The Impact of Macroeconomic Variables on Stock Price: An ARDL Approach to Sri Lanka

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ABSTRACT

The study investigates the impact of macroeconomic variables on stock prices in Sri Lanka by analyzing the monthly data from January 2001 – December 2020. ARDL bounds testing approach is applied to check the long-run relationship between macroeconomic variables and stock price. Error correction version of the ARDL model was used to identify the short-run relationship between macroeconomic variables and stock price. The findings suggest that stock price in long term is significantly affected by the consumer price index and Treasury bill rate. In the short run, all variables are insignificant except the Treasury bill rate which is negatively related to the stock price. The government should consider the stock price and these macroeconomic variables when implementing government policies such as privatization, foreign exchange control and monetary policy.

Keywords: All Share Price Index, ARDL Approach, Cointegration, Stock market.

1. Introduction

The macroeconomic variables are crucial for any change in the economy of a country. Macroeconomic factors such as inflation, industrial production, exchange rate, money supply, unemployment, risk premium, and rate of interest have large influences on stock market operations. Investors consider macroeconomic variables when they value stocks. Theoretical models such as Capital Asset Pricing Model (CAPM) introduced by Sharpe (1964) and Arbitrage Pricing Theory (APT) introduced by Ross (1976) suggest that an understanding of the macroeconomic context is essential for investors and policymakers in making effective investment decisions (Kulathunga, 2015). Economic theory implies that there should be two-way causal relationships between macroeconomic activity and stock market prices. Macroeconomic variables have a

significant impact on stock market performance and reversely, stock markets have a significant role on economic growth.

Colombo Stock Exchange (CSE) is the main stock exchange platform. It operates through the Colombo stock brokers association. It has been the only stock exchange available in Sri Lanka. The Colombo Stock Exchange (CSE) has 290 companies representing 20 GICS industry groups as of 20th January 2020, with a Market Capitalization of RS. 2,748 Bn. The CSE has two main price indices, the All Share price index (ASPI) and the S&P Sri Lankan 20 index (S & P SL 20). These values are calculated on an ongoing basis during the trading session, with the closing values published at the end of each session. The All Share Price Index (ASPI) is the broad market index of the CSE and is designed to measure the movements of the overall market. (Jayasundara et al., 2019)

Figure 1: Behaviour of All Share Price Index

Since January 2001 ASPI started to show an upward trend with a cyclical pattern. However, development in CSE was not sustained. The ASPI increased from 815.10 points in December 2002 to 1922.21 points in December 2005 and declined to 1821.53 points in October 2008 due to the global financial crisis. The decline was nearly 14% compared with the previous month's index. After the war in May 2009, CSE has grown at a considerable rate. A remarkable boom in ASPI can be observed after May 2009. ASPI reached 7798 points, the highest ASPI in CSE history, in February 2011. In May 2012, ASPI declined to 4832.15 points. Even though, ASPI increased from 5968.31

points in May 2014 to 7332.05 points in July 2015 and declined again to 6774.20 points in December 2020. (CSE, 2021)

Previous studies have been conducted to determine the relationship between macroeconomic variables and stock prices on the global scale and the country level. Even though, the findings differ when it is repeated with different sample periods and also in different frequencies of the data. Previous research findings relate to international context Sharma and Mahendru (2010), Chandrashekar (2018), Epaphara and Salema (2018), Gurloveleen and Bhatia (2015), Keswani and Wadhwa (2019), Hunja (2014) found out the controversial relationship between macroeconomic variables and stock prices. In relation to the Sri Lankan context, Jahufer (2015) found that stock price is positively related to the exchange rate and inflation rate. But, Menike, L (2006) found out Stock price is negatively related to the exchange rate and inflation rate. Further, Nijam et al. (2015) have identified the negative and positive effects of macroeconomic variables on the stock price. Therefore, investigating the impact of macroeconomic variables on stock prices is a problem of high significance.

Capital formation and well-developed capital markets are important for the country's economic development and growth. In the Sri Lankan financial market, the Colombo stock exchange and related companies are mainly involving capital formation. In the past, the Sri Lankan government has introduced various policies to develop the stock market. Therefore, this type of study will be important for local and foreign investors, policymakers, stock market regulators, and stock market analysts. Further, the objective of this study is to investigate the impact of macroeconomic variables on stock price in the Sri Lankan Stock Market.

The paper is organized as follows. Section I clarifies the Colombo stock market and the importance of macroeconomic variables in an economy. Section II discusses the empirical results of existing studies and their analytical techniques as well as objectives. Section IV then discusses the stationarity properties of the variables and the relationships among the variables in the short run and long run. Finally, Section V presents concluding remarks.

2. Literature Review

Many researchers have tried to investigate the relationship between macroeconomic variables and stock market performance in the past decades. They have done several empirical and descriptive studies to check the effect of macroeconomic variables on stock prices or the existing relationship between the two. The different findings have been identified by the various studies according to the selection of variables, methodologies, techniques and tests used. Here, we discussed some previous studies and their conclusions that are related to this study.

Sharma and Mahendru (2010) attempted to identify the impact of macroeconomic variables on stock prices in India. The study used monthly data from January 2008 to January 2009. Multiple regression analysis methods were utilized to identify the relationship between Stock price and macroeconomic variables such as exchange rate, gold price rate, inflation rate and foreign reserve. The findings reveal that exchange rates and gold prices significantly affect the stock price. But foreign exchange reserves and inflation rates don't have a significant influence on the stock price.

Similarly, Gurloveleen and Bhatia (2015) have done a study on the Indian Stock Market. The study used monthly data of ten macroeconomic variables, namely broad money, call money rate, crude oil price, exchange rate, foreign exchange reserve, foreign institutional investors, Gross fiscal deficit, index of industrial production, inflation rate, trade balance and BSE 500 stock price index have used to attain the objectives of the research. The Augmented Dickey-Fuller (ADF) test, Multiple Regression model and Granger Causality tests were utilized to find out the results. The findings reveal that two macroeconomic variables such as foreign institutional investors and exchange rate have significant relationships with the stock price. According to the Granger causality test, there is no causal relationship between these variables and the BSE 500 stock price. The study also reveals that the Indian stock market is weak and efficient since there is no relationship among the variables during the study period.

Further, Keswani and Wadhwa (2019) also conducted a study based on the Indian stock market using monthly data for the period 2006 to 2016 with the help of unit root tests, correlation analysis and Granger causality test. The study used disposable income, government policies, inflation rate, exchange rate and interest rate as macroeconomic variables and stock prices NSE and BSE. The findings show that there is a strong

relationship between disposable income, government policies, exchange rate and two stock prices. Furthermore, disposable income positively affects stock prices whereas government policies, inflation rates, exchange rates and interest rates negatively affect stock prices.

Chandrashekar et al. (2018) explored the role of macroeconomic variables on stock prices in emerging economies using the Panel Granger causality test and Johansen – Fisher Panel co-integration test. The study used monthly data for the period January 2000 to August 2016 and different macroeconomic variables such as the index of industrial production, consumer price index, lending rate and real effective exchange rate. The result of the Dynamic least squared method reveals that exchange rate and stock price have a positive and significant relationship. But other variables have insignificant impacts on the stock price. Moreover, the result of Granger causality test shows the existence of unidirectional causality between stock price and macroeconomic variables.

Using the same analytical technique Epaphara and Salema (2018) examined the effect of selected macroeconomic variables on stock prices. The analysis covered monthly data during the period from January 2012 to December 2016, and variables such as inflation rate, treasury bill rate, exchange rate and money supply. The findings reveal that money supply and exchange rate have a positive effect on the stock price. Meanwhile, the Treasury bill rate has a negative effect on the stock price. Further, the inflation rate does not affect the stock price.

Hunjra (2014) tried to produce empirical evidence between macroeconomic variables and stock prices in Pakistan. The analysis covered the monthly data for the period from January 2001 to December 2011. Granger causality tests and co-integration tests are applied to estimate the possible impact of macroeconomic variables on stock prices. The study utilized macroeconomic variables such as interest rate, exchange rate, Gross Domestic Product and inflation rate. The study reveals that there is a positive relationship between macroeconomic variables and stock prices. In addition, the Granger causality test suggests that there is no relationship between dependent variable and explanatory variables.

In Sri Lanka, Jayasundara et al. (2017), and Lakmali and Madhusanka (2015) investigated the relationship between stock price and some macroeconomic variables

such as interest rate, industrial production index, inflation, treasury bill rate, exchange rate, real GDP growth rate, global financial crisis and war were used as independent variables in these studies. The findings of these studies show that interest rate, industrial production index and civil war negatively affect all share price index (ASPI) while US dollar exchange rate and real GDP growth rate positively reacted with the all share price index. Further, the global financial crisis positively affects the share price index, which is contradictory to the experiences of developed countries. Further, the exchange rate and Treasury bill rate have a negative impact on stock price, and the inflation rate does not affect stock.

Similarly, Menike (2006) also studies the relationship between Sri Lankan stock price and four macroeconomic variables, namely, money supply, exchange rate, inflation rate and interest rate with the application of multiple regression models. The study covers the data over the period from September 1991 to December 2002 for 34 stock companies. The analysis reveals the money supply variable is significant in ten companies while it is significantly negative for five companies. Interest rate is significantly negative for 14 companies and positive for 2 companies respectively. Further, the inflation rate is also significant and negative for 15 companies while it is positive for 3 companies significantly. However, the exchange rate variable, the most influential variable, is significantly negative for 12 companies whereas it is positive for 10 companies significantly. The lagged money supply and inflation rate variables are jointly significant for only 23 companies and they are mainly negatively related to stock prices.

In 2015, Nijam et al. investigated the relationships between the all-share price index of the Colombo stock exchange and five macroeconomic variables, namely, Gross Domestic Product, inflation proxies by wholesale price, interest rate, the balance of payment and exchange rate over the period from 1980 to 2012. For this purpose, the Ordinary Least Squared method was utilized and the analysis reveals that macroeconomic variables and the stock market index (All share price index) are significantly related. Further, the stock market index significantly and positively relates to Gross Domestic Product, exchange rate and interest rate while it negatively relates to inflation. The balance of payment is found to be insignificant in determining the stock market performance.

Jahufer and Irfan (2014) analyzed the contribution of macroeconomic factors on the stock market performance in Sri Lanka with respect to inflation, exchange rate money supply and money market rate. The data were collected on a monthly basis from January 2001 to December 2011. The result shows that inflation and money supply positively and significantly affect the stock price while exchange rate and money market rate negatively and significantly affect the stock price.

The existing studies used analytical techniques such as the multiple regression model, Johansen co-integration test and Granger causality test for the analysis. Based on the empirical review there is a scarcity of new studies after 2016 in the Sri Lankan context. Therefore this study attempts to investigate the impact of macroeconomic variables on stock price using the ARDL Bounds testing approach to provide the latest empirical evidence.

3. Methodology

This study covers the Monthly data of Sri Lanka over the period from January 2001 to December 2020. The All share price index (ASPI) was used as a proxy variable for the stock price which was extracted from Colombo Stock Exchange. Exchange rate (ER), Money Supply (MS), Treasury bill rate (TBR) and Consumer price index (CPI) were employed as macroeconomic variables and data were collected from the Central Bank of Sri Lanka. All variables, except TBR, are transformed into a natural logarithm.

Before conducting the analysis, ADF and PP unit root tests were conducted to test the stationarity property of the series. Akaike Information Criterion (AIC) is applied to determine the optimal lag length of each series. Diagnostic Tests were conducted to check whether the results are robust and the Cumulative Sum (CUSUM) test was conducted to check the stability of the model. Autoregressive Distributed Lag bounds testing procedure was conducted to test the Long run relationship between variables. The ARDL method can provide robust long-run results while working on small sample sizes and it can be applied if the variables are entirely I (1) or I (0). The empirical model for the ARDL bounds test is formulated as follows:

$$LASPI_t = \beta_0 + \beta_1 LCPI_t + \beta_2 LER_t + \beta_3 LMS_t + \beta_4 TBR_t + U_t \dots\dots\dots\dots\dots\dots \quad (1)$$

Whereas in equation (1)

ASPI = All Share Price Index

CPI = Consumer Price Index.

ER = Exchange Rate

MS = Money Supply

TBR = Treasury bill rate

U_t is the error term, t = 1,2,3 ……T. Autoregressive Distributed Lag (ARDL) co – integration bound testing procedure developed by Pesaran et al. (2001) was employed to find out the long–run relationship between variables. The ARDL form of equation (1) can be presented as follow:

$$LASPI_t = \beta_0 + \beta_1 LASPI_{t-1} + \beta_2 LCPI_{t-1} + \beta_3 LER_{t-1} + \beta_4 LMS_{t-1} + \beta_5 TBR_{t-1} + \sum_{i=1}^{n} \beta_{6i} \Delta LASPI_{t-i} + \sum_{i=0}^{n} \beta_{7i} \Delta LCPI_{t-i} + \sum_{i=0}^{n} \beta_{8i} \Delta LER_{t-i} + \sum_{i=0}^{n} \beta_{9i} \Delta LMS_{t-i} + \sum_{i=0}^{n} \beta_{10i} \Delta TBR_{t-i} + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots (2)$$

Where, $\beta_1, \ldots\ldots\ldots\ldots, \beta_5$ refers to the long – run coefficients; $LASPI_{t-1}, LCPI_{t-1}, LER_{t-1}, LMS_{t-1}, TBR_{t-1}$ are the vector of explanatory variables with lag one; $\beta_6 \ldots\ldots\ldots \beta_{10}$ refers to the short – run dynamic coefficients.

$\Delta ASPI_{t-i}, \Delta LCPI_{t-i}, \Delta LER_{t-i}, \Delta LMS_{t-i}, \Delta TBR_{t-i}$ denotes the vector of explanatory variables with lag i and ε_t is the white noise error term. The first step in the ARDL bounds testing approach is to estimate equation (1) by Ordinary Least Squares (OLS) in order to test for the existence of a long-run relationship among the variables by conducting an F-test for the joint significance of the coefficients of the lagged levels of the variables, that is:

H0: $\beta 1 = \beta 2 = \beta 3 = \beta 4 = \beta 5 = 0$ against the alternative
H1: H is not true

If the F-statistic is above the upper critical value, the null hypothesis of no long run relationship can be rejected irrespective of the orders of integration for the time series. Conversely, if the test statistic falls below the lower critical value, the null hypothesis cannot be rejected. Finally, if the statistic falls between the lower and upper critical values, the result is inconclusive. The approximate critical values for the F-statistic test were obtained from Pesaran et al. (2001). ARDL Error correction model (ECM) was

adopted to examine the short–run relationship between variables and long–run adjustment. ECM is shown in Equation 3 as a transformation of Equation 2.

$$LASPI_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i}\Delta LASPI_{t-i} + \sum_{i=0}^{n} \beta_{2i}\Delta LCPI_{t-i} + \sum_{i=0}^{n} \beta_{3i}\Delta LER_{t-i} + \sum_{i=0}^{n} \beta_{4i}\Delta LMS_{t-i} + \sum_{i=0}^{n} \beta_{5i}\Delta TBR_{t-i} + \gamma ECT_{t-i} + \varepsilon_t \quad \ldots\ldots\ldots (3)$$

Where γ is the speed of adjustment which should be statistically significant and should have a negative sign. ε_t is the pure random error term.

4. Discussion

Table 1: Unit root test results

	ADF Unit root test		PP Unit root test	
Variables	Level	1st difference	Level	1st difference
LASPI	0.0860	0.0000*	0.1233	0.0000*
LCPI	0.1695	0.0151**	0.2507	0.0000*
LER	0.9797	0.0000*	0.9490	0.0000*
LMS	0.9696	0.0000*	0.9604	0.0000*
TBR	0.0313**	0.0000*	0.0411**	0.0000*

Note: probability values are given in parenthesis. *, **, *** show significant at 1%, 5% and 10% level respectively.

According to the results of ADF and PP unit root tests, the All Share Price Index, consumer price index, money supply and exchange rate are stationary at 1st difference. The obtained probability values are less than the 0.05 significance level, implying that the null hypothesis of unit root is rejected; hence, we conclude that these variables are integrated into order one. For the variable of treasury bills, it is stationary at the level as the probability value is less than the 0.05 significance level. Thus, it is suggested to proceed with the ARDL model.

ARDL Bounds Test

Table 2: Result of Bounds Test

Bounds Test	95% Level of Confidence		90% Level of Confidence	
F-Statistics	I(0) Bound	I(1) Bound	I(0) Bound	I(1) Bound
6.6596	2.56	3.49	2.20	3.09

Table 2 gives the result of the bound test for ARDL in which it can be seen that there are different critical values of upper and lower bounds corresponding to the different level of confidence. The result of the Bound test shows that F – statistics is 6.65. This exceeds the critical values of the upper bound at 1%, 2.5%, 5%, and 10%. Therefore, it can be concluded from the ARDL Bounds test findings that there is long-run cointegration in our variables. Akaike Information Criteria (AIC) advocated the use of the ARDL (1, 0, 1, 0, 0) model for the analysis. The selected model is given below in figure 2:

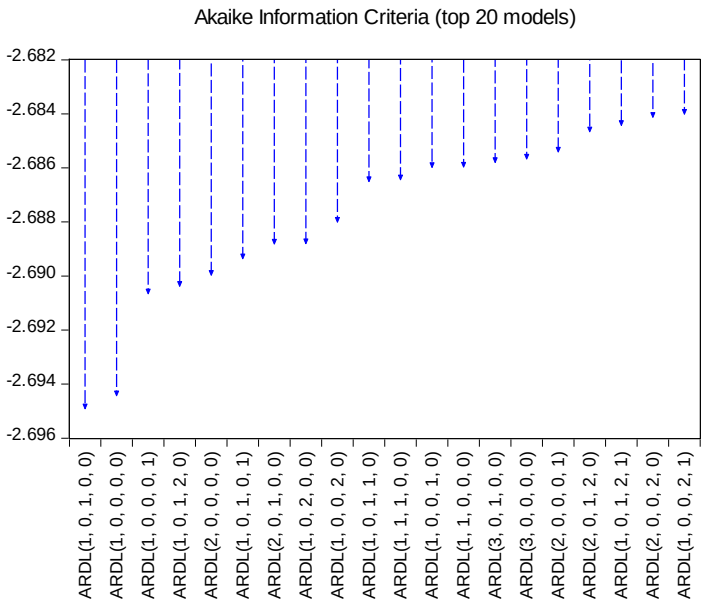

Figure 2: Selected ARDL Model

Table 3: The long-run results of the corresponding ARDL model

Dependent Variable: LASPI
Long–run Coefficient Estimates

Cons	LCPI	LER	LMS	TBR
8.1542	3.0535*	0.8684	-1.3005	-0.1170*
(0.0016)	(0.0050)	(0.7129)	(0.2485)	(0.0009)

Note: probability values are given in parenthesis. *, **, *** show significant at 1%, 5% and 10% level respectively.

According to Table 3, CPI positively and significantly affects the ASPI in the long run as expected by the Arbitrage pricing theory. This implies that increasing CPI causes to ASPI increase in Sri Lanka. Meanwhile, CPI largely affects ASPI in the long run. When CPI increases by 1 percent, the ASPI increases by 3.053 percent, holding others fixed. Whereas, TBR is the next variable that significantly affects the exchange rate in the long run. When TBR increases by 1 percent, the ASPI decreases by 0.117 percent, holding others fixed. This finding is similar to the finding of Jayasundara et al. (2019). Further, ER and MS do not impact significantly the ASPI in the long run.

Table 4: Results of Short-run Relationship and Long-run Adjustment

Short – run Coefficient Estimates $\boldsymbol{R^2}$ = 78.6 Dependent Variable: ⊗LASPI					
Variables	⊗LASPI	⊗LCPI	⊗LER	⊗LMS	⊗TBR
Lag 0		0.214	-0.386	0.017	-0.012***
		(0.4400)	(0.3121)	(0.9589)	(0.0975)
Lag 1	0.901*		0.2342		
	(0.0000)		(0.5497)		
ECT (-1) = - 0.194 (0.0000)					

Note: probability values are given in parenthesis. *, **, *** show significant at 1%, 5% and 10% level respectively.

Next, the results of the short-run dynamic and long-run adjustment coefficient are presented in Table 4. Accordingly, lagged value of ASPI positively and significantly affect the ASPI in the short run. Moreover, the current value of TBR has a negative

and significant impact on ASPI in the short run at a 10% significance level. But, ECT (-1) carries an expected negative sign, which is highly significant, indicating that there should be an adjustment toward a steady-state line, in the long run, one period after the exogenous shock. Nearly 19.4 % of disequilibrium in the ASPI is corrected every year. As a prerequisite for accurate estimations, diagnostic tests were employed and results are given in table 5. For diagnostic purposes, normality, serial correlation and heteroscedasticity tests are conducted for the equation (2). Table 5 presents the diagnostic test results.

Table 5: The results of Diagnostic Tests

Test	Probability
Normality (Jarque – Bera Test)	0.6956
Serial Correlation (BG LM Test)	0.3909
Omitted Variables (Ramsey RESET Test)	0.2300
Heterockedasticity (BPG Test)	0.3946

As displayed in Table 5, the computed probability value of Breusch – Godfrey serial correlation Lagrange multiplier (LM) test for the model is 0.3909, which is statistically insignificant at conventional significance levels and this suggests that the disturbances are serially uncorrelated. The adequacy of the models is indicated by the insignificant test value of the Ramsey RESET test and the heteroscedasticity test (BPG) test shows that the residuals of the models have a constant variance. The probability value of the Jarque – Bera Test shows that error terms are normally distributed. Considering the diagnostic and stability tests, our main model Equation (2) has the desired econometric properties in that residuals are serially uncorrelated, normally distributed and homoscedastic. Therefore, the results are valid for meaningful interpretation.

The parameter stability is assessed for Equation (2) through the Cumulative Sum (CUSUM). Figure 3 shows the plot of CUSUM of the recursive residuals. The results reveal strong stability of the coefficients in the plots of the CUSUM statistics falls inside the critical bounds of 5%.

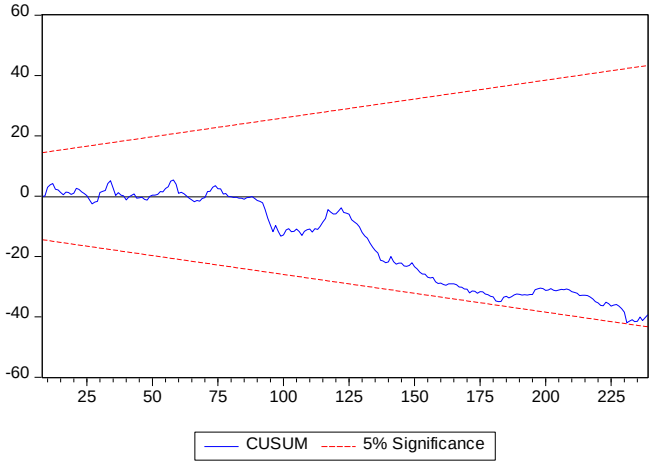

Figure 3: CUSUM Test

Table 6: Results of Pairwise Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Prob.
DLCPI does not Granger Cause DLASPI	236	0.79722	0.4518
DLASPI does not Granger Cause DLCPI		0.14766	0.8628
DLER does not Granger Cause DLASPI	236	0.54881	0.5784
DLASPI does not Granger Cause DLER		3.07152	0.0482
DLMS does not Granger Cause DLASPI	236	0.98502	0.3750
DLASPI does not Granger Cause DLMS		1.97281	0.1414
TBR does not Granger Cause DLASPI	236	4.30775	0.0146
DLASPI does not Granger Cause TBR		0.16151	0.8510

Note: *, **, *** show significant at 1%, 5% and 10% level respectively.

Based on these results, it can be concluded that ASPI Granger causes ER at the 5% significance level and ER does not Granger causes ASPI. Hence, this means that there is a unidirectional causality that runs from ASPI to ER in the short run for Sri Lanka. In addition, the results also indicate that there is a one-way causality running from TBR to ASPI.

5. Conclusions

The study investigates the impact of macroeconomic variables on stock price in Sri Lanka by applying the ARDL Bounds testing approach for the annual data from January 2001 - December 2020 periods. The selected ARDL model passes all diagnostic tests and the stability test. The result of the ARDL Bounds test implies that there exists a co - integrating the relationship between the variables. According to the long-run results, CPI positively and largely affects the ASPI in the long run. Meanwhile, TBR negatively affects the ASPI in the long run and short run. ER and MS do not impact significantly on the ASPI in the long run. Further, there is a unidirectional causality that runs from ASPI to ER and TR to ASPI. Therefore, this study suggests that the government should consider stock price and these macroeconomic variables when implementing government policies such as privatization, foreign exchange control and monetary policy. Also, the findings of the study may be useful to the public and the economy, especially stock market investors to focus on macroeconomic variables for making effective decisions to enhance their stock return.

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