



## VECTOR AUTOREGRESSIVE MODELING FOR INFLATION DATA IN INDONESIA

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### ABSTRACT

The purpose of this study was to determine the relationship of Bank Indonesia Certificate (SBI) interest rate, the value of U.S. dollar exchange rate, inflation rate and the composite share price index (CSPi) or Jakarta Composite Index (JCI). To determine the pattern of inflation and the variables that influence it, then the vector autoregressive modeling (VAR) is the modeling that is suitable for the above case, because among these variables affect each other. From the plot of the data in 1998 there were data outliers that are additive, or additive outliers (AO) is a series of events affecting the time course and its existence does not affect other observations, both before and after outlier observations. The results of calculations and data analysis, modeling VAR-AO is the best model for inflation data containing additive outlier compared with the general VAR model.

**KEY WORDS:** Autoregressive Vector, Additive outliers, Inflation, Interest rates, Jakarta Composite Index (JCI), dollar exchange rate.

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### INTRODUCTION

Indonesia experienced high inflation in the era of 1998. It was the economic recession as a result of the decline in economic conditions, deteriorating social and political situation, and the absence of adequate security for the community. There was a rise in inflated prices, level of deposit rates, and exchange rate between ID Rupiah and US Dollar. Those were a trigger to high inflation.

Yearly observation showed that investment through the capital markets in addition to providing results, also contain risk. The size of the risk in the stock market is influenced by the state of the country, especially in the economic, political and social. The situation in the company may also affect stock prices rise or fall. Growth of investment in a country will be affected by the country's economic growth. The better the economy of a country, there is better for the level of wealth of the citizens. Higher level of prosperity that is generally characterized by an increase in community income levels. With an increase in revenue, it will be more and more people who have excess funds, excess funds can be utilized for storage in the form of savings or invested in securities traded in capital markets. However, the monetary crisis that hit Indonesia until now has been devastated Indonesia's economy initially experienced rapid economic growth, giving rise to inflation. Due to continuously rising inflation and the increase can not be controlled, making all areas of the economy affected. Especially in the capital market, stock prices fluctuated so much.

VAR model is a model suitable to be used to analyze the relationship between the variables of inflation, interest rate, stock index and the dollar exchange rate, because some variables - these variables affect each other reciprocally. On the other hand, the VAR model is used to analyze the interrelationships within multivariate time series. [1]. Data taken from the period January 1997 to September 2011.

### MATERIALS AND METHODS

#### **Inflation, SBI, JCI, and Dollar Exchange Rate.**

In simple terms inflation is defined as rising prices in general and continuous. The increase in the price of one or two items alone can not be called unless inflation increases it extends (or the resulting price increase) in other articles. The opposite of inflation is called deflation. Indicators are often used to measure the rate of inflation is the Consumer Price Index (CPI). CPI changes from time to time show the price movement of a package of goods and services consumed by the public.

Bank Indonesia Certificates (SBIs) are securities in rupiah currency issued by Bank Indonesia as a short-term debt instruments. The interest rate applicable to each sale of SBI is determined by the market mechanism based

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auction system, the BI announced a target of the desired rate of SBI BI for auction during the given period. BI rate is then used as the reference market participants in the auction [2] [3]

Composite Stock Price Index (CSPI) or Jakarta Composite Index (JCI) is calculated by the Indonesia Stock Exchange (IDX) or the Indonesia Stock Exchange (IDX). This index consists of all stocks listed on the Stock Exchange. Therefore, this index reflects the movement of all the shares in BEI. To ensure that the JCI was always reflect actual market conditions, BEI has the right to exclude certain shares in the calculation process JCI. It was the exception that the number of holders of a stock ownership by public investors (free float) is very small, while its market capitalization value is very large.

Exchange rate is a currency of a country that is measured or expressed in other currencies. Exchange or the Exchange Rate is the price of a currency against other currencies or the value of a currency against other currencies. The increase in currency exchange rates in the country is called an appreciation of foreign currencies. Decline in the domestic exchange rate is called depreciation on foreign currency [4] [5].

**Vector autoregressive.**

The general form of the model VAR (p) is

$$\mathbf{y}_t = \mathbf{c} + \Phi_1 \mathbf{y}_{t-1} + \Phi_2 \mathbf{y}_{t-2} + \dots + \Phi_p \mathbf{y}_{t-p} + \mathbf{e}_t$$

$$= \mathbf{c} + \Phi(B) \mathbf{y}_t + \mathbf{e}_t$$

With,

$$\mathbf{y}_t = (y_{1t}, y_{2t}, \dots, y_{mt})'$$

$$\mathbf{c} = (c_1, c_2, \dots, c_m)'$$

$$\mathbf{e}_t = (e_{1t}, e_{2t}, \dots, e_{mt})'$$

$\Phi$  = VAR coefficient

$t = 1, 2, \dots, n$

$B$  = backshift operator

$p$  = VAR order

$\mathbf{e}_t \sim \text{IIDN}(\mathbf{0}, \Omega)$

**Vector autoregressive with additive outliers.**

Additive outlier is an event that affects a series at the time of existence. It does not affect the observations of other observations, both before and after outlier observations [6] [7]. Model of VAR-AO,

$$\mathbf{y}_t^* = \mathbf{y}_t + \mathbf{Bx}_t$$

Where,  $\mathbf{y}_t = \mathbf{c} + \Phi(B) \mathbf{y}_t + \mathbf{e}_t$

with

$$\mathbf{x}_t = \begin{cases} 1, & t = T^* \\ 0, & t \neq T^* \end{cases}$$

$\mathbf{x}_t$  = vector ( $m \times 1$ )

$\mathbf{B}$  = diagonal matrices ( $m \times m$ ) with diagonal =  $(\beta_1 \beta_2 \dots \beta_m)$

**RESULTS AND DISCUSSION**

The results of the initial plot data on inflation, SBI, Dollar, and JCI is nonstationary. In time series, stationary condition absolutely done. Differencing is required to order the data to be stationary. The differencing results are shown as stationary plot figure 1.

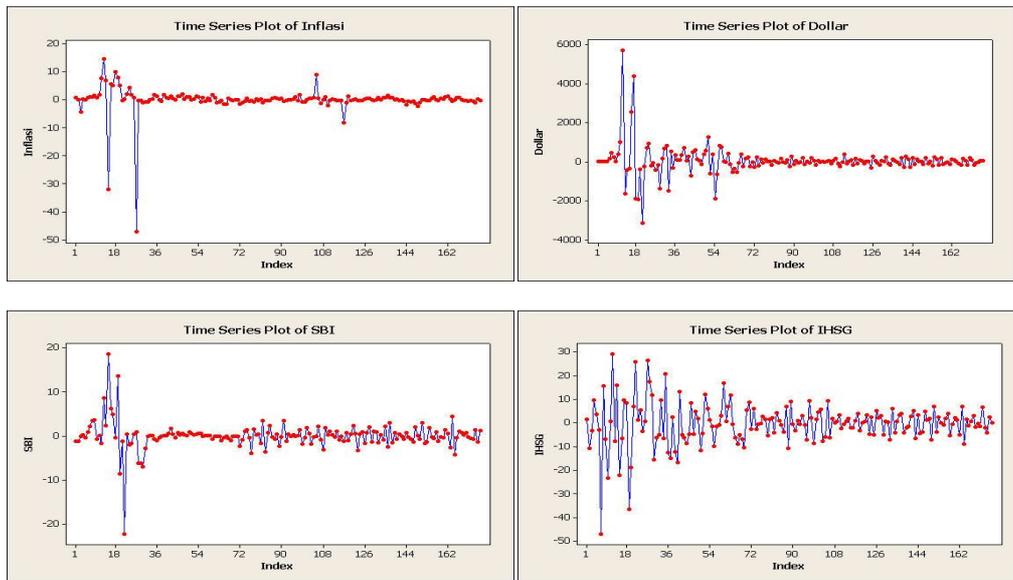


Figure 1. Time series plot

From the figure 1 shows that the inflation data are outliers in the data to the 15 and 27. As for SBI outlier data exist on the data to the 15, 19, and 22. Dollar exchange rate data are outliers in the data to 12, 16, 17 and 21. For JCI outlier data exist on the data to the 7, 12, and 19.

To model the data with the case as above, where there are outliers in the data structure, then the VAR model AO, ie VAR model that contains additive outliers are more suitable. By using the program SAS 9, obtained the best model is the VAR model (2) AO, because it has a value of AIC (Akaike Information Criteria) of 18.29812 smaller than the AIC value of the other models.

Table 1. AIC value for VAR and VAR-AO

Type	VAR(1)	VAR(2)	VAR(1)AO	VAR(2)AO	VAR(3)AO
AIC Value	22,47865	24,92837	20,71982	18,29812	22,82109

Parameter estimation results shown in the table below.

Table 2. Parameter estimation model VAR(2)AO

$\Phi_1 =$	$\begin{bmatrix} 0,08219 * & 0,15317 * & 0,00146 * & 0,05005 * \\ 0,02461 & -0,03992 & 0,00119 & 0,01304 \\ -7,26282 & 37,8081 * & -0,04475 & -4,99503 \\ -0,29536 * & -0,70634 & 0,00166 & -0,16667 * \end{bmatrix}$
$\Phi_2 =$	$\begin{bmatrix} 0,08370 & 0,00916 & 0,00178 & 0,04037 * \\ 0,10771 * & 0,32321 * & 0,00649 * & 0,05000 * \\ -28,3839 * & -58,3038 * & -0,12505 & -9,86029 * \\ -0,32757 * & -0,88217 * & 0,00405 * & -0,21146 * \end{bmatrix}$
$c =$	$\begin{bmatrix} 0,23282 * \\ -0,20029 \\ -14,99343 \\ -0,72294 \end{bmatrix}$

\*) Significance, probability value  $<0.05$  or  $t\text{value} > t(\alpha, v)$ .  $v$  is the degree of freedom

VAR(2)AO model for inflation ( $y_{1,t}$ ), SBI ( $y_{2,t}$ ), Dollar ( $y_{3,t}$ ), and JCI ( $y_{4,t}$ ) is,

$$\begin{aligned}
 y_{1,t} &= 0,23282 + 0,08219 y_{1,t-1} + 0,15317 y_{2,t-1} + 0,00146 y_{3,t-1} + 0,05005 y_{4,t-1} + 0,04037 y_{4,t-2} \\
 y_{2,t} &= 0,00119 y_{3,t-1} + 0,10771 y_{2,t-2} + 0,32321 y_{2,t-2} + 0,00649 y_{3,t-2} + 0,05 y_{4,t-2} \\
 y_{3,t} &= 37,8081 y_{2,t-1} - 28,3839 y_{1,t-2} - 58,3038 y_{2,t-2} - 0,12505 y_{3,t-2} - 9,86029 y_{4,t-2} \\
 y_{4,t} &= -0,29536 y_{1,t-1} - 0,16667 y_{4,t-1} - 0,32757 y_{1,t-2} - 0,88217 y_{2,t-2} - 0,00405 y_{3,t-2} \\
 &\quad - 0,21146 y_{4,t-2}
 \end{aligned}$$

## CONCLUSION

VAR modeling data for inflation and the factors affected it were more precise when using oilier VAR approach. The VAR model in general resulted in the AIC value greater than the VAR AO model.

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