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Original Research Article

The Effect of Exchange Rate and Financial Sanctions on the Return of the Tehran Stock Exchange Index

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This study examines the dynamic effects of exchange rate fluctuations and financial sanctions on the returns of the Tehran Stock Exchange (TSE) Index over the period March 2011 to March 2023. Employing a Time-Varying Parameter Vector Autoregression (TVP-VAR) model, the model captures the evolving and asymmetric interactions between exchange rate growth, sanction intensity—proxied by changes in Iran's oil revenues—and stock market performance. The findings reveal that exchange rate shocks generally stimulate short-term increases in TSE returns but may reverse under heightened uncertainty, while intensified sanctions exert predominantly negative impacts, particularly during the EU oil sanctions period (2012–2015) sanctions and the post-2018 U.S. withdrawal from the JCPOA. Impulse response analysis shows that neither exchange rate nor sanctions shocks converge to long-term equilibrium, indicating structural vulnerabilities and limited market depth within the Iranian financial system. These results contribute to the literature on financial markets in sanction-prone, oil-dependent economies and provide evidence-based insights for policymakers and investors aiming to enhance market stability and resilience.

Keywords: Exchange Rate, Financial Sanctions, Tehran Stock Exchange Index, TVP-VAR Model, Iran's Economy.
JEL Classification*:* G01, F31, F51

1 Introduction

Two primary frameworks explain the potential relationship between exchange rates and stock market indices: the traditional theory and the portfolio approach. According to the traditional theory, a depreciation of the national

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currency can boost exports, which may, in turn, drive up stock prices. Branson (1983) elaborates on the portfolio approach, which posits that rising stock indices signal attractive domestic investment opportunities, prompting investors to increase their holdings of local assets. This increased demand strengthens the national currency, creating a negative correlation between stock prices and exchange rates. Branson (1983) further introduced the "stock-centric" exchange rate model, suggesting that exchange rates adjust to balance supply and demand for financial assets such as stocks (Bagh et al., 2017).

Similarly, Frankel (1992) and Branson (1983) argue that strong stock market performance strengthens a country's currency by attracting capital inflows, while Dornbusch and Fischer (1980) emphasize the opposite channel—exchange rates affect international competitiveness, trade balances, and GDP growth, thereby influencing future cash flows and the intrinsic values of domestic firms. These perspectives underscore the bidirectional and context-dependent nature of the exchange rate–stock market relationship, necessitating empirical investigation.

Previous studies also highlight other macroeconomic factors influencing stock markets. Booth et al. (1997) and Chan (2003) pointed to variables such as foreign exchange reserves, exchange rates, and money supply. Bernard and Thomas (1990) and Mukherjee & Naka (1995) examined the role of inflation, interest rates, and government securities in shaping the interplay between exchange rates and broader economic variables. Because exchange rates and stock indices are critical to economic stability and investor decision-making, they serve as important indicators for forecasting future price movements (Kim, 2003). Exchange rate fluctuations affect the performance of firms engaged in international trade—whether importers or exporters (Bagh et al., 2017)—and, like stock indices, exchange rates are subject to persistent volatility. Kurihara (2006) further demonstrated that factors such as exchange rates, interest rates, GDP, employment, and central bank policies significantly influence stock market movements.

The exchange rate is thus a key determinant of financial markets, especially stock markets. Fluctuations in currency values can directly affect company profitability, the prices of goods and services, and overall stock index levels—an issue particularly critical for developing economies reliant on imports and exports. Understanding the combined effects of exchange rate volatility and financial sanctions on the Tehran Stock Exchange Index offers valuable insight into the interaction between foreign exchange and capital markets.

In Iran, exchange rate fluctuations and economic sanctions are two major forces shaping financial and goods markets. Sanctions, which are commonly

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used as economic policy tools to exert political pressure, can weaken sanctioned economies over time (Heydarian et al., 2024). A key consequence of financial sanctions is heightened exchange rate volatility, which can depreciate the national currency and drive inflation. In recent years, both sanctions and exchange rate instability have significantly affected the overall Tehran Stock Exchange index (Heydarian et al., 2025).

In capital markets, increased exchange rate fluctuations erode investor confidence, reduce investor incentives, and create uncertainty and volatile stock returns (Keshtgar et al., 2019; Keshtgar et al., 2020a). Exchange rates in Iran have experienced pronounced instability, and in developing economies with underdeveloped financial markets, such volatility can increase the likelihood of financial crises. Because risk management tools are insufficient to fully offset exchange rate risk, banking stability is particularly vulnerable. Furthermore, the lack of robust financial instruments in these economies amplifies their exposure to external shocks (Pahlavani et al., 2023; Keshtgar et al., 2020b).

Stock market fluctuations also have profound macroeconomic consequences. A substantial decline in stock prices can precipitate broader economic collapse (Adjasi et al, 2008). As Zafar et al. (2008) note, volatility reflects the tendency of stock indices to fluctuate over time. Against this backdrop, the present study focuses on the effects of two critical financial variables—exchange rate movements and financial sanctions—on returns in the Tehran Stock Exchange.

This paper offers two main contributions. First, it investigates how variations in exchange rates and sanctions influence stock market index returns. Second, it employs the TVP-VAR framework to assess the dynamic causal relationship between foreign exchange and stock markets under sanction conditions.

The study addresses the following research questions:

What is the relationship between exchange rate fluctuations and Tehran Stock Exchange returns, and how does it affect the Iranian stock index?

What is the impact of financial sanctions on Tehran Stock Exchange returns?

The remainder of this study is structured as follows: Section 2 presents the theoretical background; Section 3 reviews the empirical literature; Section 4 describes the model estimation using the TVP-VAR approach; Section 5 reports the empirical findings; and Section 6 concludes the paper.

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2 Theoretical Background

2.1 Theoretical literature

The literature on exchange rates and the stock market indices is grounded in several theoretical frameworks. Based on flow and portfolio theories, exchange rates and stock indices are closely related. The flow theory states that exchange rate fluctuations have a direct impact on the stock market. In contrast, the portfolio theory suggests that an increase in the value of the stock index can lead to an increase in the demand for the national currency, thus raising its value. Additionally, the significance of exchange rate fluctuations on stock indices under financial sanction conditions has also been discussed. Numerous studies have examined the interaction between exchange rates and stock market indices. Some studies have shown a one-way relationship between these two variables (Bagh et al., 2017).

Ajayi and Mougoue (1996) found a significant relationship in eight industrial economies during the period from 1985 to 1991. More specifically, they revealed a short-term negative and long-term positive impact of rising domestic stock prices on the value of the national currency, as the depreciation of the currency in the short term adversely impacts the stock market.

Mookerjee and Yu (1997) examined the relationship between exchange rates and stock indices in the financial markets of Hong Kong, Tokyo, and Singapore from January 3, 1983, to June 15, 1994. Using Granger causality tests, his results Indicated that stock price movements lead to exchange rate changes in the Tokyo and Hong Kong markets. When he examined the reverse causality from stock prices to exchange rates, his results indicated such causality in the Tokyo market.

Therefore, for the Tokyo market, there is a bidirectional causality between these financial variables. To find a stable long-term relationship between these financial variables in the aforementioned Asian markets, he employed the Vector Autoregressive (VAR) model.

Similarly, Granger et al (2000) focused on the causality between exchange rates and stock prices. For this purpose, he used Granger causality and impulse response function methods. He selected the financial markets of nine Asian countries, including Indonesia, Singapore, Hong Kong, the Philippines, Malaysia, South Korea, Japan, Thailand, and Taiwan. He used daily data for the period from January 3, 1986, to November 14, 1997. He concluded that exchange rates lead to stock prices with a positive correlation in Japan and Thailand. Results from Taiwan indicated that stock prices are led by exchange rates with a negative correlation. The Singapore market indicated no

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relationship between the financial variables, while bidirectional causality was found for the other countries.

An increase in the exchange rate may increase the cost of importing raw materials and equipment, which can lead to a reduction in corporate profitability. On the other hand, a decrease in the exchange rate can enhance the competitiveness of exports and increase company revenues (Mohagheghnia et al., 2022).

The theoretical foundations for explaining the relationship between exchange rate fluctuations and the overall stock index include the following:

Exchange Rate Effects on Corporate Profitability: Exchange rate fluctuations can have a direct impact on the profitability of companies operating in international markets. On the other hand, an increase in the exchange rate can raise the costs of imports, which may lead to a decrease in company profitability.

Exchange Rate Effects on Stock Prices: Exchange rates can have a direct effect on stock prices. For instance, an increase in the exchange rate can reduce the stock prices of companies that rely heavily on imports for their revenues.

Macroeconomic Transmission Channel: Exchange rate fluctuations can trigger macroeconomic changes, which can, in turn, influence the overall stock index. These economic developments can have a significant impact on the stock market index.

Financial Risk Channel: Exchange rate fluctuations can increase financial risks for investors. These risks can lead to a decrease in investor confidence and a reduction in stock prices.

Studies conducted on Iran have shown that exchange rate fluctuations constitute one of the most important determinants of the Tehran Stock Exchange's overall index. For example, a study conducted by Seifollahi and Seifollahi found that exchange rate fluctuations have the most significant effect on the Tehran Stock Exchange’s overall index (Seifollahi & Seifollahi, 2021).

Building on the theories, the model proposed by Malliaropulos (1998), focusing on both long-term and short-term components of stock prices and real exchange rates across economies, introduced a different understanding of the relationship. This model suggests that the appreciation of the domestic currency against the US dollar is accompanied by stronger performance in the domestic stock market compared to its US counterpart, offering a new perspective that helps explain stock market return changes in various economic contexts.

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The empirical literature on exchange rates and stock markets employs a wide range of methodological approaches and reports mixed findings. This effect may generally be classified into two main groups based on analytical techniques.

The first group primarily uses Granger causality tests and cointegration to examine the dynamics between these financial indices. Researchers such as Ülkü and Demirci (2012), Kollias et al. (2012), Moore and Wang (2014), Chkili and Nguyen (2014), Fowowe (2015), Sui and Sun (2016), and Yang (2017) have investigated the causal links and long-term relationships between stock prices and exchange rates.

The second group includes nonlinear models that address the relationship between exchange rates and the stock market, identifying nonlinear features that may be missed by traditional analyses. Innovative approaches, such as wavelet analysis by Afshan et al. (2018) and quantile regression by Yang et al. (2014), have been particularly informative, revealing aspects that conventional models tend to overlook. These studies highlight the time-varying and nonlinear nature of interactions between these financial markets and show that standard linear models do not fully capture their dynamics.

The empirical studies that are based on the asset market equilibrium theory demonstrate that the relationship between exchange rates and stock returns significantly depends on the nature of market disturbances. Recent research on the effects of global crises, such as the COVID-19 pandemic and geopolitical tensions like the war in Ukraine, has emphasized the context-dependent nature of this relationship (Kumeka et al., 2022; Kumar, 2024; Sokhanvar and Bouri, 2023).

Recent studies provide valuable evidence that help explain how stock market indices and exchange rates interact during economic fluctuations. For instance, Kumar et al. (2021) analyzed the nonlinear relationships between commodities and financial markets in India. Using an asymmetric nonlinear ARDL model, they highlighted the asymmetric effects and the significant impact of commodities such as gold on the stock market and exchange rates.

Finally, Chkir et al. (2020) employed a copula-based approach to investigate the nonlinear relationships between oil prices, stock markets, and exchange rates.

2.2 Relation Between Theoretical Background and Research Method

The theoretical background of this study rests on the flow-oriented approach, the portfolio-balance approach, and the asset market equilibrium framework.

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Flow theory suggests that exchange rate fluctuations influence trade balances and firms' revenues, directly affecting stock prices. Portfolio theory posits that changes in stock market returns can alter demand for domestic and foreign assets, influencing capital flows and exchange rates. Asset market equilibrium theory extends these ideas by emphasizing that the relationship between exchange rates and stock markets is context-dependent, especially during structural shocks like financial sanctions or oil revenue volatility. However, these relationships are not static. Their strength and direction vary over time due to structural breaks (e.g., sanctions), macroeconomic cycles, and shifts in investor expectations. Traditional econometric models with fixed coefficients (such as VAR, ARDL, and standard GARCH models) cannot fully capture these evolving dynamics.

The Time-Varying Parameter Vector Autoregression (TVP-VAR) model directly operationalizes this theoretical insight. By allowing coefficients to change over time, TVP-VAR can trace how the interaction between exchange rates, sanctions, and stock returns adapts to different economic regimes—such as periods of intensified sanctions, easing periods, or oil price shocks. This flexibility aligns perfectly with the theoretical expectation that the exchange rate–stock market link is sensitive to external shocks and structural changes in an oil-dependent, sanction-prone economy.

Moreover, TVP-VAR's impulse response functions reveal how shocks propagate across variables at specific points in time, rather than assuming a single, time-invariant relationship. This approach provides a dynamic, empirical test of the theoretical arguments, demonstrating not only that exchange rates and stock markets are connected, but also that the nature of this connection evolves with changing economic structures and policy environments. Accordingly, the TVP-VAR framework is particularly suitable for the present study, as it accommodates time-varying and potentially asymmetric relationships among exchange rates, sanctions, and stock market returns.

3 Empirical Literature Review

Mohagheghnia et al. (2022) Examined the effect of exchange rate fluctuations on the performance of companies listed on the Tehran Stock Exchange using the GARCH model. Additionally, to measure the lags in the impact of exchange rate fluctuations on company performance, they used the Autoregressive Distributed Lag (ARDL) model. The results indicated that exchange rate fluctuations have a significant impact on company performance, and this effect varies across industries in terms of intensity and direction of

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the relationship. These effects also manifest with different time lags in different industries.

Seifollahi and Seifollahi (2021) examined the mechanism of exchange rate fluctuations, oil prices, and economic growth on the overall index of the Tehran Stock Exchange from 2009 to 2020 using monthly data. They used the Conditional Heteroskedasticity Autoregressive (ARCH) method. Then, the model was estimated using the Generalized Method of Moments (GMM). The results suggested that the Tehran Stock Exchange's overall index is significantly affected by exchange rate fluctuations, crude oil prices, and economic growth. Among these, the previous period's overall index and the exchange rate had the most significant impact on the overall stock index.

Azarbayjani et al. (2018) investigated the asymmetric effects of exchange rates on the Tehran Stock Exchange price index using the NARDL approach over the period from 2001 to 2017 based on quarterly data. The results indicated that a decrease in the exchange rate has a positive and significant effect on the stock price index in both the short and long term, while an increase in the exchange rate does not have a significant effect on the stock market in either period. Therefore, the exchange rate has an asymmetric effect on the stock price index.

Barkhordari et al. (2017) examined the impact of exchange rate fluctuations and their spillover effects on the stock indices of selected industries on the Tehran Stock Exchange using daily data from 2008 to 2013 and the VAR-BEKK model. The results showed that, based on the ARCH and GARCH coefficients estimated in this study, exchange rate fluctuations have a positive and significant impact on the stock indices of selected industries (such as automobiles, coal, and machinery) on the Tehran Stock Exchange. These findings suggest that exchange rate fluctuations contributed positively to stock index performance in the selected industries.

Hosseini et al. (2016) analyzed the impact of exchange rate fluctuations on the financial performance indicators of banks listed on the Tehran Stock Exchange using ARIMA, ARCH, and PANEL-VAR methods over the period from 2006 to 2015. The results indicated that exchange rate fluctuations have a significant negative effect on short-term and long-term bank deposits, a positive and significant effect on non-performing loans, and a significant but divergent and negative effect on net profit and assets of banks.

El-Diftar (2023) examined the impact of exchange rates on stock market performance in emerging markets using daily exchange rate data and stock market returns across seven emerging economies (E7) from January 1, 2019, to January 1, 2022. The study employed Ordinary Least Squares (OLS),

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Autoregressive Distributed Lag Error Correction Regression, and Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models. The findings supported the presence of a long-term cointegration relationship between the exchange rate and stock market returns in all countries except Indonesia, which showed a significant negative relationship. The GARCH (1,1) results further revealed that incorporating the exchange rate in the model slightly altered stock market return volatility.

Perera (2016) explored the effects of exchange rate volatility on stock market return volatility from an emerging market using daily time-series data for the All Share Price Index (ASPI) of the Colombo Stock Exchange (CSE) and exchange rate data for the period from January 2010 to December 2015. The study employed a GARCH model to identify the impact of exchange rate volatility on stock market return volatility. The results indicated that the volatility of the Euro exchange rate has a positive and significant effect on the volatility of ASPI returns, while the volatility of the U.S. dollar and British pound had a negative and insignificant effect. Overall, the study concluded that exchange rate volatility is a key factor affecting stock market return volatility.

Mechri et al. (2019) investigated the impact of exchange rate volatility on stock market returns. The study incorporated additional determinants of stock market indices and extended the sample period to fifteen years. Using the GARCH model, their results indicated that exchange rate volatility has a significant impact on stock market volatility.

Hashmi et al. (2022) explored the interactions between oil prices, exchange rates, and stock market returns in Pakistan using quarterly data from January 2000 to December 2019 and employed the Multivariate ARDL model. The study highlighted the short- and long-term relationships among these variables under different market conditions (bullish, bearish, and normal market conditions). The findings revealed that the impact of oil prices and exchange rates on stock prices varies in different market conditions.

Seshaiah and Behera (2009) examined the relationship between stock prices, crude oil prices, and exchange rates using daily data for the BSE Sensex stock index, crude oil prices, and exchange rates from January 1991 to December 2007. They employed Engel-Granger cointegration tests, VECM, and variance decomposition tests to examine the long-term relationships between the variables. The results indicated a long-term equilibrium relationship between stock prices, crude oil prices, and exchange rates. They also found that stock prices were affected by oil prices and exchange rates with lags of up to 50 days, while stock prices were influenced by exchange

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rates with a lag of 25 days. Furthermore, their study indicated that the average real return during periods of currency depreciation was lower than during periods of currency appreciation.

Mollick & Sakaki (2019) examined the relationship between exchange rates, oil prices, and global stock returns, focusing on 14 major currency pairs against the U.S. dollar from January 1999 to July 2017. This period included the global financial crisis and fluctuations in oil prices. The results suggested that currencies sharply appreciated following positive oil price shocks, while they depreciated in response to positive global stock market shocks. GARCH models provided similar results, with coefficients typically larger for global stock returns than for oil returns.

Khazaei et al. (2025) represent the most recent study to examine the impact of informal exchange-rate fluctuations on stock market returns using a TVP-VAR approach. However, an important gap remains: their analysis did not independently incorporate financial sanctions or model the combined effect of sanctions and exchange-rate movements on the stock market.

Additionally, several important distinctions remain with Mohagheghnia et al. (2022), which our study addresses. First, financial sanctions are incorporated as an independent (exogenous) variable, which was not modeled in Mohagheghnia et al. (2022). Second, the TVP-VAR framework is employed, which allows the impact coefficients and uncertainties to vary over time—particularly across different sanction periods or exchange rate shocks—whereas Mohagheghnia et al. (2022) used methods such as ARDL and GARCH that assess lags but assume stable coefficients over time. Third, the dataset covers a more recent period and includes sanction episodes and exchange rate shocks after 2019, whereas Mohagheghnia et al. (2022) limited their analysis to earlier periods. These distinctions demonstrate that our study addresses an important gap in the existing literature and provides more comprehensive and policy-relevant evidence for Iran's current economic conditions.

Our study addresses this gap by explicitly including the financial sanctions variable and jointly analyzing exchange-rate and sanctions shocks. In terms of results, our findings indicate that, unlike pure exchange-rate shocks—which in some industries even have positive effects—financial sanctions shocks exert broader and more persistent negative impacts on overall stock market returns. Thus, the contribution of this paper lies both in adding the financial sanctions dimension and in offering distinct policy implications.

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4 Methodology

A method that has gained more attention in economic literature is the Vector Autoregression (VAR) model with time-varying coefficients (TVP-VAR). The difference between this model and the fixed coefficient VAR models is that it allows model parameters to evolve over time, providing flexibility in adjusting coefficients according to changes in conditions, structural breaks, and cyclical changes. As a result, it may provide more reliable estimates and forecasts (Koop et al., 1996).

The initial model by Sims (1980) analyzed the relationship between economic variables using impulse-response functions. In this model, the vector of variables y_t is estimated based on its lags, and can be expressed as the following equation:

$$y_t = c_t + \sum_{j=1}^{L} A_j y_{t-j} + e_t \quad (1)$$

where e is the error term with zero mean and variance-covariance matrix Ω_e, c_t is the vector of predetermined variables, and A is the matrix of coefficients considering the lags of the variables. The above model is a linear model where the predicted values of y depend on a number of variable lags and are assumed to be constant over time. However, various studies have shown that higher-order moments vary over time, starting with the introduction of ARCH models by Engle (1982).

If time variation is introduced into the coefficient matrices of Equation (1), the conventional VAR model can be extended into a Time-Varying Parameter VAR (TVP-VAR) specification. The following equation represents this standard model. Equation (2) presents the conventional VAR model, whereas Equation (4) represents its time-varying extension:

$$y_t = c_t + \sum_{j=1}^{L} A_{j,t} y_{t-j} + e_t \quad (2)$$

The matrix of lagged explanatory variables can be defined as the Kronecker product:

$$\acute{X}_t = I \otimes (1, \acute{y}_{t-1}, \dots, \acute{y}_{t-L}) \quad (3)$$

Additionally, the vector of time-varying coefficients can be defined as:

$$\theta_t \equiv vec(\left[c_t \; A_{1t} \; A_{2t} \; \dots \; A_{Lt}\acute{}\right]) \quad (4)$$

With these explanations, equation (2) can be rewritten as:

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$$y_t = \acute{X}_t \theta_t + e_t \quad (5)$$

Assuming θ_t follows a random walk, the following equation can be written:

$$\theta_t = \theta_{t-1} + u_t \quad (6)$$

Where u_t has a normal distribution with zero mean and constant variance, independent of e_t . It is assumed that the variance-covariance matrix can be decomposed as follows:

$$\Omega_e = \Lambda^{-1} \sum \sum (\acute{\Lambda}^{-1}\acute{)} \quad (7)$$

where Λ is a lower triangular matrix with ones on the diagonal, and Sigma Σ is a diagonal matrix. It can be shown that the parameters derived from Ω_e will vary over time (Hatami and Alavi-Rad, 2024).

The error term in the TVP-VAR model presented in equation (2) can be decomposed as follows:

$$e_t = \Lambda^{-1} \Sigma_t \epsilon_t \quad (8)$$

where the matrix ϵ_t can be normalized as a unit matrix, and it is assumed that the error terms in all equations of the model are independent. Estimation of TVP-VAR models is done using the Bayesian estimation based on Markov Chain Monte Carlo (MCMC) simulation techniques. Using this algorithm, we can evaluate the joint posterior distribution for the parameters.

5 Empirical Results and Model Estimation

Before estimating the model, it is necessary to define and describe the variables used in the analysis. (Table 1)

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Table 1
The Model Variables

Variables	Symbol	Operational Definition	Data Source
Tehran Stock Exchange Index Return	TSE_t	Growth rate of Tehran Stock Exchange Index (%)	Central Bank, Tehran Stock Exchange
Exchange Rate Growth	EX_t	Percentage change in the unofficial market for dollar exchange rate (to make the exchange rate variable, which was I(1), stationary)	Central Bank
Financial Sanctions	SAN_t	Oil Revenue Growth Used as a Proxy for Financial Sanctions	Central Bank

Source: Research Findings

In this study, following Pahlavani et al. (2021), to estimate the financial sanctions variable, we employ the index of Iran's oil revenues (revenues from the sale of oil and petroleum products in billions of rials). Lower oil revenues are assumed to reflect periods of more severe financial sanctions, whereas higher oil revenues indicate periods of reduced sanction intensity and improved access to international oil markets. The study period is monthly, from March 2011 to March 2024.

Figure 1 presents the evolution of oil revenues, which are employed as a proxy for financial sanctions.

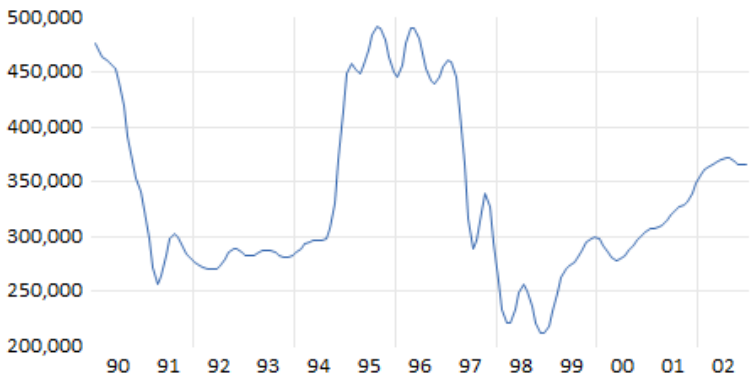

Figure 1. Monthly Oil Revenue from 2011 to 2024– in billion rials
Source: Research Findings

Figure 1 illustrates the oil revenue of Iran from 2011 to 2023, which is used as a proxy for the financial sanctions variable. The figure reflects the

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intensification of financial sanctions between 2012 and 2015 (EU oil sanctions), Oil revenues increased between 2016 and 2018 following the implementation of the Joint Comprehensive Plan of Action (JCPOA). Following the withdrawal of the United States from the JCPOA in May 2018, oil revenues again decreased to a level lower than the previous sanction period, with the peak of these sanctions occurring at the end of 2019. From the middle of 2020, oil revenue growth and a reduction in sanction pressures are also visible.

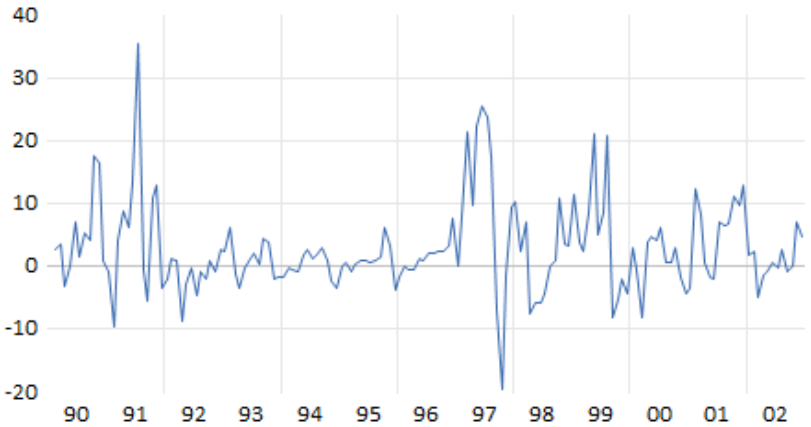

Figure 2. Monthly Growth Rate of the US Dollar in Iran's Unofficial Market from 2011 to 2023
Source: Research Findings

Figure 2 presents the monthly growth rate of the U.S. dollar exchange rate in Iran’s unofficial market over the period 2011–2023. The largest exchange-rate increases were observed in October 2012, September 2018, and August 2020, which were mainly associated with the sanction periods of 2012 and after the U.S. withdrawal from the JCPOA. The largest negative growth rate was recorded in January 2019, when the exchange rate declined by approximately 19.5 percent.

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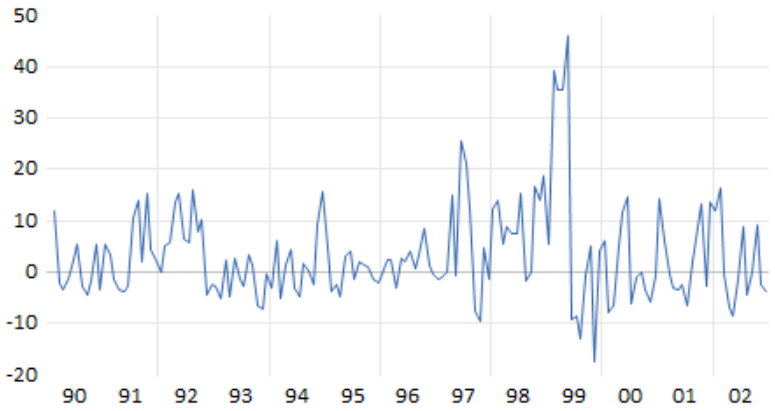

Figure 3. Monthly Return of Tehran Stock Exchange Index from 2011 to 2023
Source: Research Findings

Figure 3 illustrates the return of the Tehran Stock Exchange Index from 2011 to 2023. The highest monthly return was recorded in August 2020, after which the stock index experienced a sharp decline until January 2021.

5.1 Descriptive Statistics and Stationarity

The descriptive statistics for the variables are presented in Table 2.

Table 2
Descriptive Statistics of the Variables

	TSE_t	SAN_t	EX_t
Mean	3.31	-0.09	2.79
Median	1.34	0.28	1.21
Maximum	46.15	12.34	35.37
Minimum	-17.57	-13.46	-19.5
Standard Deviation	9.30	3.92	7.16
Skewness	1.61	0.38	1.27
Kurtosis	7.36	5.28	6.59
Number of Observations	155	155	155

Source: Research Findings

Next, we examine the stationarity of the seasonal variables. (Table 3)

HEGY Seasonal Unit Root Test

Given that the variables in this study are monthly time series, the HEGY (Hylleberg, Engle, Granger, Yoo) seasonal unit root test needs to be applied.

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This test can separately identify both seasonal and non-seasonal unit roots at different frequencies. In the HEGY test, the null hypothesis of a unit root at frequency zero (non-seasonal unit root) and at frequency two (semiannual unit root) is tested using the *t*-statistic, while the null hypothesis of a unit root at frequency four (seasonal unit root) is tested using the *F*-statistic. For each of these frequencies, if the absolute value of the test statistic exceeds the critical value, the null hypothesis of a unit root is rejected, indicating stationarity (Ebrahimi et al., 2019).

Table 3
Stationarity of Variables Using the Hegy Test for Quarterly Data

Variable	Frequency 0 (Long-term)	Frequency 2 (Semiannual)	Frequency 4 (Seasonal)
Tehran Stock Exchange Total Return (TSE)	–2.21	8.51	12.82
Exchange Rate Growth (EX)	–2.56	14.30	16.09
Financial Sanctions (SAN)	–3.48	16.21	8.55
Critical Value (5%)	–1.91	8.34	8.34

Source: Research Findings

The results of the HEGY seasonal unit root test indicate that none of the model's variables contain a unit root in the long term. In other words, they do not exhibit a unit root at frequency zero (long-term) and are stationary. The findings further show that none of the variables have a unit root at frequency two (semiannual). Based on the *F*-statistic for the seasonal unit root test at the quarterly frequency, it can also be concluded that none of the variables contain a seasonal unit root. Therefore, the model can be estimated without concern for spurious regression.

6 Model Estimation Results

First, the optimal lag length was determined using the Akaike and Schwarz criteria. Since the lowest values of these criteria were obtained with three lags, an optimal lag length of three was selected for model estimation.

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Table 4
Determination of the Optimal Lag Length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1474.148	NA	63022.58	19.56488	19.62483	19.58923
1	-1360.977	220.3470	15859.62	18.18513	18.42491	18.28254
2	-1266.991	179.2588	5146.367	17.05948	17.47910	17.22995
3	-1210.606	105.3009*	2748.525*	16.43187*	17.03133*	16.67540*
4	-1203.696	12.62950	2827.664	16.45956	17.23885	16.77615

Source: Research Findings

6.1 Time-varying Parameter Analysis

6.1.1 Impact of Financial Sanctions on Stock Market Returns

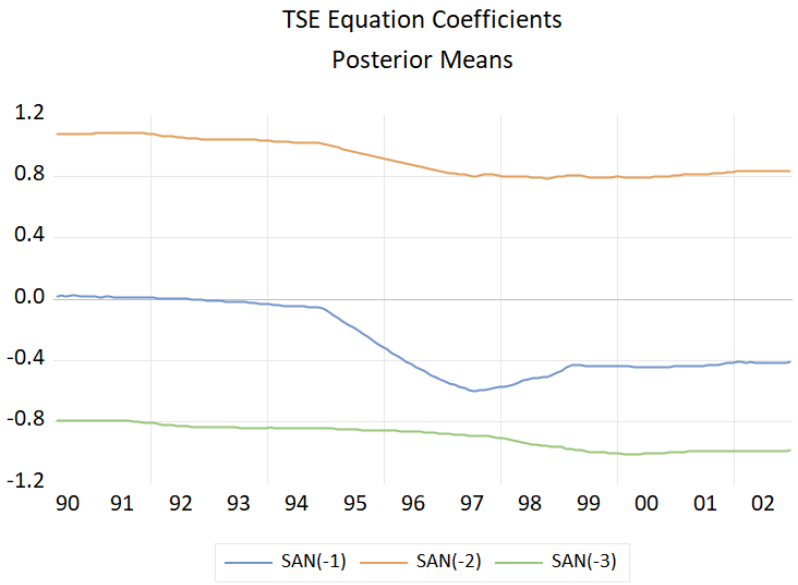

Figure 4. Time-varying Coefficients of Financial Sanctions on the Tehran Stock Exchange Returns from 2011 to 2023
Source: Research Findings

[DOI: 10.66224/jme.21.1.5]

In Figure 4, the time-varying coefficients of financial sanctions on Tehran Stock Exchange returns are analyzed. The coefficient of financial sanctions with one lag suggests that the stock market return was positively impacted by sanctions in the previous period until November 2013. However, in other periods, the effect was negative, meaning that until November 2013, stock market returns were either slightly increased or unaffected by intensifying financial sanctions in the previous period, while in other periods, returns decreased. The most significant impact of sanctions on the Tehran Stock Exchange return was in October 2018, when intensifying sanctions led to a sharp decline in stock market returns.

The Tehran Stock Exchange Index consistently showed positive effects from sanctions in the two previous periods and negative effects from sanctions in the three previous periods.

6.1.2 Impact of Exchange Rate on Stock Market Returns

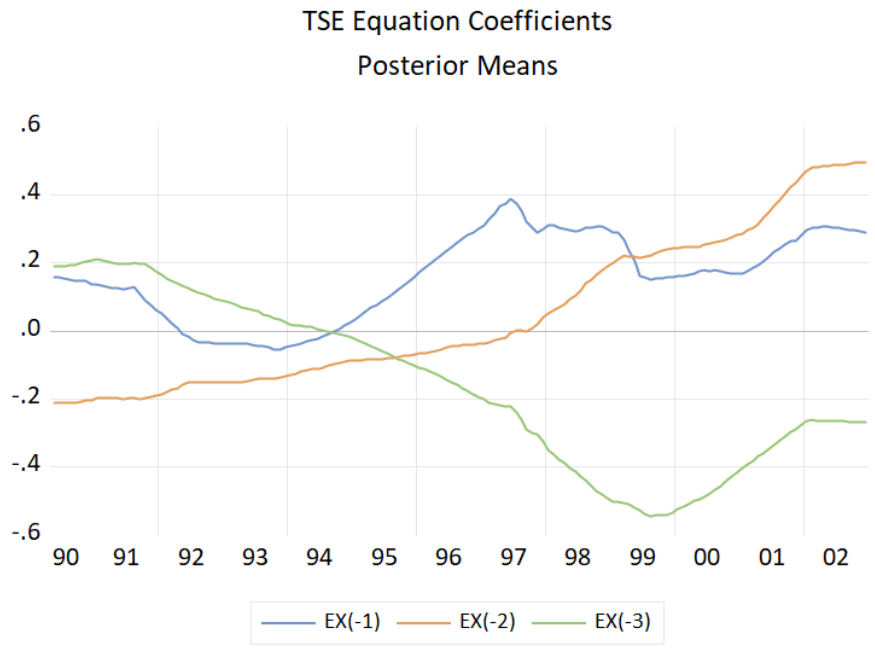

Figure 5. Time-varying Coefficients of Exchange Rate Growth on the Tehran Stock Exchange Returns from 2011 to 2023
Source: Research Findings

[DOI: 10.66224/jme.21.1.5]

In Figure 5, the time-varying coefficients of exchange rate growth on Tehran Stock Exchange returns are illustrated. An increase in exchange rate growth in the previous period led to a decline in stock market returns only during the period from August 2013 to December 2015. In other periods, it caused an increase in stock market returns. The greatest increase in stock market returns due to exchange rate growth in the previous period occurred in September 2018, while the greatest decrease in stock market returns was in January 2015.

Until September 2018, the Tehran Stock Exchange Index declined in response to exchange rate growth in the two previous periods, after which it started to increase. The three-period lag coefficients remained positive until December 2015 and became negative in subsequent periods. The greatest decline in the Tehran Stock Exchange Index due to an increase in exchange rates over three periods occurred in December 2020. As illustrated in Chart 2, August 2020 was part of the period with the highest exchange rate growth during the study period.

Overall, the results indicate that the effects of financial sanctions and exchange-rate fluctuations on Tehran Stock Exchange returns are time-varying and asymmetric, thereby supporting the use of the TVP-VAR framework.

6.2 Impulse Response Functions (IRF)

In the TVP-VAR model, the impulse response functions (IRFs) are also time-varying. Therefore, the IRFs must be examined at different time points to see how the responses to shocks change over time. Thus, we examined IRFs at four specific time points. The first date corresponds to the start of the European Union's oil sanctions in July 2012. The second date corresponds to the U.S. withdrawal from the JCPOA and resuming sanctions against Iran in May 2018. The third date corresponds to the severe decline in the Tehran Stock Exchange Index in August 2020. The fourth date corresponds to February 2021, when the new U.S. administration took office and the intensity of the sanctions was reduced.

[DOI: 10.66224/jme.21.1.5]

6.2.1 Impulse Response Functions in July 2012

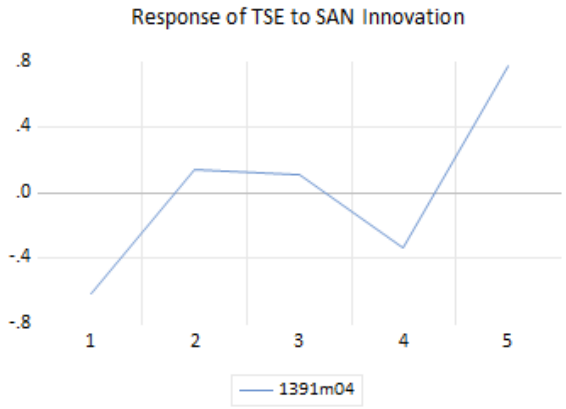

Figure 6. Impulse Response Function of the Tehran Stock Exchange Returns to a Financial Sanctions Shock in July 2012
Source: Research Findings

By imposing a one-standard-deviation shock on the financial sanctions variable in July 2012, the return of the Tehran Stock Exchange initially decreases in the same period, then rises for two periods, and then decreases again in the following two periods. Afterward, the return increases but does not tend toward its long-term equilibrium.

[DOI: 10.66224/jme.21.1.5]

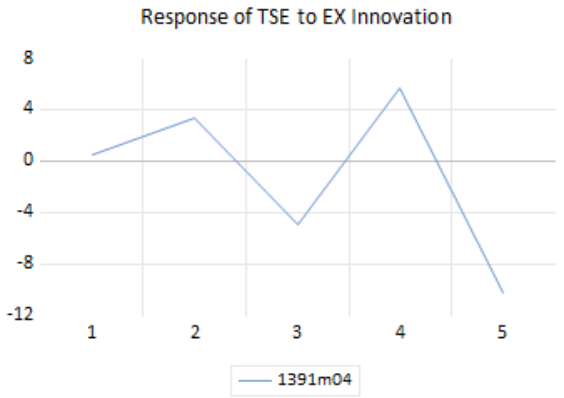

Figure 7. Impulse Response Function of the Tehran Stock Exchange Returns to an Exchange Rate Growth Shock in July 2012
Source: Research Findings

By imposing a one-standard-deviation shock on the exchange rate growth variable in July 2012, the return of the Tehran Stock Exchange initially increases slightly, continues to rise for the second period, then decreases for one period, and increases again before finally decreasing and not approaching its long-term equilibrium.

6.2.2 Impulse Response Functions in May 2018

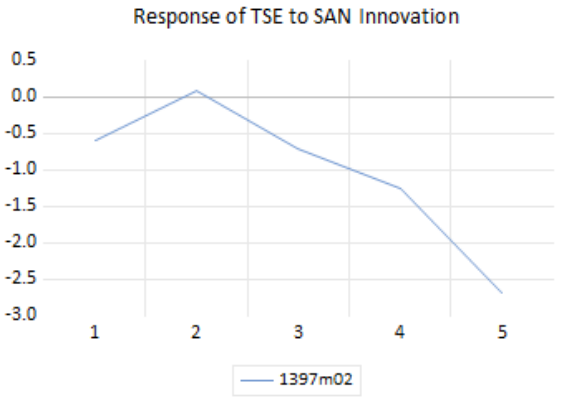

Figure 8. Impulse Response Function of the Tehran Stock Exchange Returns to a Financial Sanctions Shock in May 2018

[DOI: 10.66224/jme.21.1.5]

Source: Research Findings

By applying a one-standard-deviation shock to the financial sanctions variable in May 2018, the return of the Tehran Stock Exchange decreases in the same period, increases in the following period, and then continues to decrease, never tending toward its long-term equilibrium.

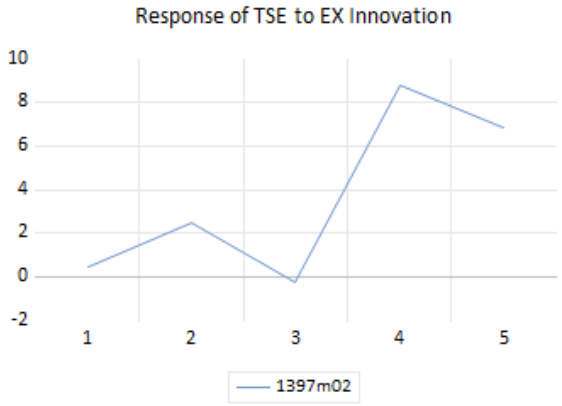

Figure 9. Impulse Response Function of the Tehran Stock Exchange Returns to an Exchange Rate Growth Shock in May 2018
Source: Research Findings

By imposing a one-standard-deviation shock to the exchange rate growth variable in May 2018, the return of the Tehran Stock Exchange increases slightly in the same period, continues to rise in the next period, then decreases for one period, increases again, and finally decreases, but does not tend toward its long-term equilibrium.

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6.2.3 Impulse Response Functions in August 2020

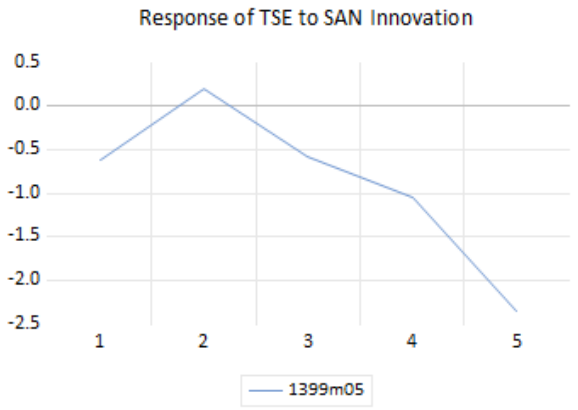

Figure 10. Impulse Response Function of the Tehran Stock Exchange Returns to a Financial Sanctions Shock in August 2020
Source: Research Findings

By applying a one-standard-deviation shock to the financial sanctions variable in August 2020, the return of the Tehran Stock Exchange decreases in the same period, increases for one period, then decreases again, and does not approach its long-term equilibrium.

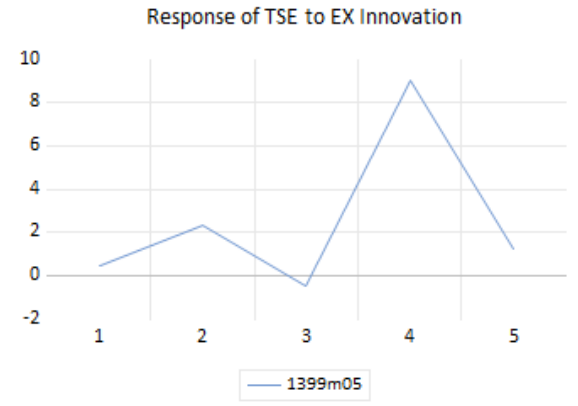

Figure 11. Impulse Response Function of the Tehran Stock Exchange Returns to an Exchange Rate Growth Shock in August 2020

[DOI: 10.66224/jme.21.1.5]

Source: Research Findings

By applying a one-standard-deviation shock to the exchange rate growth variable in August 2020, the return of the Tehran Stock Exchange increases slightly in the same period, continues to increase for the next period, then decreases for one period, increases again, and ultimately decreases, without approaching its long-term equilibrium.

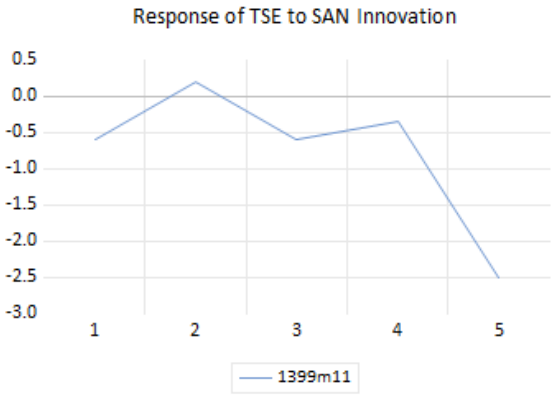

Figure 12. Impulse Response Function of Tehran Stock Exchange Returns to a Financial Sanctions Shock in February 2021
Source: Research Findings

By applying a one-standard-deviation shock to the financial sanctions variable in February 2021, the return of the Tehran Stock Exchange decreases in the same period, increases for one period, then decreases again, and does not approach its long-term equilibrium.

[DOI: 10.66224/jme.21.1.5]

6.2.4 Impulse Response Functions in February 2021

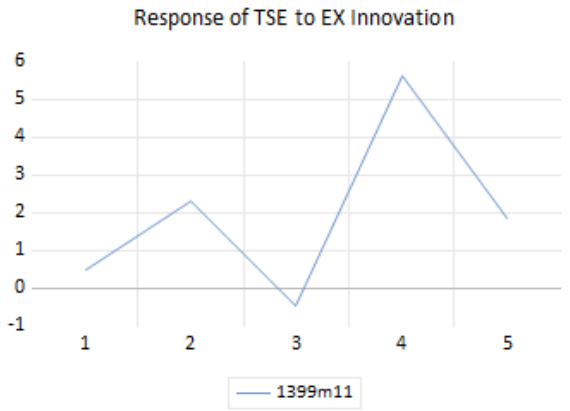

Figure 13. Impulse Response Function of Tehran Stock Exchange Returns to an Exchange Rate Growth Shock in February 2021
Source: Research Findings

By applying a one-standard-deviation shock to the exchange rate growth variable in February 2021, the return of the Tehran Stock Exchange increases slightly in the same period, continues to increase for the second period, then decreases for one period, increases again, and finally decreases, but does not approach its long-term equilibrium.

Importance of the Results and Policy Implications

The findings of this study provide important insights into the behavior of financial markets in sanction-prone, oil-dependent economies such as Iran. First, the time-varying and asymmetric effects of exchange rate fluctuations and financial sanctions on the Tehran Stock Exchange Index challenge the conventional assumption of stable and time-invariant relationships between these variables. Traditional static models are unable to fully capture these shifting dynamics. By employing a TVP-VAR approach, the study demonstrates that the stock market's responses evolve over time, particularly during periods of geopolitical tension or macroeconomic instability. Second, the results highlight the vulnerability of Iran's stock market to external shocks. The observed declines in stock returns during periods of intensified sanctions (e.g., post-2018 U.S. withdrawal from the JCPOA) show how external policy actions beyond domestic control can destabilize financial markets. This finding underscores the importance of building institutional and economic

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buffers—such as diversification of revenue sources and improved financial regulation—to enhance market resilience. Third, the evidence of short-lived positive effects from exchange rate growth highlights speculative trading behavior rather than genuine improvements in economic fundamentals. Such insights are critical for policymakers and regulators who must address systemic risks arising from excessive speculation and investor herding during periods of currency volatility. Fourth, the lack of convergence to long-term equilibrium in the impulse response functions suggests structural weaknesses in Iran's financial system, including insufficient depth, and integration with global markets. Recognizing these weaknesses can guide reforms aimed at strengthening financial institutions, promoting long-term investment, and reducing sensitivity to external shocks. Finally, these findings contribute to the global literature on the economies under sanctions by providing empirical evidence from a unique context rarely examined in international research. They not only enhance academic understanding of exchange rate–stock market dynamics under sanction but also provide actionable insights for investors, policymakers, and economic planners seeking to navigate volatile environments.

Comparison with Other Studies

The core finding — that exchange-rate shocks and sanctions have time-varying, asymmetric effects on Tehran Stock Exchange (TSE) returns — is consistent with a strand of Iranian and emerging-market research that shows nonlinear/asymmetric exchange-rate–stock relationships. For example, Azarbayjani et al. (2018) report an asymmetric effect of exchange-rate changes on the Tehran index (positive effects from depreciation declines, limited or no effect from appreciations), which matches our finding that the TSE reacts differently depending on the sign and timing of exchange-rate moves.

Several country- and sector-level studies find that exchange-rate effects vary across industries and over time. Mohagheghnia et al. (2022) show that exchange-rate fluctuations affect firm performance heterogeneously across sectors and with different lags — a result that complements our TVP-VAR finding that coefficients change over time and that the exchange-rate impact is not uniform across the sample period.

Barkhordari et al. (2017) document that exchange-rate fluctuations produced positive significant spillovers into some industry indices (automobile, coal, machinery) on the TSE. Our results likewise point to periods when exchange-rate growth is associated with positive returns (especially outside the intense-sanction windows), which suggests that

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industry composition and exposure to FX shocks can explain some of the positive episodes in your TVP estimates.

On the sanctions/oil channel, global and regional studies that integrate oil, exchange rates and equity markets (for example Mollick & Sakaki, 2019; Seshaiah & Behera, 2009) show that oil revenue shocks and FX moves are jointly important for equity performance. We employed oil revenue as a proxy for financial-sanctions intensity, and the observed strong negative TSE responses during intensive sanction periods (e.g., post-May 2018, October 2018, August 2020) align with these findings and highlights the oil-sanctions–FX–stock link in an oil-dependent economy.

On novelty, many earlier studies used fixed-coefficient VAR, ARDL/NARDL, GARCH approaches and therefore capture either nonlinearities or volatility spillovers but not smoothly time-varying parameter dynamics across long samples. By employing a TVP-VAR we show when and how the coefficients change across sanction episodes. Our findings reveal asymmetric and sector-specific aspects of the impacts. The stronger and more persistent negative responses during certain sanction episodes (e.g., 2018–2019, Aug 2020) suggest that sanctions are not just a one-off shock but can trigger structural changes (liquidity, confidence, credit conditions) that prolong market instability — a point not fully captured by studies that ignore time-variation.

7 Conclusion

This study examined the dynamic and time-varying effects of exchange rate fluctuations and financial sanctions on Tehran Stock Exchange (TSE) returns over the period 2011–2023 using a TVP-VAR framework. The findings reveal that both exchange rate growth and the intensity of sanctions exert asymmetric and time-varying effects on stock market performance. Periods of heightened sanctions—such as the EU oil sanctions of 2012–2015 and the U.S. withdrawal from the JCPOA in 2018—were associated with significant declines in stock returns, highlighting the vulnerability of Iran's equity market to external financial pressures. Conversely, phases of easing sanctions or oil revenue recovery corresponded to short-term rebounds in returns, underscoring the sensitivity of market expectations to geopolitical developments. The analysis of impulse response functions further indicates that shocks to exchange rate growth typically generate short-lived boosts to returns before reversing, suggesting speculative behavior and limited long-term equilibrium adjustments. Similarly, sanctions shocks produce volatile, non-converging responses, pointing to structural fragilities in the Tehran

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Stock Exchange under external constraints. These results suggest that policymakers may benefit from implementing stabilization policies —such as exchange rate management, diversification of export revenues, and improved investor protections—to mitigate the adverse effects of external shocks. Overall, this study contributes to the literature by demonstrating that in a sanction-prone, oil-dependent economy, the relationship between exchange rates and stock market returns is neither static nor linear. Recognizing this dynamic interaction is essential for investors, regulators, and economic planners seeking to enhance the resilience and efficiency of Iran's capital market. Future research may extend the present framework by incorporating additional macroeconomic and financial variables, alternative indicators of sanctions and geopolitical risk, or sectoral stock market indices in order to provide a more comprehensive understanding of market responses to external shocks.

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Authors' contributions
All authors had contribution in preparing this paper.

Conflicts of interest
The authors declare no conflict of interest

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