Iranian Economic Review, 2024, 28(3), 899-920
DOI: 10.22059/IER.2022.90040

RESEARCH PAPER

Evaluating the Effects of the Monetary Policy on the Total Stock Market Index in the Iranian Economy: Using the TVP-VAR and GARCH Approaches

Zhale Zarei[a,*], Maryam Hemmati[a], Pedram Davoudi[b]
a. Monetary and Banking Research Institute, Tehran, Iran
b. Strategic Studies Institute, Tehran, Iran
* Corresponding author, E-mail: Zh.Zarei@mbri.ac.ir

Article History: Received: 20 September 2022, Revised: 14 November 2022, Accepted: 07 December 2022
Publisher: University of Tehran Press.

Abstract
This study aims to evaluate the effects of the monetary policy on the total stock market index using Guangton et al. (2021)'s nonlinear approach. Contrary to other research on Iran's economy that has focused more on long- and short-term relations assuming a fixed parameter approach, this study uses the TVP-VAR (time-varying parameter) and GARCH (generalized autoregressive conditional heteroscedasticity) approaches to examine the effectiveness of monetary policy on the stock market index through the exchange rate, liquidity, and interbank market interest rate channels during 2009:5-2021:10 with a monthly frequency. Results showed that throughout the period under study, changes in monetary policy as expressed in interbank interest and exchange rates did not have the same influence on the total stock market index. While these impacts have been sometimes positive and sometimes negative, those of the liquidity growth rate on the specified index have consistently been positive and significant. The stock market is greatly impacted by changes in interbank interest, exchange, and liquidity rates, therefore monetary policymakers must consider financial stability while regulating these policy variables.
Keywords: Capital Stock Market, Inter-Bank Interest Rate, Generalized Auto-Regressive Conditional Heteroscedasticity Model, Total Stock Market Index, Non-Linear Method.
JEL Classification: G10, G12, C13.

1. Introduction
The relationship between monetary policy and financial stability has intensified in recent years, particularly in the wake of the 2008 financial crisis, and studies have shown that financial stability can ensure macroeconomics sustainable development (Kyereboah-Coleman and Agyire-Tettey, 2008; Naughton, 2006). Hence, central banks in many countries viewed financial stability as the policymaker's intermediate goal and monitored, evaluated, and modeled it, highlighting the need for conservative monetary policies to maintain it (Yi, 2019), as the latter could have an impact on the financial stability through a variety of channels.

The interest rate is a key variable that determines how money is transferred and significantly affects the capital market, particularly the stock price, and hence the total stock market index (Muktadir-Al-Mukit, 2013). For instance, the US Federal Open Market Committee (FOMC), a division of the Federal Reserve Board that determines the direction of monetary policy, employed the interest rate channel and open market operations to decrease inflation, the unemployment rate, and economic growth after the financial crisis (Shiller, 2015). Central banks in Switzerland and China also always considered the state of the capital markets when adopting expansionary monetary policies (Bohl et al., 2007).

Since the government and state-owned banks dominate some financial markets (such as the one in China), there is a large information asymmetry between their investment sectors and financing market elements (Carpenter and Petersen, 2020). When a market fails in these circumstances, the government intervenes visibly to regulate and control it, and interest rate laws are frequently utilized in these countries as a way to address the issue. With the aid of savings reserves, the Chinese central bank regulates the discount rate and financial markets by adjusting the money supply and interest rates (Lin and Ho, 2019; Thornton, 1986). On this premise and taking into account market regulatory history, monetary policymakers can use interest rate changes as a tool to help increase stock market efficiency and avert potential market failure (Kontonikas and Kostakis, 2013). The interest rate and stock return are adversely associated, according to certain studies (Alam and Salah Uddin, 2009; Richard and Hammed, 2012; Perera, 2016; Tibebe et al., 2016), while other researchers (Gay, 2016; Musawa and Mwaanga, 2017) underline their positive relationship.

In the "flow-oriented" model developed by Dornbusch and Fischer (1980) and Gavin (1989), exchange rate fluctuations are one factor that affects the stock market along with other factors such as indirect stock price impacts on total demand via wealth and effects on firm product levels and trade balance. Particularly, falling stock prices lower the wealth of domestic investors, laying the groundwork for falling interest rates, and ultimately leading to capital flight and currency depreciation, suggesting that there may be a reciprocal relationship between exchange rates and stock market returns. However, the "stock-oriented" model of Branson and Frankel (1983) describes this relationship through the country capital account. The underlying premise of this model is that as a country's currency depreciates, investors shift their assets out of the stock market and into the foreign exchange market, which lowers stock prices and, ultimately, stock indices, which has a negative impact on stock market returns.

Another factor whose effects on the stock market have consistently caught the attention of financial and economic scholars is liquidity. Their evaluations demonstrate the ambiguity of the money supply fluctuations' consequences on the

stock market. Two different angles can be used to examine the impact of liquidity on stock price: 1- An increase in money supply and liquidity raises market prices generally, and inflationary expectations lead to an increase in stock prices and the total stock market index; and 2- An increase in money supply raises the discount rate, which lowers stock value (Daei Karimzadeh et al., 2013).

The question now is: How does Iran's monetary policy affect the total stock market index in Iran? Determining these effects is crucial for the country's economy because Iran's capital market has grown recently; reaching 40% in 2019 due to the general acceptance[1], up from an average of 18%. It is reasonable to anticipate that the actual and potential financing capabilities of the capital market can be effectively utilized if the right platforms are offered, individuals receive adequate knowledge, and the investment culture is expanded. The Monetary and Credit Council enactment (2007) limits the amount of capital that banks can spend in stock purchases to up to 40% of their capital to prevent banks from owning firms and to better allocate their resources to economic activity. Hence, monetary policy changes have distinct effects on banks' resources, emphasizing the importance of looking at how those changes may affect the total stock market index.

Yet, due to similarities in market and interbank interest rates and the necessity of determining the interest rate in Iran, interbank market interest rates are used in relevant studies. The interbank market, where banks and other credit institutions fulfill their short-term financial needs, is one of the indirect money-market-based tools used by the central bank to carry out monetary policies. This market aims to govern interbank relationships in terms of short-term financial needs, making the best use of available resources, and managing/monitoring central bank overdrafts (Nazarpour and Haghighi, 2013).

The remainder of this paper is organized as follows. Section 2 reviews the literature on the effects of monetary policy on the total stock/total stock market index. Section 3 evaluates the problem's theoretical framework and the approach employed in this study using Guangtong Gu et al.'s (2021) perspective. Section 4 discusses the data and estimation results of the econometric model; Section 5 presents conclusions and some policy recommendations based on the findings.

2. Literature Review

The stock market, which is a tremendously active sector of the financial markets, serves as both a reflection of economic conditions and a practical economic barometer[2] (Galbraith, 1955). Studying the variables that influence the

[1]. The capital market size index is the ratio of market value to GDP and averages 80% in developing and developed countries. In Middle Eastern countries, this ratio is 38%.

[2]. An estimate of 219 indices including banking and consumer confidence, production, exchange rates and interest rates, stock market prices and so on, as well as a composite index measuring GDP,

performance of the stock market is particularly important because its stability can effectively contribute to the stabilization of other financial markets and because it serves as a key hub for corporate financing and the management of public savings (Kim and Mauborgne, 1999). In recent decades, economic and financial academics have continuously studied these issues and developed many hypotheses for the market size.

Studies on the relationship between monetary policy and the total stock market have been conducted because both factors have an impact on economic growth (Levine and Zervos, 1999). However, the results of these studies have been inconsistent due to model/sample heterogeneity, which has led researchers to hold divergent opinions on the impact of monetary policies on the total stock market index. Studies have shown that monetary policies have an impact on the stock market (Acharya et al., 2020; Yang et al., 2017).

Okpara (2010) found that changing the re-discount rate would change the market interest rates, which will change the stock return, after looking at the relationship between monetary policy and stock return in Nigeria.

Studying the impact of monetary and fiscal policy shocks on the performance of the stock markets in Germany, UK, and the US using the VAR model, according to Chatziantoniou et al. (2013), the money supply had positive effects on the stock index but had no direct impact on the performance of the German stock market index. Additionally, they demonstrated that while the money supply affected the interest rate in the US, the interest rate had no discernible effects on the German stock index.

Chen and Wu (2013) used the threshold regression model to analyze how monetary policy affected financial markets and how the interest rate affected stock price forecasts in the US, Australia, India, and Taiwan. They found that the interest rate and stock price index had a nonlinear relationship (before and after the central bank reduced the interest rate). They indicated that when interest rates began to fluctuate, the stock price index had a significant positive relationship with them, and that when it exceeded a certain threshold, the effect on the stock index was reversed. These findings were also consistent with those of Sheng et al.'s (2014) study for the G-8 countries.

Using nonlinear VAR models for instantaneous variance analyses, Sun & Wang (2018) examined the relationship between monetary policy-stock prices in China and showed that the two were highly associated. Additionally, they demonstrated that the money supply had significant effects on stock price; M1 had no influence, but M2 did. The stock price was impacted by bank deposits and loan

construction and banking in the Swiss economy. Overall, it is a leading index that provides good information on the economic growth and GDP, and shows the outlook for the next six months of the economy.

interest rates, but the interbank interest rate had a direct significant effect. Money supply moved in step with the stock price while interest rates moved in the opposite direction. Statistically speaking, this effect is asymmetric, and the impact of monetary policy on the stock market goes beyond a simple inverse connection.

By comparing the stock prices in the US, UK, Japan, Hong Kong, and China, Rabushka and Kress (2019) showed that, in contrast to developed stock markets, China's monetary policy only had a limited impact on the stock market index over relatively brief periods. Evidence suggests that the interest rate has negative long-term, detrimental consequences on the stock price index.

Different scholars hold different perspectives on the long- and short-term effects of the interest rate, which is a major channel of the monetary policy effects on the stock price. Some researchers think it is challenging to investigate these effects in the short run (Dabbous and Tarhini, 2021; Holston et al., 2017; Rafay and Farid, 2019).

According to Liow and Huang (2006), real estate stocks are frequently sensitive to short- and long-term interest rate changes in the Chinese financial market, and the sensitivity to and volatility of interest rate changes depend on the situation of the market.

According to Moya et al.'s (2015) study of the relationship between interest rates and the stock market in Spain at the industry level, the utilities, real estate, technology, telecommunications, and banking sectors were the most susceptible to changes in interest rates and saw the biggest impacts on their stock prices.

Musawa and Mwaanga (2017) investigated the interest rate-stock market relationship in Zambia using the autoregressive distributed lag (ARDL) and vector error correction (VEC) experimental methods, and they indicated that the stock price index had both short- and long-term (co-accumulated) relationships with the interest and exchange rates as well as the oil and copper prices. They underlined that only the interest rate and copper price had long-term effects on the stock market and claimed that a substantial decline in interest rates had a beneficial impact on the Zambian Stock Exchange and that the majority of investors would switch from bonds to equities.

When the interest rate and deposit reserve proportions were altered, it was unclear how they would affect the stock price in the short term. However, longer interest-rate adjustments had consistent long-term effects on the stock market return, as demonstrated by Papadamou et al. (2017). Only lower interest rates had short-term effects on the stock market because they signaled a recession, which drove investors to the stock market.

Guangtong et al. (2021) focused more on the time variable while examining the temporal and quantitative relationship between the interest rate and stock price in China for different income deciles/economic groups. They examined the

relationship between the stock market and monetary policy for various income classes using the Chinese monthly stock market data from January 2005 to February 2018 and a Bayesian time-variable regression model to study the effects of interest-rate changes on stock returns. The evidence and supporting documentation help to paint a more accurate picture of the relationship.

Researchers from Iran have also looked into how monetary policy affects the stock market index:

The stock market has been examined by Keshavarz Haddad and Mahdavi (2005) as a channel for the implementation of monetary policy in the Iranian economy. They examined the relationship between conditional volatility, conditional variance of the stock return, and conditional volatility of monetary variables using the generalized ARCH and VAR approaches, and they demonstrated that the stock market was not a channel for monetary transmission in the Iranian economy.

To examine the long-run relationship between macro-monetary variables and the stock price index in the Iranian economy, Karimzadeh (2006) used the convergence method, the ARDL model, and such variables as the stock price, liquidity, real exchange rate, and real interbank interest rate. He demonstrated that the stock price index and macro-monetary variables converge well. According to the estimated long-term relationship, the real exchange rate and real interbank interest rate have both had significant negative effects on liquidity, while the liquidity effect on the stock price index has been significantly positive.

Using the co-integration test, Sajjadi et al. (2010) concluded that there was a long-run relationship between the total stock-price-index growth rate and a set of independent macro variables like the inflation, liquidity, exchange, and bank interest rates; the inflation and liquidity rates were negatively correlated with the index growth rate.

While real interest rates and stock returns did not have any significant inverse relationships, the former was an effective variable on the latter; Saeedi and Pagheh (2011) found an inverse relationship between nominal interest rate variations and the profitability of financial institutions in the Tehran Stock Exchange.

Abbasian et al. (2012) looked at how monetary policy affected stock price bubbles on the Tehran Stock Exchange and found that the real interest rate had negative effects on the real stock return while production had positive but sluggish effects.

Shahbazi et al. (2012) examined the stock market efficiency based on monetary and fiscal policies and showed that the presumption that the stock market is efficient against monetary policies is acceptable because the current money supplies had significant negative effects on the current stock return. They did this using empirical evidence from Iran and the ARDL model.

Nonejad et al. (2012) examined the impact of monetary policy on the nominal and real stock price indices of the Tehran Stock Exchange using autoregressive models, instantaneous reaction functions, and variance analyses and demonstrated that the effects were positive.

Rashidi and Maddah (1397) used monthly data to examine the effects of the interbank interest rate within the ARCH and G-ARCH framework models on the stock market index (with a focus on the JCPA agreement) and concluded that the real interest rate in the interbank market had a significant negative impact on the stock index and that positive changes in the mentioned rate encouraged banks to invest their extra resources in the interbank market rather than the stock market. The interbank market plays a crucial role and is essential as a monetary tool for the central bank to affect the real sector of the economy, as highlighted by the inverse link between interbank interest rate changes and the stock price index.

The difference between this study and others done in Iran in this field is that they have used fixed parameter methods and have concentrated more on long- and short-term relationships, whereas this study has taken into account the effects of monetary policy variables on the total stock market index by assuming a time variable parameter (TVP) model. This study therefore assumes that these variables do not have consistent effects on the stock market throughout the study period and examines the effects by using the TVP-GARCH model.

3. Research Methodology

While returns in capital asset pricing (CAPM) models and arbitrage pricing theory (APT) are measured by conditional variance, conventional time series models operate under the assumption that variance is fixed; for this reason, ARCH models are used to model and predict conditional variances.

However, these models have a flaw in that they typically need many parameters and special, pre-built structures to keep the estimated variance from going negative. ARCH models, also known as GARCH (p, q) models, were created to address this issue (Shahabadi et al., 2013). They can quantify long- and short-term memories and exhibit longer-term recollections than ARCH models, which can be a key aspect of asset returns.

The GARCH (p, q) model can assess the degree of sequence and persistence in fluctuations in asset returns. Cluster fluctuations in asset returns refer to the idea that current fluctuations have an impact on anticipated ones in future periods. The GARCH-M model is frequently employed when an asset's expected return and risk are directly correlated, with the calculated coefficient dictating the risk-return relationship.

Only the risk fluctuates over time in these models' representations of the risk-return connection (Vest and Worthington, 2006), and the conditional variance

can change over time because of historical errors and conditional variance interruptions while the unconditional variance is fixed (Bollerslev, 1986). Since the conditional variance of the estimated model's error component varies with time, these models can be utilized to determine the varying uncertainty. As a result, by calculating the conditional variance, it is possible to model the swings of some monetary policy variables, such as inflation, interest rates, and the foreign exchange market (Engle, Lillian, and Robbins, 1987; Kendall and McDonald, 1989). Financial data investigations are appropriate for the GARCH (1, 1)-M model (Bollerslev et al., 1992). The ARCH risk scale was employed by Attanasio and Wadhwani (1989) to explain stock return.

The combination of GARCH models with time-varying-parameter (TVP) models, as was previously mentioned, sets this work apart from others in the area because regression approaches presume that a fix-coefficient relation can be employed at different times. Dynamic models that are near to the world's realities were produced as a result of incorrect outcomes of this irrational assumption. Due to this, TVP approaches were developed that could foresee the development of many-variable models over time. GARCH models using the TVP methodology are defined as follows:

$$R_{t+1} = X_t\beta_{t+1} + e_{t+1} \;\; then \;\; e_{t+1} \sim N(0,\mathrm{h_t}) \tag{1}$$

$$\beta_{t+1} = \beta_t + V_t \;\; then \;\; V_{t+1} \sim N(0,Q) \tag{2}$$

$$h_t = h + \sum_{i=0}^{m} \emptyset_i e_{t-i}^2 + \sum_{i=1}^{n} \gamma_i h_{t-i} \tag{3}$$

where R_{t+1} is the total stock market index, and X_t is the vector of the monetary policy explanatory variables at time *t*. In Equation 1, e_{t+1} has a normal distribution with conditional variance h_t where the variance of each period is predicted by that of the previous one and is influenced by the previous values of the stock return errors (e_{t-i}^2) and its past behavior, β_{t+1} is a random time variable coefficient, V_{t+1} has a normal distribution with a homogeneous covariance matrix concerning β_{t+1} shocks and $\emptyset_i$ and γ_i are the time-varying parameters of h_t.

Equations 1, 2, and 3 show the autoregressive TVP with ARCH equations for shocks to all the stocks. Finally, the last GARCH-process equation shows the shocks to the stock return, which is a dependent variable.

The Kalman filter algorithm, an estimation technique for time-varying parameter models, is used to observe structural variations (Chow, 1984); as a result, the new equations can be written as follows:

$$R_{t+1} = X_t E_t \beta_{t+1} + \eta_{t+1} \tag{4}$$

$$H_t = X_t \Omega_{t+1|t} X_t^T + h_t \tag{5}$$

$$E_{t+1}\beta_{t+2} = \beta_{t+1} + \left|\Omega_{t+1|t} X_t^T H_t^{-1}\right|\eta_{t+1} \tag{6}$$

$$\Omega_{t+2|t+1} = \left|I - \Omega_{t+1|t} X_t^T H_t^{-1} X_t\right|\Omega_{t+1|t} + \varrho \tag{7}$$

where $\Omega_{t+1|t}$ is the conditional covariance matrix of β_{t+1} concerning the knowledge at time *t*. The stock return conditional variance H_t depends on h_t and the conditional variance $X_t\beta_{t+1}$, which is equal to $X_t\Omega_{t+1|t}X_t^T$ (specified in Equation 5). The modifications and revisions to the β_{t+1} estimates used to forecast future stock returns are indicated in Equation 6. The last two Equations 6 and 7 show the new changes in updating the estimates of β_{t+1} and the conditional covariance matrix. Now, we can study financial market uncertainty in the context of time-varying parameters using the approach mentioned above.

As was already noted, a distinct method was utilized in this study to model the uncertainty in the financial market uncertainties. Efforts have been made to use not only equations where time-varying parameters consider the shock of the total stock market index, but also the Kalman filter algorithm to measure uncertainties related to the structural variability of the equation. This method is well-suited for measuring uncertainty in financial markets and estimating time-varying conditional variance, and variables' unpredictable variations. This process, combined with ARCH equations, was first introduced by Evans (1991) to calculate the inflation uncertainty. The financial market uncertainty can be modeled as follows:

$$R_{t+1} = X_t\beta_{t+1} + e_{t+1} \quad e_{t+1} \sim N(0,\sigma_t) \tag{8}$$

$$\beta_{t+1} = \beta_t + V_{t+1} \qquad V_{t+1} \sim N(0,\sigma) \tag{9}$$

where R_{t+1} is the total stock index and X_t (vector of explanatory monetary policy variables at time *t*) is defined as follows:

$$-X_t = [EXR_t, M2_t, INT_t, STK_t] \tag{10}$$

where EXR_t, $M2_t$, INT_t and STK_t are the exchange rate (open market dollar price), liquidity, interbank market interest rate and industrial production. In other words, this study examines the effects of the mentioned factors on the total stock market index; $\beta_{t+1}$is the vector of parameters and allows them to vary over time, and e_{t+1} is the index shock of all the stocks that are not predictable with the information available at time *t*; it has a normal distribution with variance σ_t.

The influence of structural uncertainty is indicated by the unconditional variance of trivial diseases. The structure of the dependent variable may vary significantly because of considerable changes in institutions, policies, and expectations. Time-varying parameters that affect the dependent variable demonstrate this structural unpredictability. The evolution of parameters can readily support the randomness hypothesis, and it is assumed that all structural differences result from shifting viewpoints on the nature of the economy. It will be difficult or impossible to forecast any future changes in the β_{t+1} movement; hence, $\beta_{t+1}E_t = \beta_tE_t$ shows that this procedure is random.

4. Data and Model Estimation Results

The interbank market interest rate, exchange rate, liquidity, and industrial production index have all been used as monthly frequency explanatory variables, and the total stock market index data has been used as a dependent variable to estimate the model.

Interbank interest rate: The interest rate is a key variable that significantly affects the capital market, particularly the stock price, and plays a significant role in financial markets as a means of money transfer. Due to 1- its influence on financing costs and 2- investors' anticipated higher rate of return, it plays a significant role in financing commercial enterprises and its increase can have an impact on stock returns. The performance of a stock portfolio is closely correlated with a higher interest rate (Mohammadi, 2021). Evaluating the consequences of changes in long-term, risk-free bank deposits on the stock market is crucial in Iran since they compete with investments made on the stock market. The interest rate has been demonstrated to be inversely associated with stock return by some researchers (Alam and Salah Uddin, 2009; Richard and Hammed, 2012; Perera, 2016; Tibebe et al., 2016), while others contend that they are positively related (Gay, 2016; Musawa and Mwaanga, 2017). We can now inquire as to the relationship between Iran's interest rate and the total stock market index. The interbank interest rate is used because bank deposit and facility interest rates are crucial in Iran.

Exchange rate: Based on economic theories, the exchange rate can impact a company's stock price in two ways: 1- through increasing demand, which could increase exporting companies' earnings and, consequently, their stock price; and 2- through decreasing supply, which could decrease companies' profits from importing intermediary goods and, hence, their stock price (Dornbusch and Fischer, 1980; Daei Karimzadeh et al., 2013). The portfolio theory predicts that when an asset's price declines, such as when the exchange rate does, people will move their money from the foreign exchange market to the stock market to maintain their portfolio's purchasing power, which will increase demand for stocks and, hence, the total stock market index (Rashidi, 2020).

Liquidity: This variable may serve as an indicator of the economy's monetary policy. The present value of the cash flow is influenced by the money supply via the discount rate. Although the money supply and stock price have a close relationship, it is still unclear how changes in the former will affect the latter. The following conclusions are drawn from an analysis of the effects of liquidity on stock price: 1) An increase in liquidity disturbs the real money balance, causing people to spend their excess liquidity to purchase other assets, such as stocks, to restore the real money balance; this strategy is known as the "Real Balance Effect" (Nonejad et al., 2012; Rashidi and Maddah, 2020). Another conclusion that might

be drawn is that as liquidity rises, so do inflation expectations, which in turn raise the stock prices and ultimately the broad stock index. According to some academics, an increase in liquidity has positive impacts on the aforementioned index because it might enhance investments in a variety of economic sectors (e.g., stocks). Additionally, as the real interest rate rises due to an increase in money supply, the discount rate eventually rises as well, lowering stock prices to reduce (Daei Karimzadeh et al., 2013).

Industrial production index: Studies show that the industrial production is another stock-index affecting variable (Chen et al., 1986; Kutler et al., 1989). According to Campbell and Amr (1993), there are one or two possible explanations for why changes in the stock market can have an impact on industrial production. Variations in industrial production are related to modifications in future cash flow predictions (Balvers et al., 1990). However, interest rate changes are also a significant factor in determining industrial production (due to changes in investments) and stock price (due to changes in the cash flow discounted value).

The Denton method and stock market index have been used in the Eviews software to transform real sector indicators, like the industrial production index, from their quarterly publication schedule to a monthly frequency. The interbank interest rate entered the pattern as changes[1], but all other variables were de-seasoned first, and then their logarithmic difference was determined.

The reliability of the variables should be assessed first to avoid false regression. The unit root of the model variables was investigated in this study using the generalized Dickey-Fuller test. The findings show that the variables' first-order difference was used in the model because they were not at a reliable level (Table 1).

[1]. The Denton method is an approach to seasonalization of data in which the quarterly data of an annual variable (X) are calculated using another variable (index I) whose seasonal data are available and whose variation trend is similar to that of the desired variable. It is based on the recursive least squares (RLS) method and the quarterly data to be estimated are the same model parameters. The sum of the squares considered in the Denton method is the first-order difference of the X/I ratio , which is presented as follows: Min $\sum \left[\frac{X_t}{I_t} - \frac{X_{t-1}}{I_{t-1}}\right]^2$, s.t $\sum Xt = Ay$

Table 1. Variables' Reliability Evaluation Results Using the Generalized Dickey-Fuller Test

Variable	Dickey-Fuller statistics	P-value	Dickey-Fuller statistics in the first-order difference	P-value
Inter-bank market interest rate	2.4570	0.1280	9.5707	0.0000
Exchange rate	1.5683	0.9994	6.7314	0.0000
Liquidity	0.9954	0.9965	-4.7077	0.0000
Industrial production index	1.4778	0.5424	-15.5214	0.0001
Total stock price index	0.9132	0.9955	-10.6693	0.0000

Source: Research finding.

The parasite test (Lagrange coefficient with a null hypothesis or no ARCH effect), which determines the correlation between total index shocks by estimating an autoregressive model for the square of shocks and assessing the significance of this regression, was used to check the inter-variance autocorrelation (ARCH effect) in the data. As a result, this study analyzed the variance heterogeneity and demonstrated its absence using the values of F-statistic and probability (Table 2).

Table 2. Variance Heterogeneity Test: ARCH

F-statistic	66.4958	Probability of F-statistic (1, 159)	0.0000
Obs*R-squared statistics	47.4768	Probability of Chi-Squared distribution	0.0000

Source: Research finding.

The model can be estimated after assessing variable reliability and testing variance heterogeneity. To make the estimation of the model TVP-GARCH more efficient, the variables were standardized (Erdogan, 2005), that is, they were divided by the standard deviation after subtracting the mean; therefore, standard variables have a mean of 0 and a standard deviation of 1.

Table 3. Estimation Results of the TVP-GARCH (1.1) Model

Variable	Coefficient	T-value	P-value
C	0	0	0.9999
Interbank market interest rate variations	0.0412	-5.2893	0.0000
Log difference of exchange rate	0.0165	10.1590	0.0000
Log difference in liquidity	0.0001	2.0573	0.0412
Log difference of industrial production index	0.04810	-30.3113	0.0000
First Lag of log difference of total stock market index	0.0095	58.4622	0.0000
GARCH a0	0.1183	1.0259	0.0000
sig(t-1)	0.3626	9.5012	0.0000
e(t-1)^2	0.4999	598.4315	0.0000

Source: Research finding.

The interbank interest rate, exchange rate, liquidity, and industrial production index recession have all had positive and significant influences on the total stock market index, as evidenced.

This research has employed the generalized autoregressive conditional heteroskedasticity (GARCH) to examine the effects of monetary policy on the total stock market index, in contrast to earlier studies that used the fixed-parameter approach. It performs better than earlier models because the Iranian economy is undergoing numerous structural changes (e.g., international sanctions), and the GARCH model can take these changes into account and demonstrate that they do not have an equal impact on the stock market throughout a sample period. The study's findings demonstrate that the desired variables have varied in their effects on the stock index over time, as follows:

Interbank market interest rate: In general, an increase in the interbank market interest rate is expected to lead to a decline in the total stock market index, as it affects financing costs on the one hand, and increases investors' return expectations on the other; therefore, it may have a negative impact on stock returns as well as on the total stock market index, and eventually lead to a decline in the corporate's stock value (Mohammadi, 2021); of course, this has not always been the case. The impact of the interbank market interest rate on the stock index in Iran can be studied using the estimated model in three periods:

Period 1: From 2009: 5 to 2011: 3, the interbank market interest rate had a negative impact on the stock index, and as it rose, the total index fell. These findings are consistent with those of Meisami and Ko (2000), Nan et al. (2006), and Kandir (2008).

Period 2: These effects were positive from 2011:4 to 2013:3, which indicates that investors switched their portfolios to the stock market, driving up stock prices and, as a result, the total stock market index. The expectation of inflation and the herd behavior of investors in this market, which has reversed the impact of interest rates on the total stock market index, are two major factors in the realization of these conditions.

Period 3: These effects have been reversed once more since 2013:4, and Iranians now prefer to save their money in banks or, despite the inflation expectations, increase the weight of assets from other markets (housing, gold, currency, etc.) in their portfolios.

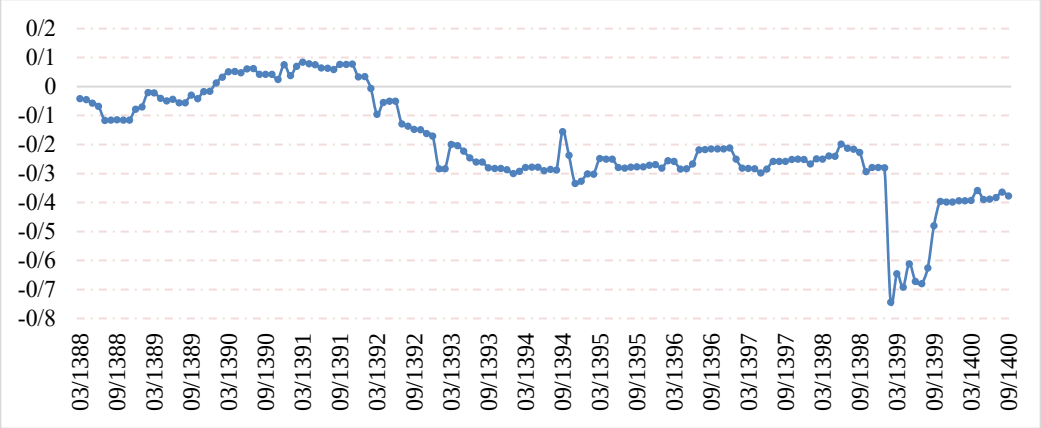

Figure 1. Time-varying Parameter Model's Estimation of the Interbank Market Interest Rate

Source: Research finding.

Exchange rate: From 2009:5 to 2021:12, three periods can be used to analyze the effects of the growth in the exchange rate (the open market price of the dollar).

Period 1: From 2009:5 to 2010:4 the total stock market index experienced beneficial effects from the growth in exchange rates (dollar price on the open market). The total stock market index rose as a result of an increase in the exchange rate, although its growth had little impact between 2010:5 and 2010:9; however, positive effects persisted until the end of February of that year.

Period 2: During the period 2010:3-2016:4, the exchange rate trend had a negative impact on the overall performance of the stock index (in line with Ebrahim and Aziz's (2003) research). During this period, the exchange rate increased from 11,068 to 34,934 Rials, which led to the devaluation of the local currency and an increase in the price of imported capital goods, which reduced the profit margin and stock returns.

Period 3: The national currency devaluation had positive effects on the rise of the stock index. The increase in the exchange rate from 34,934 to 27,772 Rials increased the competitiveness of stock market-active enterprises, leading to higher stock returns. During this time, the profit from higher export prices and increased global competitiveness outweigh the price of more expensive imported capital goods. In addition, taking into account the circumstances of the international sanctions, the demand for exported goods increased and, hence, the devaluation of the national currency enhanced the competitiveness of the local export sector, which positively affected the rise of the stock index. According to Moradoghlu (1999), since bigger devaluations increase the stock market risk, stock returns should also increase. This is demonstrated by the positive impacts of the "national currency devaluation" variable on the stock return. In addition, as the value of the "Rial" declines, it is anticipated that the stock index will rise because of future high

inflation brought on by the high cost of imported industrial goods, which will raise stock prices and ultimately raise the total stock market index.

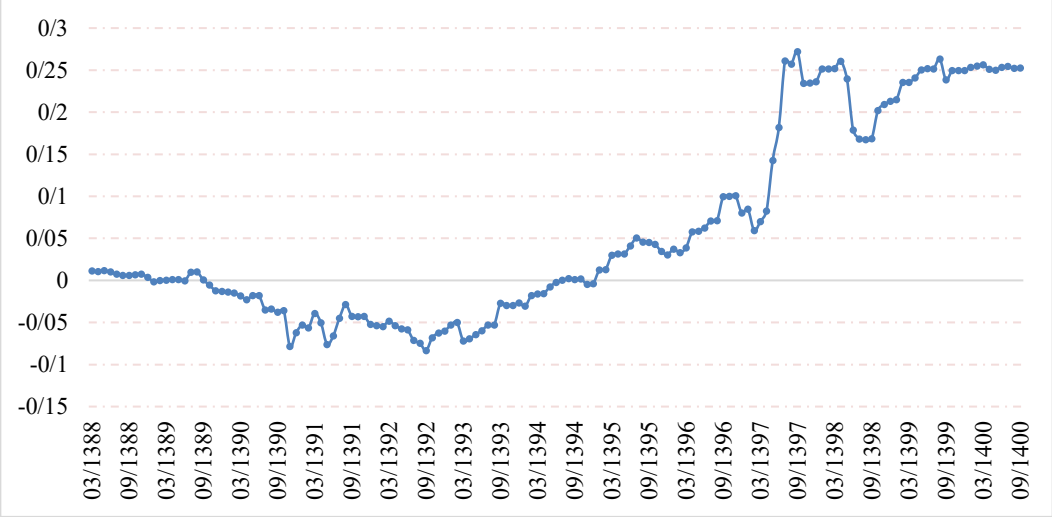

Figure 2. Time-Varying Parameter Model's Estimation of the Exchange Rate
Source: Research finding.

Liquidity growth rate: This variable's impact on stock price growth is undeniable, and it is evident from the graph that, throughout the research period, liquidity growth has had positive effects on the total stock market index. Additionally, changes in monetary policy have altered the income and laid the groundwork for rising stock prices and the total index. According to Moradoghlu and Matin (1996), Moradoghlu et al. (2000), Maisamy and Ko (2000), and Erdogan (2005), the money supply is positively correlated with stock return, increasing stock investment. The liquidity growth rate is the most significant indicator of the establishment of stock market expectations, according to an analysis of its effects on the total stock market index.

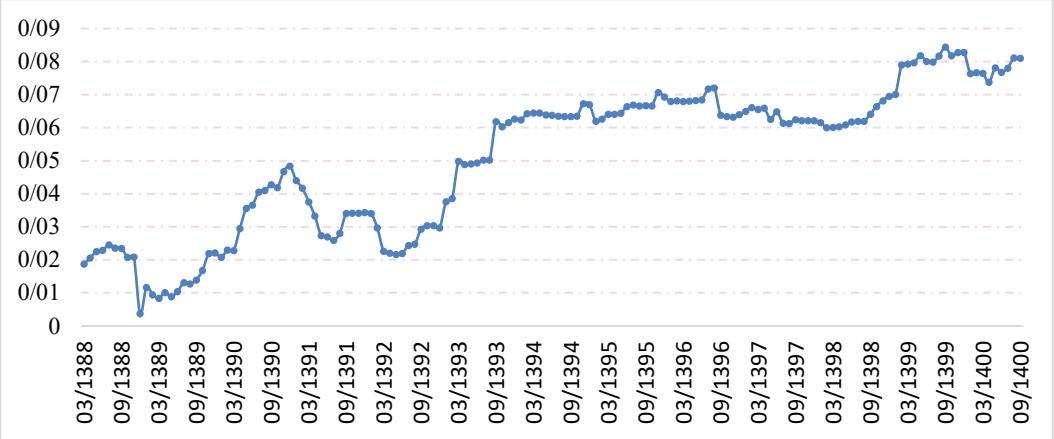

Figure 3. Time-Varying Parameter Model's Estimation of the Liquidity Growth Rate
Source: Research finding.

Industrial production index: As an indicator of the real sector of the Iranian economy, this index has positive effects on the total stock market index, indicating that rising production improves corporate income and profits, which in turn raises stock returns and the total stock market index (Chen et al., 1986; Mukhreji and Naka, 1995; Ibrahim and Aziz, 2003).

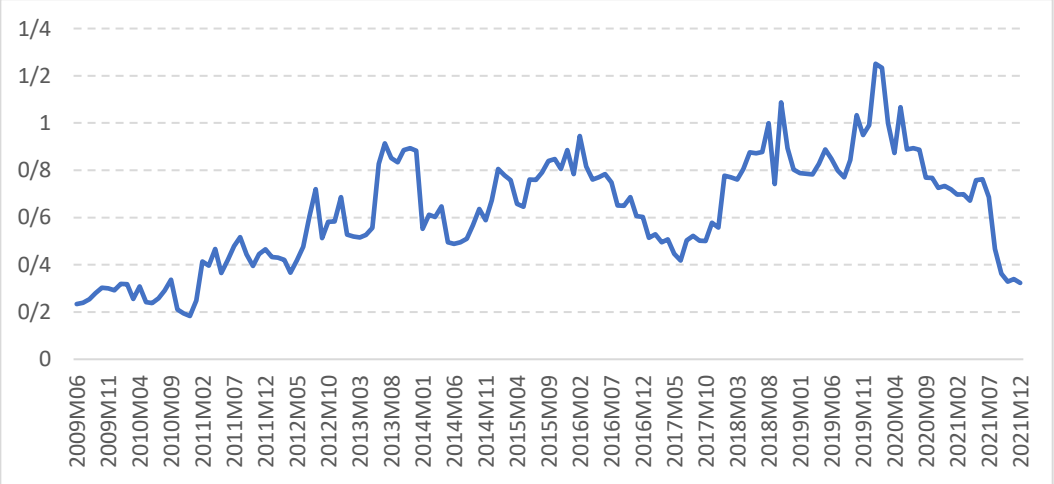

Figure 4. Time-Varying Parameter Model's Estimation of the Industrial Production Index
Source: Research finding.

Additionally, conditional variance analysis shows that several of the months in 2020 and 2021, as well as 2018:10, saw the market endure significant changes (Figure 5).

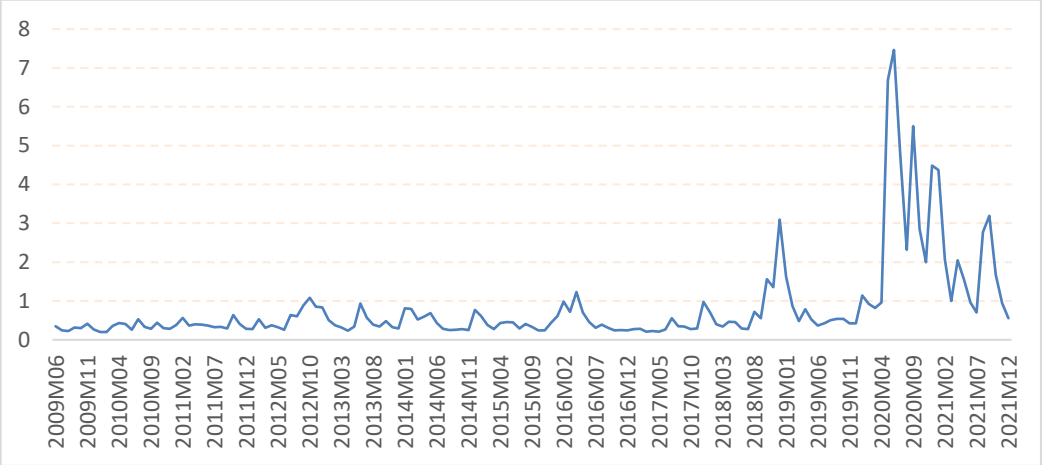

Figure 5. Conditional Variance of the Total Stock Market Index
Source: Research finding.

5. Conclusion

Since the literature review shows that the monetary policy effectiveness on the stock market index is not always the same and changes over time, this study, unlike other studies in the Iranian economy that focused more on long- and short-term relationships and assumed a fixed parameter approach, the TVP-VAR (time-varying parameter) and GARCH (generalized autoregressive conditional heteroscedasticity) approaches was used to estimate the monetary policy effectiveness on the total stock market index through the exchange rate, liquidity, and interbank market interest rate channels over the period 2009:5-2021:10 with a monthly frequency. This model uses the industrial production index as a representative of GDP and performs better than previous models because the Iranian economy has undergone many structural changes and the model with time-varying parameter model can account for them quite well.

The results of the TVP-GARCH model estimation show that the desired variables have different effects on the stock index in different periods. Based on the estimated model, the impact of interbank interest rate on the stock market index in Iran can be studied in three periods:

Period 1- these effects are negative in the period 2009:5-2011:3 and an increase in the interbank interest rate decreases the total stock market index.

Period 2- the effect is reversed in the period 2011:4-2013:3, which means that investors have shifted their portfolios to the stock market, which leads to an increase in the total stock market index; a main reason for the realization of these conditions is inflation expectations and investors' behavior in this market.

Period 3- these effects are negative again during 2013:4-2021:1 and Iranian people prefer to save their money in banks or invest in other financial markets.

Economic theory implicates that the interest rate is the cost of capital use. When the central bank tightens monetary policy by adjusting interest rates, it raises

the cost of firms and consequently lowers the expectations that investors have regarding the return of the particular firms. This may cause share prices to drop consequently. On the other hand, in inflationary periods, the increase in the nominal interest rate did not make the real interest rate positive and therefore did not have much impact on the stock market.

The effectiveness of the exchange rate growth on the increased stock index during 2009:5–2021:12 can also be examined over three periods:

Period 1: these effects are positive during 2009:5-2010:4 when an increase in the exchange rate increases the stock index;

Period 2: these effects are negative during 2010:3-2016:4 when the exchange rate growth has little impact on the total index growth; and

Period 3: these effects are positive until the end of February of the same year. As a result, an increase in exchange rates makes it more profitable for stock market-active corporations and enhances the competitiveness of those companies, as well as the global price of exported goods, which is higher than the cost of imported capital goods. Additionally, because of the country's exposure to international sanctions, there is a surge in the demand for exported goods. As a result, the domestic currency has been devalued, which has a beneficial impact on the growth of the stock index.

Growth in liquidity has had beneficial effects on the total stock market index throughout the research period; changes in monetary policy affect income and lay the groundwork for rising stock prices and the total stock market index. Analyzing how the liquidity growth rate affects the total stock market index reveals that this variable is a key indicator of how expectations are formed in the stock market.

The quantity theory of money explains the relation between liquidity and stock prices. When there is an increase in money supply, there will be a surplus in the quantity of money and this will increase the demand for purchasing more shares and thus cause an increase in share prices. Therefore, the liquidity hypothesis implicates a positive relationship between these two variables.

The industrial production index has positive effects on the total stock index as well, serving as a proxy for the real sector of the Iranian economy. As production rises, corporate revenues and profits rise as well, boosting stock returns and the total stock market index. It is possible to observe flock behavior by examining how the total stock market index growth recession affects the total stock market index itself. In addition to the aforementioned problems, the time-varying parameter method demonstrates that the total stock market index has significant fluctuations in some months of 2018 and 2020.

According to the results of the analysis, it has been determined monetary policy decisions have a significant effect on the Iranian stock market in a time-varying pattern. These findings show that monetary policy decisions in Iran affect

financial markets through the interest rate, exchange rate, and liquidity channels and there is a strong transmission mechanism between them.

In addition, for the stability of the stock market, it is necessary to conduct monetary policy in such a way that the fluctuations of the exchange rate and the interest rate are adjusted; because according to the findings, monetary policy has a significant effect on the index through exchange rate and interest rate fluctuations. Therefore, the conduct of appropriate monetary policy can affect the stability of the stock market.

These findings suggest that the shallowness of the Iranian capital market makes it susceptible to changes in monetary policy variables such as the exchange rate, interbank interest rate, and liquidity. This approach suggests that stock market investors should 1- constantly monitor how monetary policymakers behave in the monetary and currency domains, 2- avoid relying solely on technical assessments, and 3- be aware of how these three variables' behavior affects the total stock market index. On the other hand, when establishing their policies, monetary policymakers should also take into account alternative scenarios and pay close attention to how their monetary and exchange policies will affect the capital market.

References

Alam, M., & Salah Uddin, G. S. (2009). Relationship between Interest Rate and Stock Price: Empirical Evidence from Developed and Developing Countries. *International Journal of Business and Management, 4*(3), 43-51.

Bohl, M. T., Siklos, P. L., & Werner, T. (2007). Do Central Banks React to the Stock Market? The Case of the Bundesbank. *Journal of Banking & Finance, 31*(3), 719-733.

Carpenter, R. E., & Petersen, B. C. (2002). Capital Market Imperfections, High-Tech Investment, and New Equity Financing. *The Economic Journal, 112*(477), F54-F72.

Chen, N. F., Roll, R., & Ross, S. (1986). Economic Forces and the Stock Market. *Journal of Business, 59*(3), 83-403

Daei Karimzadeh, S., Sharifi Ranani, H., & Ghasemian Moghadam, L. (2013). Effects of Macroeconomic Variables on the Banks' Stock Price Index. *Monthly Economic Journal of Reviewing Economic Issues and Policies, 11&12*, 65-90

Dornbusch, R., & Fischer, S. (1980). Exchange Rates and the Current Account. *American Economic Review, 70*(5), 960-971.

Erdoğan, E., & Özlale, Ü. (2005). Effects of Macroeconomic Dynamics on Stock Returns: Case of Turkish Stock Exchange Market. *Journal of Economic Cooperation and Development, 26*, 69-90.

Esen, E., & Omit, O. (2005). Effects of Macroeconomic Dynamics on Stock Returns: The Case of the Turkish Stock Exchange. *Journal of Economic Cooperation*, *26*(2), 69-90.

Fada'i Nejad, M. E., & Farahani, R., (2017). Effects of Macroeconomic Variables on the Overall Index of Tehran Stock Exchange. *Quarterly Journal of Financial Economics*, *11*(39), 1-25

Fama, E. F. (1981). Stock Returns, Real Activity, Inflation, and Money. *American Economic Review, 71*(4), 545–65.

---------- (1965). Random Walks in Stock Market Prices. *Financial Analyst Journal, 21*(5), 1965- 1974.

Galbraith, J. K. (1955). *The Great Crash.* London: Penguin Books Paperback Edition.

Gavin, M. (1989). The Stock Market and Exchange Rate Dynamics. *Journal of International Money and Finance*, *8*(2), 181-200

Gay, R. D. (2016). Effect of Macroeconomic Variables on Stock Market Returns for Four Emerging Economies: Brazil, Russia, India, and China. *International Business & Economics Research Journal (IBER), 15*(3), 119-126.

Gopinathan, R., & Durai, S. R. S. (2019). Stock Market and Macroeconomic Variables: New Evidence from India. *Financial Innovation, 5*(1), 1-17.

Gu, G., Zhu, W., & Wang, C. (2022). Time-Varying Influence of Interest Rates on Stock Returns: Evidence from China. *Economic Research-Ekonomska Istraživanja*, *35*(1), 2510-2529.

Kim, W. C., & Mauborgne, R. (1999). Creating New Market Space. *Harvard Business Review*, *77*(1), 83-93.

Kontonikas, A., & Kostakis, A. (2013). On Monetary Policy and Stock Market Anomalies. *Journal of Business Finance & Accounting*, *40*(7-8), 1009-1042.

Kyereboah-Coleman, A., & Agyire-Tettey, K. F. (2008). Impact of Macroeconomic Indicators on Stock Market Performance: The Case of the Ghana Stock Exchange. *Journal of Risk Finance, 9*(4), 365-378.

Lin, F. J., & Ho, C. W. (2019). The Knowledge of Entry Mode Decision for Small and Medium Enterprises. *Journal of Innovation & Knowledge, 4*(1), 32-37.

Mehrara, M. (2006). The Relationship between Stock Market and Macroeconomic Variables: a Case study for Iran. *Iranian Economic Review, 11*(17), 138-148.

Mohamadi, Y., Mohamadi, A., & Esmaili Kia, G. (2021). The Effect of Macroeconomic Variables on Stock Portfolio Performance Based on Traditional and Modern Networks. *Advances in Mathematical Finance and Applications, 6*(3), 1-25.

Musawa, N., & Mwaanga, C. (2017). The Impact of Commodity Prices, Interest Rate and Exchange Rate on Stock Market Performance: Evidence from Zambia. *Journal of Financial Risk Management, 06*(03), 300-313

Naughton, B. J. (2006). *The Chinese Economy: Transitions and Growth*. Cambridge, MA: MIT.

Obstfeld, M. (1998). The Global Capital Market: Benefactor or Menace? (NBER Working Papers). *Journal of Economic Perspectives*, *12*(4), 9-30.

Pedram, M., Mousavi, M. H., & Abbasi Aghda, S. (2016). Asymmetric Effects of the Interest Rate on Iran's Stock Price Index. *Management and Accounting Studies, Series 2*(4), 162-171.

Perera, P. R. M. R. (2016). The Importance of Interest Rate in Determining Stock Returns of Banks Finance and Insurance Companies in Seri Lanka. *International Journal of Management and Commerce Innovations, 3*(2), 451-454.

Quadir, M. M. (2012). The Effect of Macroeconomic Variables on Stock Returns on Dhaka Stock Exchange. *International Journal of Economics and Financial Issues*, *2*(4), 480-487.

Rashidi, R., & Maddah, M. (2020). The Effect of Interbank Interest Rate on Stock Price (With emphasis on Joint Comprehensive Plan of Action). *Quarterly Journal of the Macro and Strategic Policies*, *7*(5), 50-70.

Richard, A., Adekunle, A., & Hammed, O. (2012). Impact of Interest Rate on Capital Market Growth (A Case of Nigeria). *Universal Journal of Management and Social Sciences, 2*(11), 1-24.

Ross, S. A. (1976). The Arbitrage Theory of Capital Asset Pricing. *The Journal of Economic Theory, 13*, 341-360.

Shahabadi, A., Naziri, M. K., & Havvaj, S. (2013). Effects of Macroeconomic Variables on Tehran Stock Exchange Systematic Risk. *Quarterly Journal of Economic Researches and Policies, 21*(67), 89-104

Shiller, R. J. (2015). *Irrational Exuberance: Revised and Expanded* (3rd Ed.). Princeton, New Jersey: Princeton University Press.

Thornton, J. (1986). Bank Rediscounting at the Central Bank: A Survey of Alternative Theories and Some Evidence. *The South African Journal of Economics*, *54*(2), 120-128.

Tibebe, A., Omar, A., & Esqueda Andr´e, V. (2016). Stock Returns and Interest Rates around the World: A Panel Data Approach. *Journal of Economics and Business*, *89*, 20-35.

Yi, G. (2019). *Money, Banking, and Financial Markets in China*. London: Routledge.

Cite this article: Zarei, Z., Hemmati, M., & Davoudi, P. (2024). Evaluating the Effects of the Monetary Policy on the Total Stock Market Index in the Iranian Economy: Using the TVP-VAR and GARCH Approaches. *Iranian Economic Review*, *28*(3), 899-920.