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Vector Auto Regressive (VAR) Model Approach in the Capital Market

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ABSTRACT

As an important instrument in the economy, the capital market requires indicators to determine its growth. One of the influencing indicators is the Composite Stock Price Index (IHSG) with various factors that influence it. This research aims to test and analyze the relationship between inflation, exchange rate, BI-rate, and the amount of money in circulation (M2) on the IHSG for the period January 2017-March 2022 using the Vector Autoregression (VAR) method analyzed with Eviews 12. Process results The data in the research provides evidence that the variables only have a one-way relationship, where the R-squared value shows that the independent variables in the model can explain the changes in the dependent variable that occur. A high F-Stat value in the data processing results indicates that the variables in the model have a simultaneous influence on the dependent variable. The implications of this research can provide insight to market players and regulators regarding macroeconomic factors that can influence capital market growth.

ABSTRAK

Sebagai salah satu instrumen penting dalam perkonomian, pasar modal memerlukan indikator-indikator untuk mengetahui pertumbuhan di dalamnya. Salah satu indikator yang mempengaruhi adalah Indeks Harga Saham Gabungan (IHSG) dengan berbagai faktor yang mempengaruhinya. Penelitian ini bertujuan untuk menguji dan menganalisis hubungan inflasi, nilai tukar, BI-rate, dan jumlah uang yang beredar (M2) terhadap IHSG untuk periode Januari 2017-Maret 2022 dengan menggunakan metode Vector Autoregression (VAR) yang dianalisis dengan Eviews 12. Hasil olah data pada penelitian memberi bukti bahwa variabel-variabel hanya mempunyai hubungan satu arah, dimana nilai R-squared menunjukkan bahwa variabel independen dalam model dapat menjelaskan perubahan variabel dependen yang terjadi. Nilai F-Stat yang tinggi pada hasil olah data mengindikasikan bahwa variabel-varaibel dalam model memiliki pengaruh secara simultan dengan variabel dependen. Implikasi dari penelitian ini dapat memberikan pandangan kepada pelaku pasar dan regulator mengenai faktor-faktor makroekonomi yang dapat memengaruhi pertumbuhan pasar modal.

1. INTRODUCTION

One instrument that has an impact on economic development is the capital market (Sumaryoto et al., 2021). This statement is because the capital market is one of the foundations of the economy in providing capital to run the economy. The role of the market is to collect funds from the public or investors which becomes a means of funding for a company (Adisetiawan & Surono, 2016). According to Adisetiawan & Surono (2016), an indicator is needed that can be used by the public as investors to find out the value and the capital market condition before investing. The capital market is also a source of additional funding for companies and the government (Suhartini & Widoatmodjo, 2022). The Composite Stock Price Index (CSPI) defined as index that contains stocks listed on the Indonesia Stock Exchange so that their movements indicate the condition of Indonesian Stock Exchange capital market.

In periode January 2017 – March 2022, the CSPI showed fluctuating movements. In January 2020, the CSPI show its lowest condition due to the Covid-19 pandemic that hit the world and Indonesia in particular, which had a significant impact on stock market conditions (Sukmawati et al., 2021). Facts also provide clues to the causes of the decline in economic conditions and the regulations provided by the government to overcome the current pandemic (Imam et al., 2020).

Some research literature mentions the impact of inflation variables, BI rate, exchange rate and money supply (M2).(Azhar et al., 2020) researchs it shows that the exchange rate, M2, and interest rate variables do not have a reciprocal relationship, but only a one-way relationship for each variable. Sonia et al., (2022) researchs found the variables of inflation, interest rates, exchange rates and money supply had a partial effect at the long-term balance of the CSPI. Research of (Sumaryoto et al., 2021) shows that money supply was significant to the CSPI, while inflation was not significant to the CSPI.(Mulyani et al., 2020) stated that the money supply and inflation had a negative effect on the CSPI. Research of Yuliani et al., (2021) shows inflation, exchange rate, money supply simultaneously influences the CSPI.

The research gap in this study is the fluctuation in the growth of the CSPI because of changes in various aspects that are factors in the CSPI, both internal and external factors. In addition, the Covid-19 pandemic has had a real impact causing adjustments to regulations in various aspects of life, including the economy. This study aims to examine and analyze the variables of inflation, BI rate, exchange rate and the money supply (M2) as the dependent variable on changes in the CSPI variable as the independent variable.

The application of the Vector Autoregression (VAR) model is one model which is used to determine forecasting, and is linked to the economy one of which is macroeconomic policy making. Basically a VAR Model used to explain the dynamic behaviour between observed variables and are interconnected and will be explained further through functions the properties are the Impulse Response and Variance Decomposition functions. By Therefore the VAR model is very suitable to be applied in relation to economy. This is due to most areas of the economy uses time series data to describe economic fluctuations. Like macroeconomic policy making regarding developments in the real sector through a mechanism that generally does not have an immediate impact, usually requires a certain grace period (lag). There is a solution to this problem answered by the VAR model as a form of macro econometric model which is most often used to see the problem of economic fluctuations.

The Vector Autoregression (VAR) model has simple estimates 4 namely with Ordinary Least Square (OLS) and a separate model can be created for each endogenous variable. The forecast results produced are several cases is better compared to using a simultaneous equation model complex one. Apart from that, the Vector Autoregression (VAR) model is very useful in understanding the existence of reciprocal relationships (interrelationships) between economic variables and in the formation of a structured economy

The relationship between fiscal and monetary policy has become a polemic for many circles which is included in the field of economics and policymaking. This matter because monetary policy is more about achieving targets to maintain price stability. Meanwhile, on the other hand, fiscal policy is more about achievement economic growth. This problem is caused by trade-off between price stability and economic growth in the short term. The illustration is that high policy has an impact on increasing inflation, and vice versa In an economy high inflation has a negative impact on growth economy.

2. LITERATURE REVIEW

2.1. Portfolio Theory

A portfolio was first defined as an investment in various financial instruments in the 1950s by Harry M. Markowitz. A portfolio is able reduce the risk of loss when investing by diversifying, namely dividing funds into various assets so that if one asset experiences a loss while the other assets do not experience a loss, the investment value will not be lost at all. Markowitz (2009) further explains that portfolio theory is an investment approach that is related to investors' risk estimates and return expectations, which are measured statistically to create an investment portfolio, financial assets collection, such as shares, bonds, mutual funds, commodities, and ect al. The basis for selecting a portfolio was first proposed by Harry M Markowitz in the 1952s called portfolio theory Markowitz. Markowitz's theory uses several statistical measurements the basis for developing a portfolio plan, including expected return, standard deviation of both securities and portfolios and inter-correlation returns. This theory formulates the existence of return and risk elements in an investment, where the element of risk can be minimized through diversification and combining various investment instruments into portfolio.

2.2. Composite Stock Price Index (CSPI)

The Composite Stock Price Index (CSPI) is one of the indexes on the Indonesia Stock Exchange. This index is a combination of stocks listed on the Indonesia Stock Exchange and is used a measuring tool to determine the performance value of these stocks. CSPI is used to find out how a capital market develops in general so that it becomes basic information for investors (Parulian & Mahendra, 2021). All shares are included in the CSPI calculation, including preferred shares and ordinary shares (Fuad & Yuliadi, 2021). CPSI also plays a role in assessing general market conditions, seeing whether market fluctuations occur. The CPSI value is obtained by calculating all share prices listed on the Indonesian Stock Exchange (Anoraga & Pakarti, 2001).

2.3. Inflation

Inflation a process of continuous increase in prices in general because of the inappropriateness of the program by the system in procuring commoditi (production, printing money, determining prices, etc.) with people's income levels (Putong, 2015). An increase the price of certain goods occurs only once isn't included the inflation category even though increase is large. Inflation is related to the CSPI because inflation affects people's purchasing power (Hasanudin, 2021). Conditions and situations of decreasing or weakening currency values and increasing prices of goods are inflationary phenomena (Aryani & Maupula, 2021). Sustained inflation will have an impact in the form of a decline in overall economic conditions and disrupt the country's political stability (Fahmi, 2015). Not only does it have a significant impact on the economic sector, inflation will also have an impact on wages and income levels (Rahmani et al., 2019)

The definition of inflation rate is the percentage increase in prices of goods between periods. This inflation rate is measured by the Consumer Price Index (CPI) to determine changes in a good or service. Those who benefit from inflation are entrepreneurs whose income is higher than the increase in goods prices. If the price of goods rises, producers will increase production levels. An increase in the number of goods will increase the producer's income. High and unstable inflation reflects economic instability which results in general and continuous increases in the price level of goods and services, and results in higher levels of poverty in Indonesia.

2.4. Exchange Rate (ER)

The exchange rate is the amount of domestic currency that must be paid to obtain one unit of foreign currency. refers to recent changes in exchange rates. if a currency appreciates, it is said that the currency is strengthening because it can buy more foreign money.

In an open economic system, exchange rates have an important role because they influence the value of international transactions. Exchange rate shows the balance between supply and demand for foreign currency against domestic currency (Azhar et al., 2020). The dollar exchange rate is price of one dollar unit in rupiah. Increase and decrease in the exchange rate depend on supply and demand occurs for the money in circulation (Sa'adah, 2020). An increase in domestic exchange rate occurs is called an appreciation of foreign currency, while a decrease in domestic exchange rate is called a foreign currency's depreciation. Exchange rate as one of the basics of an open economy has an important role in the CSPI (Hutauruk, 2021).

2.5. BI-Rate

The definition of BI Rate according to Bank Indonesia is a monetary policy instrument in the form of an interest rate set by Bank Indonesia and announced to the public. BI-rate is one of the indicators used to determine economic stability (Gunawan & Bawono, 2021). BI Rate is implemented in liquidity management in monetary operations in the money market, so that monetary policy targets can be achieved. The BI rate is announced monthly at Bank Indonesia Board of Governors meetings. Bi rate is also a picture of the economy, both micro and macro in Indonesia (Pasaribu, 2018).

2.6. Amount of Money Supply (M2)

The money supply is all types of money circulating in economic activities, including demand deposits stored in commercial banks (Sukirno, 2004). In Indonesia, the money supply is the duty and authority of Bank Indonesia. The money supply is a monetary policy whose management involves the monetary system of the central bank, commercial banks, and rural banks (Alfian & Mustafa, 2019). Nopirin (1994) explains that the money supply is divided into several types based on the level of liquidity, namely M1, M2, and M3.

Discount politics is a central bank policy to increase or decrease the amount of money in circulation by increasing or decreasing bank interest rates. If there are symptoms of inflation, the central bank will increase interest rates to reduce the amount of money in circulation and vice versa.

3. METHODS

This research is quantitative research with secondary data in the form of time series data in the form of monthly data for the period January 2017 to March 2022. The secondary data processed comes from Bank Indonesia and the official Yahoo Finance website. Data collection uses the technique of directly downloading time series data related to the variables studied for the period January 2017 to March 2022 from Bank Indonesia and the official Yahoo Finance website. This research uses several statistical tools such as Microsoft Excel 2016 which is used for data processing regarding table creation and analysis, while E-Views 12 is used for time series data processing.

This research uses the Vector Autoregression (VAR) method to analyze data. Some of the research variable data was converted into natural log form, namely IHSG, exchange rate and M2 data, while inflation and BI rate were not converted into natural log form. VAR test was chosen in this research because this model does not need to differentiate between endogenous and exogenous variables and is very suitable for modeling economic problems because it focuses more on events or phenomena that occur. VAR analysis is very good to use because VAR can be used to find out and understand the relationship between variables (Tesa, 2012). Data description and forecasting can use VAR model. The VAR can be written in a general equation as follows:

$$Y_t = A_0+A_1Y_{t-1}+A_2Y_{t-2}+\ldots+A_PY_{t-P}+\varepsilon_t$$

Which is:

Y_t = vector with size (n.1) containing n variables according to the number contained in the VAR model
A_0 = intercept vector with size (n.1)
A_i = coefficient matrix of size (n.n) for the value of i = 1, 2, 3, …, p
ε_t = vector error with size (n.1)

The VAR method will be followed by the Impulse Response Function (IRF) method used to determine the effect or response of a variable to shocks on other variables where this method aims to identify and specify changes to certain variables. With the VAR method, it can also be known how much the proportion of a variable is to a shock through Variance Decomposition which is used to predict the contribution of variables to changes in certain variables.

4. RESULTS AND DISCUSSION

4.1. Data Stationarity Test

After performing the Classical Assumption Test (normality test, multicollinearity test, heteroscedasticity test, and autocorrelation test) so that the data is free from problems, the next step is to determine the stationarity of the data. Stationarity test was carried out using the Augmented Dickey-Fuller (ADF) test with none, intercept, and trend & intercept models.

Table 1. Augmented Dickey-Fuller (ADF) Test Results

Name of Variable	ADF Level			ADF First Diff		
	Trend & Intercept	Trend & Intercept	Trend & Intercept	None	Intercept	Trend & Intercept
IHSG	0,8905	0,3945	0,7050	0,0000	0,0000	0,0000
Inflation	0,3595	0,6441	0,1878	0,0000	0,0000	0,0000
Kurs	0,8313	0,0209	0,0218	0,0000	0,0000	0,0000
BI rate	0,4174	0,5760	0,3770	0,0145	0,1244	0,3236
M2	1,000	0,9988	0,9337	0,2499	0,0000	0,0015

Source : Data Processed (2022)

Data processing in table 1 shows that the variables IHSG, Inflation, Exchange Rate, BI-rate, and M2 are not stationary in First Diff, both in the none, intercept, and trend & intercept models. Meanwhile, at level, the variables IHSG, Inflation, Exchange Rate, BI-rate, and M2 show stationarity in the none model but are not stationary in the other models. Probability value indicates stationarity, if the probability value less than 0.05 then the variable is known to be stationary. So based on the ADF test, the IHSG, Inflation, Exchange Rate, BI-rate and M2 variables are stationary at the level using none model.

4.2. Optimal Lag Test

The optimum lag length is determined based on the Likehood Ratio (LR), Financial Prediction Error (FPE), Akaike Information Crition (AIC), Schwarz Information Crition (SC), Hannan-Quin Critition (HQ) values. The optimal lag test of 0 to 5 is selected as the lag length. Lag 0 to 5 is sufficient to test monthly data for the period January 2017 to March 2022.

Following are the results of the optimal lag test:

Table 2. Lag Test Result

Lag	LR	FPE	AIC	SC	HQ
0	NA	5,38e-17	-23,27121	-23,09359	-23,20203
1	605,1574	1,23e-21*	-34,04679*	-32,98104*	-33,63166*
2	38,01047	1,21e-21	-33,99345	-32,03958	-33,23238
3	35,42241	1,30e-21	-33,97477	-31,13278	-32,86776
4	14,42475	2,30e-21	-33,50256	-29,77245	-32,04961
5	27,74126	2,72e-21	-33,50741	-28,88917	-31,70851

Source: Data Processed (2022)

The results of Optimal Lag Test table show that the lag that best meets the criteria is lag 1 with 4 suitability criteria, namely FPE, AIC, SC, and HQ. So, it can be stated that lag 1 is the optimal lag used in modeling the VECM equation.

4.3. Polynomial Stability Test

The lag stability test is carried out after the optimum lag value is obtained. This test aims to ensure that VAR estimates with the selected lag will provide accurate results.

Table 3. Lag Stability Test Results

No	Root	Modulus
1	0,984261 - 0,017778i	0,984421
2	0,984261 + 0,017778i	0,984421
3	0,880513 - 0,048369i	0,881841
4	0,880513 + 0,048369i	0,881841
5	0,507436	0,507436

Source: Data Processed (2022)

The results in table 3 above show that the lag 1 length modulus value has a range of values smaller than one. A modulus value of less than 1 indicates stability in the VAR when using lag 1 so that lag 1 can be used in making equations.

4.4. Autocorrelation Test

Autocorrelation test is to find out whether there is a data correlation between variables. The autocorrelation problem causes the data to be non-stationary. To find out whether there is an autocorrelation problem. To perform the correlation test, the test that can be used is the Lagrange Multiplier test (LM Test).

Table 4 .Cointegration Test Results

Lag	LRE*stat	df	Prob.	Rao F-stat	df	Prob
1	40,77585	25	0,0242	1,710182	(25.176,1)	0,0247
2	39,13401	25	0,0357	1,633901	(25.176,1)	0,0363
3	11,28070	25	0,9915	0,436561	(25.176,1)	0,9915
4	23,72108	25	0,5355	0,949440	(25.176,1)	0,5374
5	24,95312	25	0,4650	1,002108	(25.176,1)	0,4670

Source: Data Processed (2022)

Lagrange Multiplier test (LM Test) result in the table above show a prob value greater than 0.05. This means that there there is no autocorrelation problem in the selected variables.

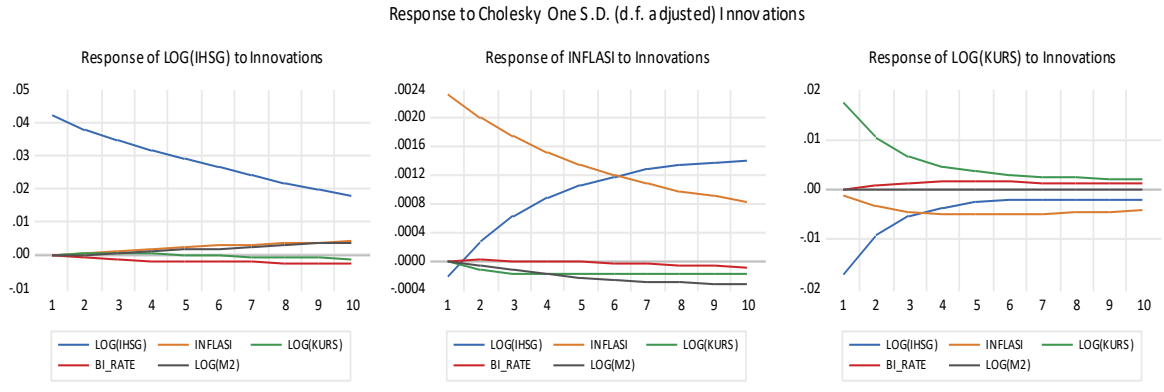
4.5. Vector Autoregression (VAR)

Table 5. VAR Test Result

	LOG (IHSG)	INFLATION	LOG (KURS)	BI_ RATE	LOG (M2)
LOG(IHSG(-1)	0,913425	0,008498	0,009797	0,009509	-0,017675
	(0,07580)	(0,00417)	(0,04321)	(0,00229)	(0,02593)
	[12,0512]	[2,04027]	[0,22673]	[4,14660]	[-0,68162]
INFLATION(-1)	0,376270	0,857144	-1,114693	-0,045182	-0,369704
	(1,38177)	(0,07593)	(0,78778)	(0,04181)	(0,47272)
	[0,27231]	[11,2880]	[-1,41499]	[-1,08072]	[0,78208]
LOG(KURS(-1))	0,025483	-0,004530	0,588800	0,034676	-0,101174
	(0,24535)	(0,01348)	[-0,33599]	(0,00742)	(0,083394)
	[0,10386]		0,009249	[4,67107]	[-1,20533]
BI_RATE(-1)	-0,487459		0,722835	0,873238	0,154658
	(1,05969)	(0,05823)	(0,60415)	(0,03206)	(0,36253)
	[-0,46000]	[0,15883]	[1,19645]	[27,2359]	[0,42661]
LOG(M2(-1))	0,034628	-0,006052	0,010734	-0,015566	1,004379
	(0,11692)	(0,00643)	(0,06666)	(0,00354)	(0,40000)
	[0,29617]	[-0,94189]	[0,16103]	[-4,40046]	[25,1104]
C	-0,015469	-0,06284	3,674703	-0,164016	1,062228
	(2,24580)	(0,12342)	(1,28037)	(0,06795)	(0,76831)
	[-0,0689]	[0,54518]	[2,87002]	[-2,41381]	[1,38254]
R-squared	0,806823	0,935375	0,600549	0,979335	0,988470
Adj. R-squared	0,789576	0,929605	0,564884	0,977490	0,987440
Sum sq. resids	0,0042557	0,002339	0,032965	9,28E-05	0,011870
S.E. equation	0,042557	0,002339	0,024262	0,001288	0,014559
F-statistic	46,77804	162,1083	16,83850	530,7772	960,1687

Source: Data Processed (2022)

VAR Test results above show that there is a relationship between IHSG variables, Inflation, Exchange Rate, BI-rate, and M2 using lag=1. Statistical t value shows trelationship between variables as follows: VAR test results show a significant relationship betweenvariables IHSG, Inflation, Exchange Rate, Bi-rate, and M2. This relationship is in the same direction as the estimates made. R-squared value provides evidence that independent variables in model are able explain changes in dependent variable by 80.6%. High F-stat value of 46.77 indicates that variables in the model have a joint influence on dependent variable.



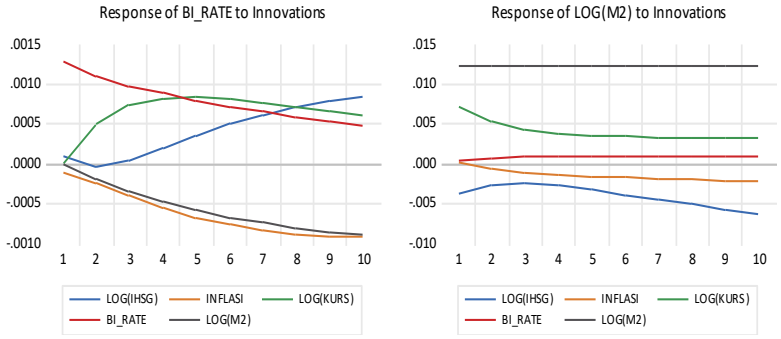


Figure 1. IRF Results
Source: Data Processed (2022)

From figure 1, response to an increase in inflation occurs, where when there are an increase in inflation there will be decrease in exchange rate variable, BI-rate, M2, and the inflation variable itself. The decline occurred constantly for the inflation variable, but gradually stagnated for exchange rate variable, BI-rate, M2. The response to an increase in exchange rate can cause a decrease in inflation variable and exchange rate itself, while for BI-rate variable, an increase in the exchange rate variable will cause an increase. Response to increase in BI-rate is an increase in the exchange rate variable and a decrease in inflation variable, M2, and Bi-rate itself. The response to increase in M2 was a slight increase in BI-rate variable and a decrease in exchange rate and inflation variables. Meanwhile, in face of an increase in the M2 variable, it does not show an increase or decrease or is constant.

4.6. Analysis of Variance Decomposition

Analysis of Variance Decomposition shows a large difference before and after the occurrence of shocks in variables, both on other variables and on the variables themselves. From tests carried out using variance decomposition method with the E-views analysis tool, following results were obtained:

In inflation variable, when a shock occurs at lag 1, the change is explained by inflation variable itself, followed by the CSPI variable. In the 10 test periods, proportion of changes was dominated by the inflation variable itself, followed by the CSPI variable. In exchange rate variable, when a shock occurs at lag 1, the change is explained by exchange rate itself (52%) followed by the CSPI variable (47.7%). In the 10 test periods, inflation variable showed a fairly large change in the 7th period, namely 11.6% and continues to increase.

In BI-rate variable, when a shock occurs at lag 1, the change is explained by BI-rate variable itself (98.7%) and is followed by CSPI, inflation, and exchange rate variables with each proportion below 1%. In the test period, proportion of changes in each variable in each period showed an increase. In the 10th period of testing, proportion of changes, namely CSPI was 11.42%; inflation of 20.43%; exchange rate of 20.63%; BI-rate of 30.73%; and M2 by 16.77%. In M2 variable, when there is a lag 1 shock, change is explained by M2 variant itself by 70.21%; exchange rate of 23.46%; and CSPI at 6.16%. Changes in the proportion increased and decreased in each variable

5. CONCLUSION

This study purpose to examine and analyze variables of inflation, BI rate, exchange rate and the money supply (M2) as the dependent variable on changes in the CSPI variable as the independent variable. The vulnerable period was chosen as the latest period, January 2017-March 2022. E-Views analysis tool with the VAR research model was used in this research. Analysis tools and models were chosen to determine relationship and influence of dependent variable on independent variable so that it

can provide suggestions and conclusions in future based on economic phenomena that occurred in selected period. From results of tests that have been carried out, it is known that CSPI, inflation, exchange rate, BI-rate, and M2 variables can be estimated using Vector Auto Regressive (VAR) model. This was done because variables used did not pass cointegration stage. By testing using VAR, relationship between CSPI, Inflation, Exchange Rate, Bi-rate, and M2 variables only has a unidirectional relationship based on estimates made. R-squared value indicates independent variables contained in model are able to explain the changes in dependent variable that occur by 80.6%. Variables in the model are also indicated to have a joint influence on dependent variable.

There is a need for further research using other approach models, because in the VAR model the theoretical approach is very minimally used and focuses more on events or phenomena that occur.

In future research, for other researchers who want to use similar topics. It is recommended to use other independent variables such as gold prices, oil prices world, other country indices that influence domestic index movements and other factors outside of economic factors that can influence price movements Composite Stock Price Index, due to economic factors alone cannot explain or influence changes in the Composite Stock Price Index.

For potential investors who want to invest in BEI, it is recommended to look at and wait for market conditions to stabilize and do not speculate in advance of conditions. The economy is stable so the losses experienced are not large.

When the JCI experiences a decline, immediately check the cause, and weighing the decision, whether the shares will be sold or retained, and for potential investors who are planning to buy shares, it is recommended when IHSG has increased, this means that capital market conditions are busy and enthusiasm for purchasing shares is increasing, so you can maximize profits and minimize losses

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