflation, consistent with the findings of Table 4, which confirm the driving role of inflation in transmitting volatility spillovers to markets such as coin and gold.

Moreover, the results indicate that structural shocks in Iran's economy and the adoption of expansionary monetary policies have strengthened the role of coin and gold markets as investment safe havens, thereby amplifying the

connectedness among markets. In contrast, the relative decline in the TCI during periods of economic stability—such as 2016–2017 (following the JCPOA agreement)—reflects reduced volatility spillovers across markets. Overall, the findings reveal that long-term inflation volatility reinforces inter-market linkages, emphasizing the need for dynamic policy frameworks to manage systemic risks arising from inflation-induced fluctuations in asset markets.

4. Conclusion and Recommendations

This study focused on the nonlinear analysis of the impact of inflation on asset markets (stocks, coin, gold, and housing) in the Iranian economy over the period March 2011–February 2025, utilizing an empirical approach based on the Time-Varying Parameter Vector Autoregression (TVP-VAR) model. The results from the descriptive statistics table reveal the average monthly changes in inflation and asset returns, with negative skewness observed for most variables, including stocks, coin, and housing, indicating asymmetric distributions and a tendency toward negative shifts during crisis periods. The excess kurtosis greater than 3 across all variables further confirms the likelihood of extreme shocks in the data. The correlation matrix (Table 1) demonstrates strong associations between coin and gold, and between inflation and coin, highlighting the role of these markets as safe-haven assets. These findings align with those of [Khani et al. \(2021\)](#) and [Wang et al. \(2022\)](#). Additionally, based on the results of the study, the effects of inflation shocks on the housing market exhibit a gradual nature, with these effects intensifying over the long term. This is consistent with [Almeida et al. \(2024\)](#), who found that price shocks in the housing sector typically appear with a delay and have a more persistent effect over the long horizon.

The Augmented Dickey-Fuller test results, with a p-value less than 0.05 for all variables, confirm the stationarity of the series after logarithmic transformation and differencing. The findings from the variance decomposition and dynamic connectedness tables show an increase in inflation spillover from 0.07 over a 1-month horizon to 0.12 over a 12-month horizon, accompanied by a rise in the total connectedness index from 0.19 to 0.27. These dynamics, emphasizing the role of inflation as a net transmitter of shocks (0.12 at the 12-month horizon), reinforce its growing impact on the coin (total connectedness rising from 0.40 to 0.74) and gold (from 0.37 to 0.55) markets in the long term, which is in line with the studies of [Ahmadi et al. \(2022\)](#) and [Motameni et al. \(2019\)](#). The standardized volatility plot (Figure 1) also demonstrates intensified volatility in stocks and coin during critical periods (2018–2019 and 2022–2023), corresponding with major exchange rate and inflationary shocks. These findings align with the main objective of the research, which examines the nonlinear and dynamic relationships between inflation and asset markets, and seeks to address the empirical gap in previous studies that largely overlooked time-varying dynamics. Moreover, the innovation of this study lies in the application of the TVP-VAR model to analyze these relationships, enabling the identification of structural changes and showing that

inflation not only intensifies market volatility but also increases the interconnectedness between markets under unstable economic conditions.

A key innovation of this study lies in its application of the TVP-VAR framework, which enables the identification of structural changes over time. The findings indicate that inflation not only amplifies market volatilities but also strengthens inter-market connectedness, particularly under unstable economic conditions. Based on these results, which demonstrate increasing inflation spillovers into asset markets, several policy recommendations are proposed:

1. For policymakers, it is essential to focus on regulatory instruments such as transaction taxes on coin and enhanced stock market supervision, aimed at mitigating inflation spillovers.
2. Implementing contractionary monetary policies (e.g., liquidity control) can help limit total connectedness and maintain the housing market as a buffer against short-term shocks.
3. Regarding the gold market as a traditional safe-haven asset, it is recommended to develop supportive programs promoting investment diversification within this market to reduce systemic risks.

Based on the findings and scope of the current study, the following suggestions are made for future research:

1. Incorporating Additional Variables: Future research could extend the model by including additional variables such as the exchange rate or liquidity growth. This would provide a more comprehensive understanding of cross-market interactions and allow for a better assessment of the dynamic relationships between inflation and various asset markets, especially in response to external economic shocks.
2. Utilizing Longer Forecast Horizons: To enhance the precision of long-term business cycle analysis, employing longer forecast horizons could be beneficial. This would allow for a deeper exploration of the sustained effects of inflationary shocks on asset markets over extended periods and contribute to more robust long-term policy recommendations.
3. Segmenting the Sample Period: A promising avenue for future research is the segmentation of the sample period, for example, into pre- and post-JCPOA (nuclear agreement) phases. Analyzing these distinct phases within the TVP-VAR framework could provide valuable insights into how different economic conditions, such as sanctions and policy shifts, influence the dynamics of inflation and asset markets, thereby enriching the study's innovative contribution and offering more targeted and effective policy recommendations.

4.1. Research Limitations

The limitations of this study include the focus on a specific time period (2011–2025) and the exclusion of certain external factors such as global commodity prices and geopolitical events, which could further influence asset

markets in Iran. Finally, the research primarily focuses on the Iranian economy and its domestic factors, limiting the ability to generalize the findings to other emerging markets or developed economies. Additionally, the study relies on monthly data, which may not fully capture the immediate market reactions to short-term shocks, suggesting the potential benefit of using higher-frequency data in future research.

Author Contributions

At all stages of writing the article, including the literature review, methodology, validation, results analysis, preparation of the original draft, review, and editing, all authors have read and approved the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

Data Availability Statement

The time series data were collected on a monthly basis from reliable statistical sources and databases, including the Central Bank of Iran, the Statistical Center of Iran, the Tehran Stock Exchange, and the Gold and Coin Unions.

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Appendices

Table 1. Output of stationarity testing and model fitting

Variabl e	Dickey_Full er	p_valu e	KPSS stat	KPS S p	Decision	LjungBo x p(12)	Norma l 5%
inflatio n	-9.317354	0.01	0.07593 5	0.1	Stationary (ADF<0.0 5 & KPSS>0.0 5)	0.26	YES
stock	-9.317354	0.01	0.08676 7	0.1	Stationary (ADF<0.0 5 & KPSS>0.0 5)	0.99	YES
housin g	-3.721946	0.02	0.39761 8	0.06	Stationary (ADF<0.0 5 & KPSS>0.0 5)	0.08	YES
coin	-6.709425	0.01	0.13877 3	0.08	Stationary (ADF<0.0 5 & KPSS>0.0 5)	0.17	YES
gold	-5.790023	0.01	0.36902 7	0.06	Stationary (ADF<0.0 5 & KPSS>0.0 5)	0.09	YES

Source: Research findings