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The dynamic relationship between trading volumes, share market returns and return fluctuations in companies listed on the Tehran Stock Exchange at different periods

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Abstract

This study aimed to assess the relationship between exchange volume and share market volatility. The present research measured exchange volume and shared market volatility variables and analyzed the data. The Statistical population is all companies accepted to the Tehran Stock Exchange. Sampling has been performed by the Systematic Elimination method. The data needed to test the research hypotheses were collected from the Stock Exchange reports (annual financial statements and Explanatory Notes) and daily share market statistics through the Stock Exchange websites for five years (2017-2021) and stored in a database to calculate the research variables. Data software of the Tehran Stock Exchange, including Rahvard and Tadbir Pardaz software, have been used to monitor and control information. Descriptive Statistics, Inferential Statistics, and the Granger causality approach were used for statistical analysis. The research variables were calculated after collecting information and data by entering information in Excel. Then, the results of measuring the variables were entered into the EVIEWS software for statistical calculations. The results show a significant relationship between trading volume and share market volatility.

Keywords: Trading volume, share market volatility, Return, Return Volatility
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1 Introduction

Fluctuations in financial markets play an essential role in decisions because they are the main risk factors in financial markets. High share fluctuations can cause uncertainty and capital outflow. Share fluctuations were used in financial decisions such as risk management, pricing, and asset allocation [1]. Securities markets are always a sensitive part of financial markets. Fluctuations and business cycles in the economy quickly affect this market and reflect economic changes, while the turbulence in the market are the cause of concern among market policymakers. A share market boom (increase in share price in comparison to the long-term or expected trend) makes the share market more attractive to investors. These investors are divided into two groups. The first group is foreign investors who transfer their capital to the target country along with the share market boom. The second group is domestic investors who have invested in parallel markets and transfer their capital to this market when the capital market is developing [14]. Investors invest to earn more profit. The Rate of return is one of the factors affecting the investment portfolio. Return

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on investment creates motivation as a driving force and is a reward for investors. An investor must first ensure that the Return on Capital will have occurred in the first step, then the Expected Return will be obtained to make an investment decision. Share returns depend on many factors. Market fluctuations are one of these factors. Uncertainty about market fluctuations theoretically affects foreign trade and the domestic economy, especially the share market [20]. The final result of a company's performance, i.e., net profit, is the first variable that most investors associate with a company's profitability. Unfortunately, the pure emphasis on the revenues and net profits of a company can be misleading. It will not always provide a clear picture of the company's performance. This pure emphasis can have adverse consequences. In return, transaction margin ratios can provide investors with a deeper sight into management efficiency. These ratios take into account the amount of revenue that the company will get from the sales of products, assets, and investments instead of considering how much the company's management has earned from the assets, shares, and investments [21]. In recent years, the capital market has fluctuations and, in some cases, has been growing and booming. At the same time, some of the main and important indicators in the Tehran Stock Exchange and other Stock Exchanges indicate partial trust in the capital market, the invention and evolution of new financial instruments, information, culture, clarification, training, and excellent and optimal supervision. In general, it seems that investing in the capital market and Stock Exchange is clear. It will help to attract new capital and growth indicators. Share market statistics and indicators have shown significant growth in most indices. This growing trend is expected to continue in the long term. However, some experts believe that the rate of increase of indices has decreased in the short term due to various reasons, including fluctuations related to sanctions and the circumstances after their abolition, special situations of international financial relations, and other variables affecting the economy and the share market. It may even have a descending trend at some times [9]. But investigating the role of influencing factors on fluctuations in the share market to increase participation.

In this market, study and research are required to identify the direction of the capital market. It should be done based on scientific methods. In the current environment governing the economy and capital markets of Iran and the world, through the analysis of the influencing factors, it can examine investors' behavior and try to identify and understand their reactions accurately and deeply and the current research has been done a step in this process. What is emphasized more than anything by the researchers is how and the cause of the relationship between transaction volume and share market fluctuations in the Stock Exchange. Researchers have offered different hypotheses. Most of the studies are about developed countries, and there are not enough empirical studies on emerging markets. However, the capital market is rapidly developing and changing. The markets of developing countries are more important in the economic globalization process. Therefore, studying the markets of developing countries is a higher priority. Studies focusing on the relationship between trading volume and share market volatility are seriously needed to analyze the share market situation. This study aimed to assess the relationship between exchange volume and share market fluctuations in the Tehran Stock Exchange. This research aims to identify the effects of trading volume on share market fluctuations, to highlight the importance of trading volume in increasing shareholder wealth for financial managers. Finally, increasing the awareness of managers will provide better decision-making in the optimal allocation of resources.

2 Literature review and theoretical foundations

The ultimate purpose of any economic enterprise is to maximize the inherent value of a share for shareholders, meaning sustainable value creation in the long term. Therefore, organizational strategies for resource allocation and performance evaluation systems should all be focused on realizing this goal. In this regard, maintaining the optimal level of cash to pay outstanding debts, and using sudden opportunities suitable for investment, is a sign of the business unit's flexibility. Access to raw materials for production is such that the company can quickly respond to customer demand, which is one of the reasons for the importance of the working capital concept. Therefore, any decision made in this department by the business unit managers will have severe effects on the operational efficiency of the business unit, which will ultimately lead to changes in the company value and shareholder wealth [13].

2.1 Exchanges Volume

Exchanges volume is the number of shares or contracts that are traded in a certain period of time (usually one day). The higher the volume, the more active the share. To determine the movement of volume (upturned or downturned), analysts look at volume bars, which are usually found at the bottom of each price chart. Volume bars show the number of shares traded in each time period and the trend with a method similar to the price [15]. The volume should change with the trend. Volume should also increase if prices change in an upward trend (and vice versa). For example, it is a sign that the trend is weakening and will end if a share is in an uptrend but sees low volume on positive trading days

[18]. When the volume tells a different story than the price, a divergence occurs, which is called a contradiction between two indicators. The simplest example of divergence is an upward trend with a downward volume [12]. Another use of trading volume is to confirm chart patterns. Patterns such as Head and Shoulders, Symmetrical Triangles, Flags, and other price patterns can be confirmed and fixed confirmed by using the volume of the exchange and through the process that we will explain in more detail in the following sections. There are several basic points in chart patterns that play a key role in transferring some content to the reader. In general, the quality of signs formed by graphical patterns decreases and weakens if there is no exchange volume to confirm the basic and axial points of this pattern. Another basic idea in technical analysis is that the volume of the exchange has priority over the share price. Exchanges volume is carefully examined by Experts and Chartists to develop ideas for predicting future changes. An uptrend price stops if exchange volume decreases in a rising trend price. Now that we have a better understanding of some important factors in technical analysis, we can discuss the charts, which help in identifying business opportunities during price changes [19].

2.2 Share market volatility

The Tehran Stock Exchange is an organized and formal market based on specific rules and regulations for buying and selling shares. The Share Price index is usually considered an obvious indicator of the performance of the stock exchange in Iran. Evaluating the trend of share price changes and its fluctuations is the most common starting point for investors when buying shares [5]. There is a price fluctuation in the stock exchange when the share price of the stock exchange suddenly rises, and then the prices decrease for two or three days and then rise immediately and fall again. It is measured based on the total index [7]. Share market volatility is measured based on the total index [7].

The prices of financial assets have a form of volatility due to the fluctuations of economic activities, and these fluctuations in prices are considered a common phenomenon in the share market performance. But it is possible to develop a more uniform and more efficient process for allocating capital by finding volatility patterns for shares in the stock exchange and using share price predictability [4]. In Tehran Stock Exchange, the share price fluctuation limit mechanism is used to limit the extreme volatilities in the share price, following the extreme fluctuations in the share price, and the range of share price fluctuations is faced with changes in certain periods. The fluctuation range of share prices has been determined based on trial and error, and there have been many changes in the procedures related to determining the range of share price volatility in the short term, regardless of the effect of these decisions on the market and investors' reactions to changes in the range of volatility. Price should be measured [11]. The following hypothesis has been proposed and tested based on the mentioned theoretical foundations:

H: There is a two-way and significant correlation between the exchange volume and stock exchange volatility

In the following, some of the research conducted in this field have been reviewed. Ahmadi and Rajabi [1] concluded that in studying the relationship between the volume and number of exchanges with share return fluctuations, understanding the relationship between variables in the capital market is important for investors to make better decisions. In the present research, the relationship between the number and volume of exchanges with return on investment fluctuations has been studied using Autoregressive Conditional Heteroscedasticity variance models. The results indicate a significant relationship between the volume and number of exchanges for formal and informal investors with return volatility. Mohammadi Yarijani et al. [15] developed and presented a model for exchange volume based on the most important psychological variables. The findings indicate that there is a significant positive and negative correlation between the variables of investors' pessimism/optimism and the exchange volume, But there is no significant relationship between the variables of investors' rationality, Loss aversion, and momentum with the trend of exchange volume. In other words, in the final model of the research, the two components of pessimism and optimism describe the changes in the volume of transactions in the Tehran Stock Exchange market. Tovanai Ahoi et al. [19] examined the relationship between Earnings quality, return on shares, and the moderating role of exchange volume in companies listed on the Tehran Stock Exchange. The results of the hypothesis test show that there is a significant relationship between earnings quality and stock on shares, and the relationship between earnings quality and stock returns in companies with high exchange volume is stronger than that in companies with low exchange volume. Haj Khan Mirzai Saraf et al. [7] performed Bayesian modeling of stock return fluctuations and exchange volume in the Tehran Stock Exchange. The findings show that the hypothesis of constant conditional correlation of the CCC model between the variables is rejected. There is a negative dynamic conditional correlation of the DCC model, which shows that with the increase in returns, investors do not have much desire to sell their shares due to optimism. By not selling shares, they reduce the volume of the exchange in the market and vice versa. On the other hand, the findings of the research show that considering the Student-Chole t distribution for residuals with a wider tail than the normal distribution and applying skewness has a better performance than other statistical distributions.

Rabibeigi [16] discussed the internal and external factors influencing the return and the effect of the volume of pure exchanges on the profitability of companies listed on the Tehran Stock Exchange. Bahrami and Dastgir [2] investigated the information content of the profit margin/assets turnover model in identifying return management. The purpose of the study is to determine the explanatory power of the Margin X Asset Turnover model in terms of changes in the future operating profit ratio in companies listed on the Tehran Stock Exchange. The results show that the diagnostic model of profit margin/asset turnover has less information content in identifying profit management than the abnormal accruals model. In a study of 26 countries, Saffi and Sigurdsson [17] concluded that exchanging volume has a positive effect on exchange market volatility but does not have a significant effect on loss reduction. However, a large number of shareholders have a fixed sight of exchange volume and share volatility. Henry and McKenzie [8] claim that exchanging volume can cause stock market volatility due to information asymmetry and market inefficiency. At the same time, some policymakers in some countries believe in the influence of exchange volume on stock fluctuations. Haj Khan Mirzai Saraf et al. [7] performed Bayesian modeling of return volatility and exchange volume of the Tehran Stock Exchange. Hong and Stein [10] presented a theory indicating that investment is limited and the investor cannot trade well with bad news in the market if exchanging volume is prohibited.

3 Methodology

This study is applied research with the analytical-descriptive approach for collecting data because its results can be used by companies, auditing organizations, auditing institutions, students, and researchers. It is classified in the post-event surveys group. In this research, the researcher has no control over the collected data. This study is also correlational research because we seek to determine the relationship between the exchange volume and stock market fluctuations.

The Statistical population is all companies accepted to the Tehran Stock Exchange from 2017 to 2021. Sampling has been performed by the Systematic Elimination method. So, the selected sample included all the companies accepted to the Tehran Stock Exchange that meet the following conditions:

- The financial year of the companies ends on 29 march 2023.
- The companies have not changed their financial year in the surveying period.
- They should not be among investment, mediation, financing, and holding companies because they have a special operating environment and are governed by special laws.
- The financial information of the companies in the surveying period should be available.

The statistical sample in this research includes 178 companies. The information required for the research literature is collected from Persian and Latin scientific books and magazines and articles extracted from the Internet (library method). The data needed to test the research hypotheses were collected from stock exchange reports (annual financial statements and explanatory notes) and daily stock exchange statistics on stock exchange websites for a period of 5 years (2017-2021) that were stored in a database to calculate the research variables. Data software of the Tehran Stock Exchange, including Rahvard and Tadbir Pardaz software, have been used to monitor and control information. The research variables were calculated after collecting information and data by entering information in Excel. Then, the results of measuring the variables were entered into the EVIEWS software for statistical calculations. Financial statements are available through databases such as Tadbirpardaz and Rahevard Navin software, audited financial statements of companies accepted to the stock exchange, which are stored in the library of the Tehran Stock Exchange. They are also provided with comprehensive information about the companies accepted to the stock exchange (Tehran Stock Exchange website). The research variables are trading volume and stock market volatility, which is calculated through the following formula:

$$VOL_t = \frac{(P_t^H - P_t^L)}{(P_t^H + P_t^L)} * 2 \tag{3.1}$$

where P_t^H is the max daily price, and P_t^L is the min daily price.

The VAR model has been used to examine the relationship between trading volume and stock market volatility. Autoregressive vectors are one of the econometric models used to control interrelations among many time series, which is a generation of auto-regression models. All the variables in the self-reversal model are systematically defined by previous variables and other elements of the model in one equation.

An autoregressive vector seeks to explain the evolutionary process of a set of k variables (which are called endogenous variables) in the same financial period using a linear function of only their previous values. The variables are combined into a vector called y_t, whose ith element is y_{it}, the observed element in period t of the variable y_i. Note that all variables must have the same aggregation rank. VAR is a set of regression models that can be defined as a connector between the Univariate Time Series Model (TSM) and Simultaneous Equation Model (SEM):

$$\begin{aligned} y_{1,t} &= c_1 + A_{1,1}y_{1,t-1} + A_{1,2}y_{2,t-1} + e_{1,t} \\ y_{2,t} &= c_2 + A_{2,1}y_{1,t-1} + A_{2,2}y_{2,t-1} + e_{2,t} \end{aligned} \tag{3.2}$$

In general, the estimation steps of the VAR model are as follows:

1. Analyzing the reliability of the variables (Unit Root Test)
2. Analyzing the Convergence (tests such as Johansen Test)
3. Choosing the optimal lag number of the model (through Akaike, Schwarz's Bayesian, and Hannan-Quinn criteria)
4. Model estimation

The Granger causality test is usually used to test the causality between macroeconomic variables. According to this test, we say that y is the Granger causality of x if the past values of the time series variable can significantly predict the values of X_{t+1} and vice versa.

As we said in the previous sections, the review of the literature and the obtained results show that there is a Bi-directional relationship between the variables of trading volumes and stock market volatility. It is better to use the Granger causality test to study how these two variables affect each other. Granger [6] presented a method to investigate the direction of causation between two variables by presenting the following model:

$$\begin{aligned} y_t &= \sum_i^n a_i y_{t-1} + \sum_i^n b_i x_{t-1} \\ x_t &= \sum_i^n c_i x_{t-1} + \sum_i^n d_i y_{t-1} \end{aligned} \tag{3.3}$$

Now, after estimating the above model, if the coefficients are statistically significant, it means that the xt variable is the Granger causality of the y_t variable. The variable y_t is also the Granger causality of the variable x_t if the d_i coefficients are also statistically significant. The causal relationship between two variables is One-directional, and if both are significant, if only one of the coefficients is significant, then the causality relationship is Bi-directional, which means there is a feedback relationship between the two variables, such that x_t and y_t are time series variables and u_t and v_t are disturbance items (residuals) of two regressions, and t is time, and i and j are the lag number. In the Granger causality test, the statistical hypothesis testing is as follows:

$$\begin{cases} H_0 = \beta_i = d_i \\ H_1 = \beta_i \neq d_i \end{cases} \tag{3.4}$$

In other words, the H_0 hypothesis shows the lack of a causal relationship between the two variables x_t and y_t, and the H_1 hypothesis shows at least a one-directional causal relationship between the two variables x_t and y_t.

The economic concept of collocation is when two or more time series variables are connected to each other based on theoretical foundations to form a long-term equilibrium relationship. Although these time series may have an unstable and random trend and be, they correlate with each other in the periods of time so that the difference between them is dynamic. There are different methods to implement the Cointegration test. One method is to create a linear relationship between the variables in the following pattern and fit the model using Eviews and then implement the unit root test for u_t. The variables are plural, and there is a long-term relationship between the variables if the disturbance components of this pattern do not have a single root and are stable [14].

The ARCH model is a technique for analyzing the structure of the variance u of random values of the model, which are defined as the autoregressive conditional variance. Let's see that in a regression model, the error term has a normal characteristic with zero mean and sigma variance to the power of two. Assuming the variance u constant

ensures that the OLS estimators are unbiased and efficient. The ARCH model is one of the suitable procedures for variability modeling. We describe this model with the concept of conditional variance u. The distinction between conditional and unconditional variance is similar to the distinction between conditional and unconditional mean. The conditional variance of u, which is represented by $\sum 2$, is:

$$\sigma_t^2 = var(u_t|u_{t-1}, u_{t-2}, ...) = E\left[(u_t - E(u_t))^2|u_{t-1}, u_{t-2}, ...\right] \tag{3.5}$$

Let's $E(u_t) = 0$:

$$\sigma_t^2 = var(u_t|u_{t-1}, u_{t-2}, ...) = E(u_t^2|u_{t-1}, u_{t-2}, ...) \tag{3.6}$$

The equation states that the conditional variance u is equal to the Conditional Mathematical Expectation u_t^2. So, σ_t^2 is calculated for time t, provided that the number of past errors is known. In the ARCH model, autocorrelation in variability is expressed by the conditional variance of the error term, which, in the simplest case, depends on the Mean squared error in the previous period:

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 \tag{3.7}$$

The above model is ARCH (1) because the conditional variance depends only on the Mean squared error of the previous period. Note that the above equation is only a part of the total model because it is not about the conditional mean of Y, that is, the main equation. In the ARCH model, the Conditional Mean Equation can be defined in different ways.

For example, lets,

$$\begin{aligned} Y_t &= \beta_1 + \beta_2 X_{2t} + \beta_3 X_{3t} + \beta_4 X_{4t} + u_t;\ u_t \sim N(0, \sigma_t^2) \\ \sigma_t^2 &= \alpha_0 + \alpha_1 u_{t-1}^2 \end{aligned} \tag{3.8}$$

The first equation is the conventional regression, which defines the conditional mean as follows:

$$E(Y_t|X_{2t}, X_{3t}, X_{4t}) = \beta_1 + \beta_2 X_{2t} + \beta_3 X_{3t} + \beta_4 X_{4t} \tag{3.9}$$

The second equation describes the conditional variance of Y; let it be constant. This model can be extended, and in general, it can be shown as ARCH(q):

$$\begin{aligned} Y_t &= \beta_1 + \beta_2 X_{2t} + \beta_3 X_{3t} + \beta_4 X_{4t} + u_t;\ u_t \sim N(0, h_t) \\ \sigma_t^2 &= \alpha_0 + \alpha_1 u_{t-1}^2 + \alpha_2 u_{t-2}^2 + ... + \alpha_q u_{t-q}^2 \end{aligned} \tag{3.10}$$

If we take the autoregressive moving average (ARMA) model for error variance, we will have the generalized autoregressive conditional heteroscedasticity GARCH [3]. In this case, we will have the GARCH (p, q) model, where p is the order of σ^2 in the GARCH model, and q is the order of ϵ^2 as follow:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \epsilon_{t-1}^2 + ... + \alpha_q \epsilon_{t-q}^2 + \beta_1 \sigma_{t-1}^2 + ... + \beta_p \sigma_{t-p}^2 = \alpha_0 + \sum_{i=1} \alpha_i \epsilon_{t-i}^2 + \sum_{i=1} \beta_i \sigma_{t-i}^2 \tag{3.11}$$

In the test of all the coefficients that indicate the significance of the relationship between the independent variables and the dependent variable, the F statistic has been used to assess the significance of the regression models used in the research. The comparison of the F statistic according to the following formula and the F value calculated with K-1 and n-K degrees of freedom at the 5% error level has led to the investigation of the following hypothesis model:

$$F = \frac{\frac{R^2}{(K-1)}}{\frac{(1-R^2)}{(n-K)}} \tag{3.12}$$

The hypothesis is proven when the calculated F (according to the calculations of Eviews software) is greater than the F in the table because, in this research, it is considered an alternative hypothesis (H_1) for the statistical test of the hypothesis. The t statistic has been used in each model to assess the significance of the coefficient of the independent variables. The following formula is used to calculate this statistic:

$$t = \frac{\hat{\beta}}{Se_{\hat{\beta}}}$$
$$\hat{\sigma}^2 = \frac{\sum e^2}{n-k} \tag{3.13}$$

where, $\hat{\beta}$ estimated coefficient, $Se_{\hat{\beta}}$ is the standard deviation of estimated coefficient, e^2 is squared difference between real and estimated observations, n is the number of observations, and k is the number of parameters.

The t statistic is compared with the t in the table, which is calculated with the $n-K$ degree of freedom at the 90%, 95%, and 99% confidence intervals. The desired coefficient will be significant if the calculated absolute value of t is greater than the t in the table, which indicates a relationship between the independent and dependent variables.

4 Findings

The Granger causality model was used to test the hypotheses. For this purpose, the fitting model and the related hypothesis are tested before the static test. First, the reliability and validity of the research were analyzed. The Augmented Dickey-Fuller test for unit root test was used to analyze the reliability, and the results are shown (table 1).

Table 1: The results of the Augmented Dickey-Fuller (ADF) test for unit roots (*Significant at the 5% level)

Variable	**ADF statistic**	**P-Value**	**Result**
Trading volume	6576.998	0.0001*	No trend and breadth from the origin at a reliable level
VOL	718.203	0.0001*	No trend and breadth from the origin at a reliable level

According to the results of the Augmented Dickey-Fuller test, all the variables are reliable based on P-Value (table 1). It is possible that the variables have a normal distribution with zero mean. We use the Jarque-Bera test to test the goodness of fit and normality of the variable. According to the findings, normality is accepted (table 2).

Table 2: Normal test results (*Significant at the 5% level)

Variable	**Jarque-Bera statistic**	**P-Value**	**Result**
Trading volume	55.443	0.0001*	The variable is normal
VOL	34.628	0.0001*	The variable is normal

4.1 Modeling stock market volatility using ARCH and GARCH model

The autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) are shown in Table 3. All values are small and low values of autocorrelation indicate series non-correlation. The LM test has been used to test the effect of ARCH in different intervals. Since the null hypothesis is that there is no effect of ARCH, it is accepted.

Table 3: ARCH test results

Lag	**ACF**	**PACF**	**LM statistics**	**P-Value**
1	0.413	0.413	1.709	0.112
5	0.143	0.031	1.540	0.116
10	0.193	0.061	1.329	0.124
15	0.109	0.041	1.190	0.145
20	0.102	0.007	1.034	0.166

Table 4: GARCH test results

t-Statistics	Value	Confiscation
11.72	0.688	μ
5.20	0.0126	α_0
9.89	0.477	α_1
9.86	0.2554	β_1
61.76	0.884	p
0.118	0.0071	q
1384.6		$Log(L)$
32.879		σ^2
0.895		π

The results of GARCH (2,2) modeling indicate that it is not suitable for market fluctuations (table 4).

Breusch-Godfrey test has been used to investigate the Autocorrelation in residual sentences in the regression model. The results and probability of LR coefficients show that the null hypothesis of the absence of first-order serial Autocorrelation between disturbance components is not rejected. It means that there is no first-order serial autocorrelation between the disturbance sentences. We investigate the second-order autocorrelation because one of the advantages of the Breusch-Godfrey test compared to the Durbin-Watson test is that it can investigate the autocorrelation in the second order and higher. We also analyze the phenomenon of second-order autocorrelation, and these results also show that there is no second-order serial autocorrelation between the disturbance sentences.

Table 5: second-order serial Autocorrelation test

F statistics	P-Value	Obs∗R-squared	P-Value
1.995	0.112	2.521	0.175

F statistics	P-Value	Obs∗R-squared	P-Value
0.994	0.265	2.654	0.391

4.2 Cointegration test

The VAR model is used to know the interaction between variables and also their causality by using stationary variables after implementing the reliability test of variables and their degree of reliability. The results of the reliability evaluation of the disturbance sentences variable (residual) show that the null hypothesis is rejected at the 5% level based on a single (Lack of reliability) root of the disturbance sentences. In other words, the disturbance sentences obtained from the estimation of the model are at the reliable level and have no unit root. It can be said that there is a long-term equilibrium relationship between model variables.

Table 6: The results of the Augmented Dickey-Fuller test for unit root test for model residual (*Significant at the 5% level)

Variable	ADF Statistics	P-Value	Result
U_t	-5.70	0.0001^*	No trend and breadth from the origin at a reliable level

4.3 Determine the number of optimal lag in the model

Cointegration analysis using the Johansen methodology requires the determination of the optimal interval length in the vector auto-regression model of VAR so that the results of long-term relationship estimations are very sensitive to the selected lag time for VA. In this study, the number of optimal lags is determined according to the minimum criteria of Akaik, Schwarz's Bayesian, and Hannan-Quinn criteria and the maximum value of the likelihood function. The optimal lag two is determined according to the criterion maximization rule.

4.4 Hypothesis test

The Granger causality model was used to test the hypotheses regarding the reliability and normality of the variables. In this case, TRADING VOLUME and VOL variables are the trading volume and stock market volatility, respectively.

Table 7: Determine optimal lag

Lag	HQ	SC	AIC	FPE	LR	Log L
0	−12.81	−12.70	−12.87	3	–	229.36
1	−13.53	−12.48	−14.08	9.40	19.21	282.50
2	−13.95	−13.37	−14.26	7.59	68.92	269.57
3	−13.89	−12.38	−14.69	5.66	33.50	309.15

The Granger causality test was implemented to find causality between two-time series. In other words, this test examines the relationship between the current value of one variable and the past value of another variable. Considering the model for the two-time series of TRADING VOLUME and VOL, we will have the following:

$$VOL = \beta_0 + \beta_1 \text{TRADING VOLUME}_{t-1} + u_t$$

$$\text{TRADING VOLUME} = \beta_0 + \beta_1 VOL_{t-1} + u_t$$

A VAR model between the exchange volume and stock market fluctuations with an interval of 2 was estimated according to the reliability and normality of the variables and the Granger causality test, and the results were obtained (table 8). This test is implemented by the P-Value obtained in the table, which is written against each coefficient so that if the P-Value is less than α, the null hypothesis is rejected (the relationship is significant). In general, the research hypothesis is accepted by accepting the Granger causality relationship between these two variables. It means that there is a two-tailed and significant relationship between the exchange volume and stock market fluctuations.

Table 8: Granger causality test results (*Significant at the 5% level)

Null hypothesis	P-Value	F-Statistics	Result
The null hypothesis was rejected	0.0001*	6.665	Trading volume is not the Grangerian causality of stock market volatility
The null hypothesis was rejected	0.0001*	6.436	Stock market volatility is not the Grangerian causality of trading volume

Variance analysis can describe the role of each updated variable on another variable, that is, the description of the relative effect scale. The result of the variance analysis of stock market fluctuations is shown in Table 9. As can be seen, more than 80% of the variation in the error variance of the stock market volatility is from the stock market volatility.

Table 9: Variance analysis of stock market volatility (VOL)

Period	Trading volume	VOL	S.E.
1	0.000	100.000	0.120
2	16.2752	83.7248	0.120
3	16.3997	83.6003	0.121
4	16.4033	83.5967	0.121
5	16.4532	83.5468	0.121
6	16.4841	83.5159	0.121
7	16.4841	83.5159	0.121
8	16.4841	83.5159	0.121
9	16.4841	83.5159	0.121
10	16.4841	83.5159	0.121

5 Discussion and conclusion

In the first case, the results of the Granger causality test in the research period between the variables of exchange volume and stock market volatility show that there is a two-way causal relationship between the exchange volume and

stock market fluctuations. This relationship shows that the changes in exchange volume have an effect on the stock market volatility in the short term. On the other hand, stock market volatility towards the exchanging volume has a causal relationship in the short-term or at least the Granger causality relationship shows it. This research studied the effect of exchange volume on market volatility in the stock market. This research shows that with fundamental statistical analysis, VAR model construction, and Granger causality test, and variance analysis based on the Granger causality test during the time period studied, exchanging volume is the Granger causality of market fluctuations, and market fluctuations are the Granger causality of the exchanging volume. There is a two-way relationship between exchanging volume and market volatility. In this case, the Granger causality model was used to test the hypothesis regarding the reliability and normality of the variables. Therefore, the TRADING VOLUME variable is considered as exchanging volume and VOL as stock market fluctuations. A VAR model between exchanging volume and stock market volatility with lag two is estimated according to the reliability and normality of the variables, which at the 5% error level exchanging volume is the Granger causality of stock market volatility and vice versa.

In general, the hypothesis of the research (variable of purchase margin as a symbol of exchange volume) is accepted with acceptance of the Granger causality relationship between two variables; that is, there is a two-way and significant relationship between exchanging volume and stock market fluctuations. The results of variance analysis of stock market fluctuations show that in the first period, all error variance is reflected in stock market fluctuations. In the second period, more than 80% of the error variance in stock market volatility is justified. This process continues to the end. Therefore, it has an almost uniform trend in the short-term (the first forecast periods), mid-term, and long-term. It can be concluded that the share of exchanging volume in the interpretation of the error variance of stock market fluctuations is significant. In general, it is suggested that the factors in the plans for the development of the stock market should be emphasized as much as possible, considering the effect of the exchange volume on the stock market fluctuations on the one hand and on the participation of investors in the stock market on the other hand. Planners, decision-makers, and general managers at the national level, while paying attention to these factors, identify as many other trust-building factors as possible and promote them to increase the participation of real investors in the stock market and this capital market development.

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