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Investigating the Effect of Stock Market Variables on GDP in Iran Using Autoregressive Distributed Lag (ARDL) Model

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ABSTRACT

Paying attention to the development of macroeconomic variables, including GDP, has been an important part of the planners' concerns in different communities, because it is not only affected by the economic and political conditions of the communities, but also by financial and capital markets. This study aimed to investigate the effect of stock market variables on GDP in Iran. In this regard, this has been studied using quarterly statistical data from 2009 to 2020 and an autoregressive distributed lag (ARDL) model. To do this, three variables of total index, industrial index and trade value as the stock market activity and GDP variable have been used. The results showed that the variables of total index and industry index have no effect on GDP in the short run and in the long run, but the value of stock trading affects GDP, and this effect is reversed. The number of vector error correction (VEC) factor was -0.49 that showed the equilibrium in almost two time periods.

Keywords: GDP, Stock Market Variables, Autoregressive Distributed Lag (ARDL) Model

Introduction

Economists, financial experts, and policymakers pay close attention to the significant benefits that the stock market creates for the economy, and consider it as the support of capital market activities. This market is known as an important instrument in equipping and allocating savings, which is vital for the efficiency and growth of an economy. In other words, the stock market facilitates the transfer of funds for economic growth. The stock market enables governments to increase their long run capital to finance the development and modernization of existing industrial units or the implementation of new projects. Thus, the stock market contributes to economic growth through the specific services it provides [1]. Gross domestic product (GDP), which is one of the macroeconomic variables, is one of the indicators and economic information of the money and capital markets. This component originates from the important pillars of the financial sector of society's economy and is used in the analysis and evaluation of the financial economy of any country [2]. The study of fluctuations in GDP and its various aspects is one of the topics that has attracted much attention in the economy. Many efforts have been made to identify the factors affecting the fluctuation in production, however, reasons such as differences in the political and economic structure of countries, different effects of a similar factor in different countries, etc. have prevented the formation of a coherent theory in relation to the most important factors affecting fluctuations. The economic literature show that economic fluctuations do more harm to the developing countries than to the developed countries. The economy of Iran, as a developing country with rich oil resources, has experienced various periods of economic instability, and trying to establish a stable environment has always been one of the biggest goals of economic policymakers. Study of the time series of the GDP variable of Iran also shows that this variable did not have a uniform trend over time and had different behaviors [3]. GDP and its changes are the

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determining factor of economic growth in a country. In other words, economic growth is the continuous increase of real GDP in a country, and is considered as a measure of economic performance of a society, and increasing its rate leads to improved social welfare [4].
In this study, the effect of some stock market indices, which is one of the most important mechanisms facing the world economy is examined, and the main role of this market is to collect stagnant liquidity and direct it to investment expenditures and financing of economic activities and production services of the private sector to address the GDP in Iran. GDP is one of the macroeconomic indices whose growth is considered as the economic growth, but the economic growth is not considered as the GDP growth. Once these variables are identified, the question must be asked whether the stock market actually has an effect on economic growth and GDP. Finally, an attempt is made to use statistical data from the Statistics Center of Iran, the Central Bank and the Ministry of Economy and Finance to examine the effect of stock market variables on the Iranian economy over a period of time. The main purpose of this study is to investigate the effect of stock market variables on GDP in Iran using the autoregressive distributed lag (ARDL) model.

Theoretical Foundations and Literature Review

Theoretical Foundations

The relationship between stock market development and economic growth has been a major concern among academics, policymakers and economists around the world in recent decades. Typically, a significant positive or negative relationship between financial market development and economic growth varies according to the country under study. Given the importance of economic growth and development in a country, recognizing the factors affecting the growth is very important. Among the factors affecting economic growth and development, stock market development has been considered by most researchers and government officials and efforts have been made to develop stock market in different countries.
Always recognize the causal relationship between financial development and economic growth due to its impact on the adoption of different economic development policies, not only for economists and researchers but also for policymakers has also been of great importance [5]. Researchers and policymakers have made many efforts to find measures that lead to economic growth. Most analysts such as Mckinnon (1973) [6], Shaw (1973) [7], and Levine and Zervos [8] believe that financial deepening can accelerate the economic growth. As a result, policymakers need to focus on creating and promoting financial institutions. Others, such as Patrick (1966) [9], Lucas (1988) [10], Jang (1986) [11], Friedman and Schwartz (1963) [12], Stern (1989) [13], and Irland (1994) [14], have opposed this view. They believe that if there is no causal relationship between financial development and economic growth, policies aimed at developing and promoting financial intermediaries cannot help the growth process [15].
Economists have proposed different theories about the relationship between financial development and economic growth. Studies on financial development and economic growth are divided into four categories:
The first group believes in the causal relationship from financial development to economic growth (supply leadership view); This means that policymakers can achieve economic growth by developing the financial sector (trough increasing the level of savings, investment volume and investment efficiency). Therefore, policymakers should pay more attention to the creation and promotion of financial institutions such as banks, credit institutions and capital markets for the real development of the economy. This view was first proposed by Schumpeter (1911) [16]. He argues that the financial sector, as a source of funds for productive investment, promotes economic growth and accelerates it. Hasan et al. [17] also emphasize the positive impact of financial development on economic growth and believe that financial development opportunities in the developing countries are more than the developed countries.
The neoclassical theory of growth (Paul Romer [18], Sergio Rebelo [19], Grossman, Elhanan Helpman [20]) also emphasizes the importance of financial development over economic growth and believes that financial functions affect economic growth through two channels: capital accumulation rate and technology innovation rate. Experiences of countries have indicated that financial development has had a pure and positive effect on savings, capital formation and economic growth.
The second group believes that economic growth leads to financial development and the causal direction is from growth to financial development (demand leadership view). Thus, economic growth follows the demand for financial services, which leads to the development of the financial sector. Robinson (1952) [21] and Jang (1986) [11] are proponents of this view.
The third group are theories that believe in the two-way relationship between economic growth and financial development. Greenwood and Smith (1997) [22], Luintel and Khan (1999) [23], and Demetriades and Hussein (1996) [24] support this view. Regarding the relationship between financial development and growth, Patrick (1996) [25] posed this question: "which one is more important? financial sector development or the real sector?" In response to this question, he proposed the following two hypotheses:
1) Supply Leadership Hypothesis: In this hypothesis, the supply of services and financial instruments are authentic; So that the development of a country's

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financial sector is ahead of economic growth in terms of time.

2) Demand tracking hypothesis: Economic growth in a country is the reason for the development of that country's financial sector. The cause-and-effect relationship develops from growth to financial development.

Patrick (1966) [9] believes that in the early stages of economic growth, the financial sector plays an important role in economic growth through the expansion of financial markets and opening the financial institutions and the supply of financial assets (supply-party view); But with increasing economic growth at higher levels, the expansion of the financial sector is affected by economic growth (demand-party view).

The fourth group believes that there is no relationship between financial development and economic growth. Ram (1999) [26] and Dawson (2003) [27] confirm this view [28].

One of the topics that has been considered by economists since the beginning of economics is the issue of economic growth, and in the new economic era that the world is experiencing today, capital has a much higher position in the process of economic growth. Therefore, it is necessary for domestic savings and foreign capital to be directed to high-yield production activities. This will be possible through an efficient stock exchange market as the main participation institution of joint-stock companies [29].

Literature Review

In some studies, the positive relationship between two variables of the stock market and GDP has been mentioned, and in others, the negative relationship and sometimes the two-way relationship of these variables have been mentioned.

Gerami Asl et al. [30], did a study entitled "Study of Stock Market Profitability in Iran Economy". Findings showed high profitability of Tehran Stock Exchange over 2000-2011. The average annual return was 36% for each industry and 32% for the entire market. According to these results, an average risk of 14% for each industry and 10% for the entire market were considered.

Dejpsand and Bokharaie [28] studied the relationship between financial development and economic growth in Iran based on the post-Keynesian macroeconomic model using the autoregressive distributed lag (ARDL) model, and concluded that since Iran is a developing country and cannot devote more resources to the development of its financial system and financial markets are not efficient enough, therefore, financial markets have not been able to serve the real sector of the economy and investment. For this reason, the post-Keynesian view on the relationship between financial development and economic growth in Iran in the period under study has not been statistically accepted.

Sadeghi Klidsar and Mirzapur Babajan [31] did a study on the relationship between stock market and economic growth in Iran using a nonlinear model. Using a linear regression model and nonlinear regression of generalized method of moments (GMM), they found that the impact of financial development on economic growth depends on the country under study and the model used. The results were significant when the whole sample was measured using a nonlinear model but the linear model was not significant. There was also no non-linear relationship between Iran stock market development and economic growth.

Farman Ara et al. [32] studied on the role of the capital market in financing and economic growth using panel data. The results of this study showed that financing through the capital market was statistically significant and had a positive effect on economic growth in the short and long run. Also, the level of development of the financial market leaded to the greater effectiveness of the capital market in economic growth.

Ramkelawon et al. [33] did a study on the relationship between stock market development and economic growth in Mauritius using the ARDL model and concluded that there was no significant relationship between stock market development and economic growth in Mauritius.

Krchnivá [34], did a study entitled "Does the Stock Market Affect Real Economic Activity?" by the ARDL model found that the stock market may be considered as an important predictor of economic activity, however there is no correlation between the stock market and economic activity.

Pan and Mishra [35] in a study entitled "Development of The Stock Market and The Real Economy (by Empirical Evidence from China)" using the unit testing method, structural autoregression model and ARDL model found that with the development of the stock market in Shanghai, China, the Shanghai stock market has had a long run negative relationship with the real economy.

Nathaniel et al. [36] did the study entitled "Do stock market stocks financially predict economic growth in Merkin Marquez? (New documents from Nigeria)" by the ARDL model and found that there is a positive relationship between the development of the Nigerian stock market and economic growth. It can be said that the development of the stock market plays a very important role in the Nigerian economy.

Method

In this study, in addition to long run relationships between variables, short run dynamics between variables are also studied, thus a model should be selected that links short run dynamics to long run ones. In many economic and financial models, the effectiveness of explanatory variables is significantly delayed; These delays can be due to economic

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structures or the reactions of economic agents to these variables [37]. In 1997, Pesaran & Shin [38] proved that if the cointegration vector obtained by applying the least squares method in a ARDL model with wide and well-defined lags, in addition to have a normal distribution, it is less basie and more efficient in small samples [39].

A ARDL model that estimates a variable relative to values with own lags and other variables, can be calculated using Formula (1).

$$\Delta^d Y_t = \Delta^{d-1} Y_t - \Delta^{d-1} Y_{t-1} \quad (1)$$

In general, the form of a ARDL model is as follows:

$$Y_t = \beta_0 + \sum_{h=1}^{p-1} \eta_h Y_{t-h} + \sum_{h=0}^{q-1} \lambda_h X_{t-h} + \varepsilon_h \quad (2)$$

Here, Y is the dependent variable and X represents the independent variables and ε_t is white noise. The white noise process is a sequence of time-dependent variables that are not related to each other, so that the average of their values is zero [40].

According to the cointegration theory, it is necessary to use methods in estimating functions when using time series that pay attention to reliability and cointegration. In ARDL model, the appropriate model can be selected by determining the appropriate lags for the variables. This model also estimates the long run and short run models at the same time and solves the problems of variable deletion and autocorrelation. ARDL model estimates are basie and inefficient due to the absence of problems such as cointegration and endogeneity [41].

Error correction models relate short run fluctuations to long run values, or more simply, these models show how the short-run process adjusts to the long run one.

Error correction models based on the Pesaran & Shin [37] approach are as follows.

$$\Delta Y_t = \alpha_0 + \sum_{j=1}^{p-1} \phi_j^* \Delta Y_{t-j} + \sum_{j=0}^{q-1} \beta_j'^* \Delta x_{t-j} + \omega_0 y_{t-1} + \sum_{i=1}^{k} \omega_i x_{i,t-1} + \varepsilon_t \quad (3)$$

Here, the left part of equation is the first-order difference of the dependent variable; The right part is respectively the y-intercept or trend, the first-order difference lag values of the dependent variable, lag values, the first-order difference of the independent variable, EMC, independent lag variables, and the white noise. k is the number of regressor or the number of vector elements x_t ; x is independent variable. $\omega_0 y_{t-1}$ is an error correction, and the coefficient ω_0 is the very ECM (-1) which indicates how quickly the short run is adjusted to long run; In other words, it shows the speed of process adjustment.

The coefficient ω_0 must be negative and less than one and indicates what percentage of the imbalance is corrected in each period. If this coefficient is greater than one or positive, it cannot be interpreted economically (Wooldridge, 2016) [42].

Specify the Research Model

This study aimed to investigate the effect of stock market variables including total stock index, industry index, trading value index on GDP in Iran using ARDL model. The variables mentioned in this model are introduced as follows.

Total Stock Index: An index that shows the trend of general price level of all companies listed on the stock exchange and the changes in the general price level compared to the origin date; It is displayed as TX.

Industry Index: It is the weighted mean of the stock portfolio price ratios of companies in industrial sectors with a weight equal to the value of their shares at the base time, which is displayed as IX.

Trading Value Index: The value of securities traded on a stock exchange, which is calculated as the sum of the number of securities traded at its current price; It is displayed as VX.

Gross Domestic Product: Gross domestic product is the market value of all final goods and services produced in a country over one year; It is displayed as GDP.

The ARDL model according to the research variables will be specified as follows.

$$GDP = \beta_0 + \sum_{h=1}^{p-1} \eta_h GDP_{t-h} + \sum_{h=0}^{q-1} \lambda_h TX_{t-h} + \sum_{h=0}^{q-1} \theta_h IX_{t-h} + \sum_{h=0}^{q-1} \alpha_h VX_{t-h} + \varepsilon_h \quad (4)$$

Examining the short run and long run relationships between research variables and how to adjust the short run to long run process is possible using the above formula. The relationships between variables through this formula can be positive or negative, significant or insignificant, and direct or indirect. After determining the relationship between variables through the error correction mechanism, the equilibrium process from short to long run is examined.

Analysis of Findings

In this study, the effect of stock market variables on GDP is investigated using ARDL model. In this model, the variables include stock market variables such as total stock index, industry index, trading value index and GDP. An overview of the research variables over 2009-2020 is presented in Figure (1) to identify similarities and differences.

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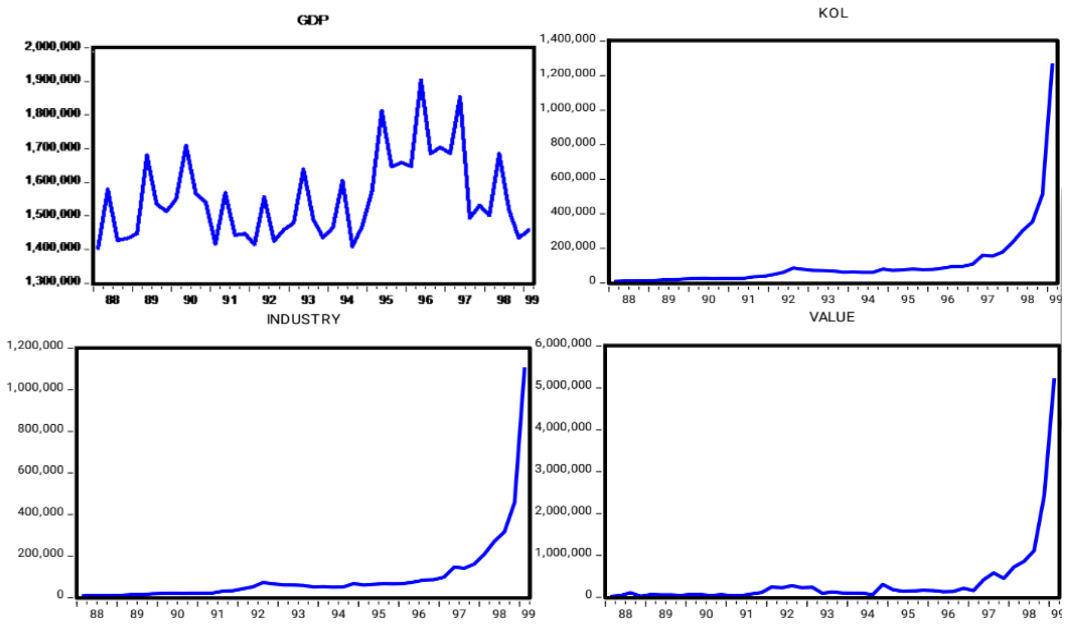

Figure1. Overview of research variables (Source: Research Findings)

Over the period, the lowest value of GDP was related to the autumn of 2015 and the highest value was related to the summer of 2017. The variable of total stock index had an upward trend; This increasing trend over 2009-2018 had an almost uniform growth. Over 2018-2020, it grew significantly and finally reached its peak in the spring of 2020. The industry index variable over this period was uniform and increasing and over 2009-2018 has gone through almost a trend. From 2018 to 2020, this index has reached its peak. The trading value from the beginning of 2009 to the end of 2018 has gone through a steady and uniform trend. Since the end of 2018, it has increased with a very steep slope and finally reached its maximum in the spring of 2020.

All the results of this research have been analyzed using EViews-10 software and also the data are taken from the database of the Central Bank, Statistics Center of Iran and the Ministry of Economy and Finance.

Check Stationary of Data

Stationary test is done to prevent false regressions and find an equilibrium relationship between variables. Stationary is an important factor that has a serious impact on the behavior of a time series [37]. In this study, the Phillips-Prone test was used to examine the stationary of data. The results related to the stationary of the research variables are presented in Table (1).

Table 1
Results of the stationary of variables over 2009-2020

Variable	Phillips-Prone test statistic value	Significance Level
GDP	-4.392013	0.0011
Total Stock Index	7.032905	1.0000
Industry Index	6.707441	1.0000
Trading Value Index	11.13237	1.0000

Source: Research Findings

In general, after examining the four variables, it is concluded that the variable of GDP is at the level of stationary, but the variables of total stock index, industry index and trading value index are not at the level of stationary.

Check Cointegration of Data

The variables of the total stock index, industry index and trading value index are not at the level of stationary. Here, since not all cointegrating variables are at the same rank, Pesaran's band test is used for cointegration analysis. The results of Pesaran's band test are presented in Table 2.

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Table 2
Results of Pesaran's band test of variables over 2010-2020

	Statistics value	Lower limit (bound)	Upper limit
Pesaran's Band Test Statistics	1.015725	2.37	3.2
		2.79	3.67
		3.15	4.08
		3.65	4.66

Source: Research Findings

- Estimate The Model

After examining the long run relationship between the variables, the ARDL model of variables can be estimated using the following formula.

$$GDP = \beta_0 + \sum_{h=1}^{p-1} \eta_h GDP_{t-h} + \sum_{h=0}^{q-1} \lambda_h TX_{t-h} + \sum_{h=0}^{q-1} \theta_h IX_{t-h} + \sum_{h=0}^{q-1} \alpha_h VX_{t-h} + \varepsilon_h \quad (5)$$

The results of a ARDL model are estimated in the form of an equation, Formula (6), as follows.

GDP = 0.744315222824*GDP (-1) - 0.0671599185588*GDP (-2) - 0.128387836242*GDP (-3) + 0.771868749499*GDP (-4) - 0.825439577753*GDP (-5) + 0.389242603265*KOL + 0.834528540979*INDUSTRY - 0.261365008352*VALUE + 751112.956469 (6)

Estimating the ARDL model, the values are presented in Table (3).

Table 3
Results of the ARDL model

Variables	Coefficients	t-statistic value	Significance level
GDP (-1)	0.7744315	6.455145	0.0000
GDP (-2)	-0.067107	-0.70446	0.4889
GDP (-3)	-0.128388	-1.435616	0.1611
GDP (-4)	-0.771769	-7.536497	0.0000
GDP (-5)	-0.825440	-6.135260	0.0000
KOL	0.389243	0.097922	0.9226
INDUSTRY	0.834529	0.181647	0.8570
VALUE	-0.261365	-2.746120	0.0099
C	0.751113	2.760079	0.0096
Statistic	p-value		
Coefficient of Determination	0.820312		
f-statistic	17.690020		
Durbin-Watson statistic	1.865454		
Statistic	Significance level		
f-statistic	0.000000		

According to the above table, the model estimated based on Schwarz statistics is estimated as ARDL (5,0,0,0). Also, the coefficient of determination is 82%, which indicates that the estimated model is largely consistent with the real model, and the Durbin-Watson statistic is calculated to be 1.8. According to the theoretical literature, the closeness of this statistic to the number 2 indicates the absence of serial autocorrelation of residual.

Error correction model based on the Pesaran & Shin approach is another tool that this model provides to the researcher, which is presented as the formula (7).

$$\Delta Y_t = \alpha_0 + \sum_{j=1}^{p-1} \phi_j^* \Delta Y_{t-j} + \sum_{j=0}^{q-1} \beta_j'^* \Delta x_{t-j} + \omega_0 y_{t-1} + \sum_{i=1}^{k} \omega_i x_{i,t-1} + \varepsilon_t \quad (7)$$

Since the ARDL model can examine both short run and long run relationships, this formula can be used to achieve short run and long run relationships between variables, as well as error correction model, which indicates the adjustment of the process of short run to long run relationships. The results of this estimate are presented in Table (4).

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Table 4
Investigation of short run relationships between the variables

Variables	Coefficients	t-statistic value	Significance level
GDP(-1)(D)	0.237916	1.488391	0.1468
D(GDP (-2))	0.180180	1.270893	0.2132
D(GDP (-3))	0.058093	0.443272	0.6606
D(GDP (-4))	0.816049	7.273551	0.0000
D(KOL)	-3.067923	-0.415707	0.6807
D(INDUSTRY)	5.004415	0.572116	0.5714
D(VALUE)	-0.245923	-3.314052	0.0023
Coint Eq (-1)	-0.491243	-3.450309	0.0016

Source: Research Findings

Considering the significant level of regression coefficients, only the fourth differential lag of the GDP variable and differential of the trading value variable are significant in the short run; That is, in the short run, the total stock index and the industry index have no effect on GDP in Iran. Findings indicate that the trading value in the short run has an effect on GDP, which indicates an inverse relationship. Also, in the short run, the significance of the fourth lag of GDP means that GDP has a mechanism of autoregressive effect; That is, GDP in Iran is affected by GDP in last years. The vector error correction (VEC) coefficient here is -0.491247; This number indicates that it takes two periods from non-stability to stability or STD Stade. The error correction model as formula (8) shows how to get the long run process.

Cointeq = GDP - (0.7711*KOL + 1.6532*INDUSTRY - 0.5178*VALUE + 1487931.7684) (8)

Long run relationships between variables are presented in the table below.

Table 5
Examining the long run relationships between the variables

Variables	Coefficients	t-statistic value	Significance level
KOL	0.771078	0.095879	0.9243
INDUSTRY	1.653178	0.189892	0.8506
VALUE	-0.517756	-2.761594	0.0096
C	.31.768373	39.624185	0.0000

Source: Research Findings

According to above, the total stock index and the industry index have no effect on GDP in the long run in Iran, but the trading value has an effect on GDP in the long run, and the opposite is true.

Validation of Estimated Model

Determining the appropriate model, tests should be conducted to check the validity of the model. The results of these tests indicate the accuracy and validity of the estimated model. CUSUM Test, Jarque-Bera Test, Heteroscedastic Variance Test, Breusch-Pagan Test and Breusch-Godfrey Test have been used here, which are described below.

In the first step, the CUSUM test for the ARDL model, is estimated by the least square method. According to the values, the stability of research parameters has been established over 2009-2020. Therefore, the null hypothesis based on the structural stability is accepted and its absence is rejected.

Next, it is examined normality of the Jarque-Bera test which is used specially to check the normality of residuals in the time series and regression. Since the significance level of Jarque-Bera statistic is more than 0.1 (it has become non-significant), then in the estimated model, the distribution of residuals has a normal variability.

In an estimated regression model, the value of variance of the residuals should be a constant value. This means that the residuals must have heteroscedastic variance. This test is one of the simplest tests used in this field and was introduced by Mr. Breusch and Mr. Pagan in 1979. Given the non-significance of the F-statistic, the null hypothesis is accepted, which states that the residuals (errors) have the heteroscedastic variance. Therefore, the heteroscedastic variance of the residuals is proved in this test.

Breusch-Godfrey test was used to investigate serial autocorrelation in the research. Given that the probability level (0.8681) is higher than the acceptable probability level (0.1) and has become non-significant, then the null hypothesis is accepted. Therefore, there is no serial autocorrelation for residuals and the model is valid

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Conclusions

The stock market development is a reflection of the developing economy which creates a positive and two-way relationship between economic growth and stock market development indices in the long run. Providing a source of capital for business, the possibility of foreign investment and providing a source for government budget, are the characteristics of the stock market that leads to economic growth of countries and has a positive impact on the world economy. In fact, most of the researches done in Iran on macroeconomic variables and the stock market has indicated that there is no significant relationship between these variables. The reason for the inverse relationship between the trading value and GDP can be the increase in the trading value on the stock exchange which indicates the movement of money and liquidity from the real sectors of the economy to speculation. In other words, money and liquidity transfer from the productive sectors of the economy to the stock market; During this process, the investment in the manufacturing sector is reduced. In the stock market, the increase in the trading value indicates that prices in the stock market are not real and money and liquidity have entered the market for the purpose of speculation, which is a destructive economic operation. Liquidity should be divided into two parts; Liquidity from the growth of money of production units that is useful for the country's economy and liquidity from the debts of banks, which is inflationary. The strategy to increase the liquidity of production units is price liberalization, and this liberalization is the most appropriate way to support the stock market. Manufacturing enterprises must be able to produce, sell and export their products in a competitive environment; Such competition will be meaningless with mandatory pricing. It has long been common in our country that imports are controlled and there has been a limited competitive environment, however one cannot suddenly expect a change in the economic structure of the country because many industries and businesses in the country cannot compete with foreign companies. With the current situation, the interior can be made competitive. The car market may be monopolized by two major car companies, but other markets, including home appliances, food products, detergents, etc., have several suppliers in the country and competition between producers and price liberalization will provide the conditions for increasing the liquidity of production units.

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