EARLY DETECTION OF THE FINANCIAL CRISIS OF DEVELOPING COUNTRIES

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International Journal of Civil Engineering and Technology (IJCIET)
Volume 9, Issue 7, July 2018, pp. 584–597, Article ID: IJCIET_09_07_061
Available online at http://iaeme.com/Home/issue/IJCIET?Volume=9&Issue=7
ISSN Print: 0976-6308 and ISSN Online: 0976-6316

  Scopus Indexed

EARLY DETECTION OF THE FINANCIAL CRISIS OF DEVELOPING COUNTRIES

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ABSTRACT

The paper examines the early detection model of the financial crisis of developing countries. The model used is APT Multifactor and Early Warning System. Data analysis using this is Vector Autoregression. The results show that most developing countries are particularly vulnerable to financial crises derived from exchange rates rather than from financial or stock positions. The most appropriate model in early detection of developing country financial crisis is the control of exchange rate and stock stability. Long-term foreign exchange reserves can be used as a model to detect financial crisis.

Key words: Interest, GDP, Exchange Rate, Foreign Exchange Reserves, APT Multifactor, Early Warning System.

Cite this Article: Dede Ruslan, Rusiadi, Ade Novalina and Annisa Ilmi Faried Lubis, Early Detection of The Financial Crisis of Developing Countries, International Journal of Civil Engineering and Technology, 9(7), 2018, pp. 584–597.
http://iaeme.com/Home/issue/IJCIET?Volume=9&Issue=7

1. INTRODUCTION

In the age of technology, information is important to obtain [1]–[8] in finance in order to avoid the monetary crisis. The monetary or financial crisis of East Asia began on July 2, 1997, with the devaluation of the Thai currency, Bath. Detection of financial problems in Thailand has been there for the past year. In the first period of 1997 speculation spawned Bath's devaluation that spawned a speculative attack that nearly finished the foreign exchange reserves so that on July 2 the Thai government completely devalued Bath 15% [9]–[12]. The country worst hit by the impact of the crisis in Indonesia due to the most severe fluctuations in the exchange rate. The exchange rate crisis in Thailand in early July 1997 affected the forex market in Indonesia. Subprime mortgage crisis in 2008 that occurred in the US has triggered the global economic crisis. In line with the fall of Dow Jones stock prices in Asia such as Hang Seng Hong Kong and JCI also fell. JCI which in early 2008 entered the golden age at 2,830, due to investor panic, JCI also fell to the level of 1.174 on October 30, 2008, or has corrected 59% [13]–[16]. BSESN (BSE Sensex) representing the Indian stock exchange, JKSE representing the Indonesian stock

exchange, KLSE representing the Malaysian stock exchange and 000001.SS representing the Chinese stock exchange [17]–[19].

Since 2007, almost no country has reported a decrease in the ratio of debt to GDP. Debt which includes Government debt, corporate debt, and household debt increased significantly. There are 14 countries in the period reporting a 50% increase in total debt to GDP. Moreover, more than 20 countries in the world today have the total debt to GDP more than 200%. Government debt (bonds and loans) has risen by more than 100% since 2007, from USD25 trillion to USD 58 trillion. Government debt to GDP surpasses 100% in 10 countries, including Japan which has reached 240% [20]–[22]. With a combination of low economic growth, low interest rates, disinflation, and inconsistencies between State revenues and State expenditure, it is feared that Government debt has reached unsustainable levels [23]–[26].

In the case of Indonesia, although Indonesia's economic fundamentals are better (low inflation, improved economic growth, stable exchange rate, current account deficits at safe levels, safe foreign exchange reserves), the Government needs to be aware of the continuing negative balance of primary equity since 2012. Primary balance became negative since 2012 in the range of Rp. 52.8 -Rp. 98.6 trillion per year. It is indeed not healthy because of some debt interest payments made by issuing new debt. Also, this certainly has an impact on the increase in debt interest payments. Government debt interest rose from Rp. 100.5 trillion in 2012 to Rp184.9 trillion in the 2016 state budget or Rp. 84.4 trillion (84%) increase since 2012. In percentage, the ratio of interest payments on debt to central government spending rose from 10% in 2012 to 14% by 2016.

The global economic slowdown in 2015 starts from a Shanghai stock exchange action on Tuesday (25/08/15) again showing the falling value of China's stock index by 6 percent. This situation also affects trade in Tokyo, Japan. While in Indonesia, at the opening of the stock market, the exchange rate of the Rupiah penetrated nearly 14,000 per US Dollar. Investors are now putting China to the top of the rankings triggering global fears, shifting the position of Greece. "A sense of panic over the stock market, global investors mutualize. The leading German daily Süddeutsche Zeitung also reported, the collapse of the stock exchange rate in China continues and only knows one direction, downwards. Also, the stock exchange rate in Japan dragged down. (www.dw.com Wednesday, August 26, 2015). Here is a graph showing the progress of each index.

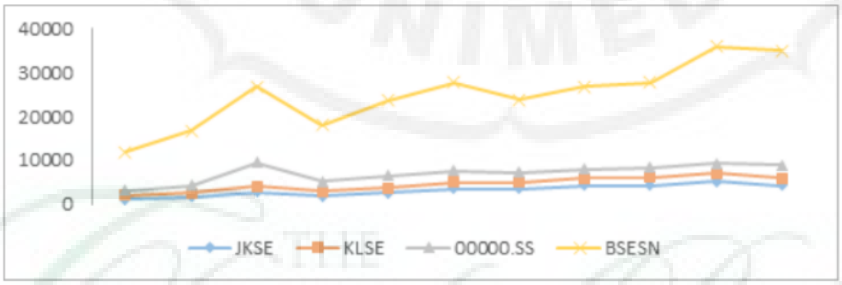

Figure 1 Development of Developing Country Shares, 2012-2016

Source : Financeyahoo.com, 2017

According to Figures, it is known that at least three financial markets were formed, namely during the booming economy of 2007 and at the time of the 2008 global financial crisis, then the third integration in booming conditions in 2014. At the time of the subprime mortgage crisis in America (2008), Asia is experiencing a decline in its share price index, but countries in other continents are also affected. Countries that are still classified as developing countries are still

vulnerable to world economic conditions. The subprime mortgage crisis in America has had an impact on stock market declines in the US and followed by stock exchanges in other parts of the world. The subprime mortgage crisis has a negative impact on the capital market, particularly the developing country capital market [27]–[29].

The economies of Asia, especially the southeast, have been interconnected with each other through trade and investment so that economic conditions reflected in index movements will affect other countries. According to previous research, (Oktavilia, 2008) states that GDP significantly affects the probability of a financial crisis [30]–[32].

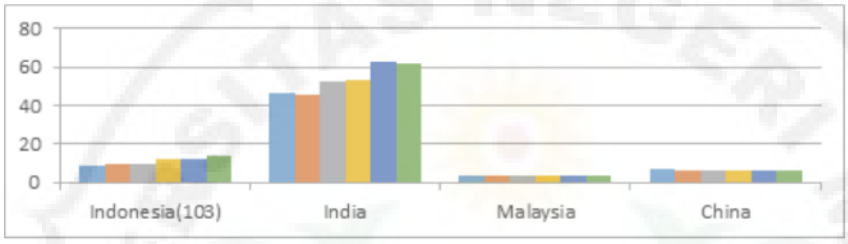

Figure 2 Graph of currency exchange rate of the country, 2012-2016

Based on graph 1.3, it is known that the movement of state exchange rates tends to be stable except for Indonesia and India. It cannot be separated from the Indonesian exchange rate system that still uses the floating system. In August 2015 the value of the rupiah penetrated Rp. 14,050 per US $ caused by the devaluation of Yuan which also affect the global financial market. This fluctuation in the rupiah also has an impact on Indonesia's foreign exchange reserves, which will sell dollar stocks when the rupiah falls. Based on previous research, foreign exchange reserves are used as one of the variables in the study entitled "Early Detection of Indonesia's Exchange Rate" with the result of 10 periods of the crisis month from 1997 to 2011. The data of central bank - 2010-2015 world countries in the form of charts.

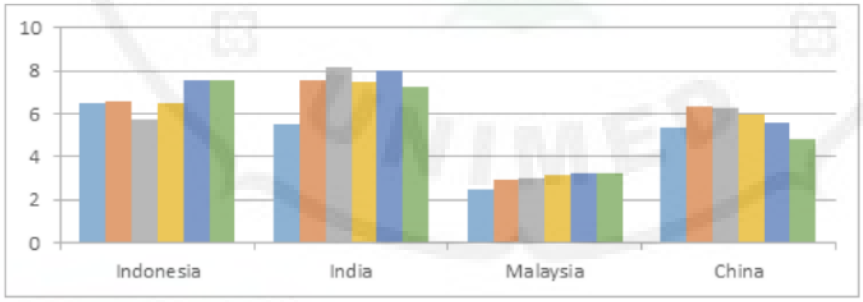

Figure 3 Interest rate graph of central bank 2012-2016

From the chart above shows that the interest rate of Malaysia's central bank remains stable from 2010-2015. As for Indonesia, India, and China, the central bank interest rate fluctuated from year to year. The importance of this research is to be able to detect as early as possible the crisis that will occur globally. The financial crisis needs to be in early detection as early anticipation and policy-making. Crisis in a country can affect other countries that are integrated with the economically integrated countries in crisis. The economy is very shaken and even declined sharply with the crisis that occurred.

2. THEORIES

2.1. Theory of Rational Expectations of Financial Markets

The rational expectations of financial markets are based on the assumption that the price of the security is reflected thoroughly by the available information [33]. The return rate of a security is the number of capital gains or capital gains plus the cash payments divided by the purchase price, such as:

$$RET = \frac{C}{P_t} + \frac{P_{t+1} - P_t}{P_t}$$

$$RET^e = \frac{C}{P_t} + \frac{P^e_{t+1} - P_t}{P_t} \quad (1)$$

This means that the rational expectation of price $[P^e_{t+1}]$ and return of bond is equal to price and return of equilibrium [P_{t+1}, RET], that is:

$$P^e_{t+1} = P_{t+1} \quad (2)$$

$$RET^e = RET \quad (3)$$

Equations (2) and (3) explain that current prices that occur in financial markets are shaped in such a way that the optimal forecast of return on all available information equals the equilibrium return. The financial economy merely says that all information in an efficient market reflects the price of a security.

2.2. Some Applications of Rational Expectations and Stock Price Models

A critical aspect of rational expectations is that the value of one or more variables is determined by the random shock of the variable itself or the random shock of other variables. The application of rational expectations of financial markets is called EMH. The implications of the rational expectations theory are two. First, if there is a variable change, the expected value of the variable is formed as well as the change of the variable. Suppose that long-term interest rate movements rise above the standard interest rate then expectations of long-term interest rates in the future will fall to normal levels. Secondly, the forecasting errors of rational expectations have a zero average value or $E[\varepsilon_t | I_{t-1}] = 0$ at first this average value is unpredictable. The cool expectation app on the current stock price [S_t] is a function of future stock price expectations $[E_t S_{t+1}]$ and random shocks $[\varepsilon_t]$:

$$S_t = \alpha_0 + \alpha_1 E_t S_{t+1} + \varepsilon_t$$

The solution of rational expectations is that stock prices are now determined by white noise on the stock market, such as:

$$S_t = \phi_0 + \phi_1 \varepsilon_t$$

The determination coefficients [ϕ_0 dan ϕ_1] are based on terms or conditions are constants or $E_t S_{t+1} = \phi_0$. Substitute $S_t = \phi_0 + \phi_1 \varepsilon_t$ and $E_t S_{t+1} = \phi_0$ ke $S_t = \alpha_0 + \alpha_1 E_t S_{t+1} + \varepsilon_t$ produce:

$$S_t = \alpha_0 + \alpha_1 E_t S_{t+1} + \varepsilon_t$$

$$\phi_0 + \phi_1 \varepsilon_t = \alpha_0 + \alpha_1 \phi_0 + \varepsilon_t$$

Equation $\phi_0 + \phi_1 \varepsilon_t = \alpha_0 + \alpha_1 \phi_0 + \varepsilon_t$ is fulfilled with two terms coefficient or parameter, such as:

$\phi_0 = \alpha_0 + \alpha_1 \phi_0$ atau $\phi_0 = \alpha_0 /(1-\alpha_1)$ and $\phi_1 = 1$, so the solution to $S_t = \phi_0 + \phi_1 \varepsilon_t$ is

$$S_t = \frac{\alpha_0}{1-\alpha_1} + \varepsilon_t$$

First-order autoregression [AR (1)] from ε_t is $\varepsilon_t = \rho\, \varepsilon_{t-1} + \partial_t$, where the absolute value of $\rho < 1$. Substitute AR(1) to $S_t = \phi_0 + \phi_1 \varepsilon_t$ will produce the equation:

$$\varepsilon_t = \rho\, \varepsilon_{t-1} + \partial_t$$

$$S_t = \phi_0 + \phi_1 \varepsilon_{t-1} + \phi_2 \partial_t$$

$$E_t S_{t+1} = \phi_0 + \phi_1 \varepsilon_t + \phi_2 E_t \partial_{t+1}$$

$= \phi_0 + \phi_1 (\rho\, \varepsilon_{t-1} + \partial_t)$ dan $E_t \partial_{t+1} = 0$

Substitution of these three equations into $S_t = \alpha_0 + \alpha_1 E_t S_{t+1} + \varepsilon_t$ will produce the equation:

$$\phi_0 + \phi_1 \varepsilon_{t-1} + \phi_2 \partial_t = \alpha_0 + \alpha_1 [\phi_0 + \phi_1 \rho\, \varepsilon_{t-1} + \phi_1 \partial_t] + \varepsilon_t$$

$$\phi_0 + \phi_1 \varepsilon_{t-1} + \phi_2 \partial_t = \alpha_0 + \alpha_1 \phi_0 + \alpha_1 \phi_1 \rho\, \varepsilon_{t-1} + \alpha_1 \phi_1 \partial_t + \rho\, \varepsilon_{t-1} + \partial_t$$

$$\phi_0 + \phi_1 \varepsilon_{t-1} + \phi_2 \partial_t = \alpha_0 + \alpha_1 \phi_0 + [\alpha_1 \phi_1 \rho + \rho]\varepsilon_{t-1} + [1 + \alpha_1 \phi_1]\partial_t$$

The above equation can be fulfilled with three condition parameters or coefficients, such as:

1. $\phi_0 = \alpha_0 + \alpha_1 \phi_0$ or $\phi_0 = \alpha_0 / (1 - \alpha_1)$,
2. $\phi_1 = \alpha_1 \phi_1 \rho + \rho$ or $\phi_1 = \rho / (1 - \alpha_1 \rho)$, and
3. $\phi_2 = \alpha_1 \phi_1 + 1$ atau $\phi_2 = \rho / (1 - \alpha_1 \rho)$.

Substitution of these four parameters or coefficients to $S_t = \phi_0 + \phi_1 \rho\, \varepsilon_{t-1} + \phi_1 \partial_t$ will produce the stock price in period [t] as follows:

$$S_t = \frac{\alpha_0}{1-\alpha_1} + \frac{\rho}{1-\alpha_1 \rho}\varepsilon_{t-1} + \frac{\rho}{1-\alpha_1 \rho}\partial_t$$

Noted that $\varepsilon_{t-1} = [1/\rho]\,[\varepsilon_t - \partial_t]$ so the stock price in period [t] is

$$S_t = \frac{\alpha_0}{1-\alpha_1} + \frac{\rho}{1-\alpha_1 \rho}\varepsilon_t$$

The stock price of period [t] is not determined by the stock price period [t + 1] but is determined by the stock price in period [t - 1]. Hence the equation $S_t = \alpha_0 + \alpha_1 E_t S_{t+1} + \varepsilon_t$ transformed into:

$$S_t = \alpha_0 + \alpha_1 E_{t-1} S_t + \varepsilon_t$$

$$S_t = \phi_0 + \phi_1 \rho\, \varepsilon_{t-1} + \phi_2 \partial_t$$

$E_{t-1}\, S_t = \phi_0 + \phi_1\, \varepsilon_{t-1}$, $E_{t-1}\, \partial_t = 0$

First-order autoregression [AR(1)] from ε_t is $\varepsilon_t = \rho\, \varepsilon_{t-1} + \partial_t$. Substitute AR(1) to the equation $S_t = \alpha_0 + \alpha_1\, E_{t-1} S_t + \varepsilon_t$ will produce the equation:

$$\phi_0 + \phi_1 \varepsilon_{t-1} + \phi_2\, \partial_t = \alpha_0 + \alpha_1 [\phi_0 + \phi_1\, \varepsilon_{t-1}] + \rho\, \varepsilon_{t-1} + \partial_t$$

$$\phi_0 + \phi_1 \varepsilon_{t-1} + \phi_2\, \partial_t = \alpha_0 + [\alpha_1\, \phi_0 + \alpha_1\, \phi_1 + \rho]\, \varepsilon_{t-1} + \partial_t$$

The above equations can be fulfilled with three condition parameters or coefficients, such as:

1. $\phi_0 = \alpha_0 + \alpha_1\, \phi_0$ or $\phi_0 = \alpha_0/(1 - \alpha_1)$,
2. $\phi_1 = \alpha_1\, \phi_1 + \rho$ or $\phi_1 = \rho/(1 - \alpha_1)$, and
3. $\phi_2 = 1$.

Substitution of these three parameters to $S_t = \phi_0 + \phi_1\, \rho\, \varepsilon_{t-1} + \phi_2\, \partial_t$ will produce the stock price period [t] as follows:

$$S_t = \frac{\alpha_0}{1-\alpha_1} + \frac{\rho}{1-\alpha_1}\varepsilon_{t-1} + \partial_t$$

This means that the stock price of period [t] is determined a random shock from the stock price period [t - 1] and random shock period [t].

Suppose that the stock price in period [t] is determined by price expectation in period [t + 1] and price in period [t - 1], that is:

$$S_t = \alpha_0 + \alpha_1\, E_t S_{t+1} + \alpha_2\, S_{t-1} + \varepsilon_t$$

The solution of rational expectations is that the stock price is determined by the price period [t - 1] and random shock period [t], ie:

$$S_t = \phi_0 + \phi_1\, S_{t-1} + \phi_2\, \varepsilon_t$$

$$E_t S_{t+1} = \phi_0 + \phi_1\, S_t$$

$$= \phi_0 + \phi_1 [\phi_0 + \phi_1\, S_{t-1} + \phi_2\, \varepsilon_t]$$

Substitution of these two equations into $S_t = \alpha_0 + \alpha_1\, E_t S_{t+1} + \alpha_2\, S_{t-1} + \varepsilon_t$ will result in stock price period [t], that is:

$$\phi_0 + \phi_1 S_{t-1} + \phi_2 \varepsilon_t = \alpha_0 + \alpha_1 [\phi_0 + \phi_1 (\phi_0 + \phi_1 S_{t-1} + \phi_2\, \varepsilon_t)] + \alpha_2 S_{t-1} + \varepsilon_t$$

$$\phi_0 + \phi_1 S_{t-1} + \phi_2 \varepsilon_t = \alpha_0 + \alpha_1 \phi_0 + \alpha_1 \phi_1 \phi_0 + (\alpha_1 \phi_1^2 + \alpha_2) S_{t-1} + (\alpha_1 \phi_1 \phi_2 + 1) \varepsilon_t$$

The above equation can be fulfilled with three condition parameters or coefficients, such as:

1. $\phi_0 = \alpha_0 + \alpha_1 \phi_0 + \alpha_1 \phi_1 \phi_0$,
2. $\phi_1 = \alpha_1 \phi_1^2 + \alpha_2$, dan
3. $\phi_2 = \alpha_1 \phi_1 \phi_2 + 1$.

Quadratic equation $\phi_1 = \alpha_1 \phi_1^2 + \alpha_2$ will produce the following equation roots:
$\phi_1 = [1 + \sqrt{1 - 4\alpha_1\alpha_2}]/2\alpha_1$ and $\phi_1 = [1 - \sqrt{1 - 4\alpha_1\alpha_2}]/2\alpha_1$. If $\alpha_2 = 0$ then $\phi_1 = 1/\alpha_1$ or $\phi_1 = 0$.

The use of the value $\phi_1 = 1/\alpha_1$ and $\alpha_2 = 0$ raises the S_{t-1} variable as a determinant of the stock price period [t] or not the rational expectations solution. In contrast the use of $\alpha_1 = 0$ does not give rise to the St-1 variable as a determinant of stock price period [t] or rational expectations solution. Therefore the solution of rational expectation of stock price in period [t] is if value $\alpha_2 = 0$, that is:

$$S_t = \frac{\alpha_0}{1 - \alpha_1} + \varepsilon_t$$

This means that the stock price in period [t] is the average stock price $[\alpha_0 / (1 - \alpha_1)]$ plus a random shock from stock prices $[\varepsilon_t]$.

2.3. Model Early Warning System (EWS)

The Early Warning System (EWS) model is a model used to anticipate whether and when a country is affected by a crisis or economic instability. This model was built about the economic cycle especially during the financial crisis that occurred in Europe (1992-1993), Turkey (1994), Latin America (1994-1995) and Asia (1997-1998). EWS in the economic cycle is very important for the government and the real sector in the framework of policy planning and formulation and decision making. The early warning system is a model that aims to look at various economic and financial indicators as a sign that a crisis will occur within a relatively short period of 12 to 18 months. The early warning system is beneficial for economic actors to minimize the potential risks they will face in the event of a crisis, and also provide opportunities for performing the speculative action.

A "Signal" Approach for Measuring Indicator Performance

The possibility of unconditional probability of crisis or denoted P (crisis) (A + C) / (A + B + C + D), while the possibility of a crisis with the condition of a signal or denoted by P (crisis | S) = A / (A + B), the marginal predictive power or denoted by P (crisis | 'S) - P (crisis) or in other words is often called a noise-to-signal ratio that shows the ratio of false signals to good signals. This ratio makes it easy to interpret the crisis. The noise-to-signal ratio is defined by

$$\text{Noise-to-signal ratio} = \frac{B/(B+D)}{A/(A+C)}$$

The smaller the value of this ratio, the better the ratio of the false signal to the good signal. If the indicator of this ratio is equal to one denotes a false signal as large as the good signal.

The Econometrics Approach (Probit / Logit)

In the econometric approach generally, use probit or logit model. This approach estimates the chances of a financial crisis by using discrete dependent variables in its econometric model. The logit or probit model uses the qualitative dependent variable as the discrete / pupil variable of value 1 and 0 while the independent variables are non-discrete or continuous variable. The general function of the logit function equation is as follows (Imansyah, 2009: 70):

$$Dln\left(\frac{P_i}{1 - P_i}\right) = \beta_0 + \beta_1 X_i + \beta_2 X_i + \cdots + \beta_k X_i + \mu_i$$

D = dependent variable whose contents = 1 in case of crisis, and 0 = if not crisis

Pi = probability

Xi = independent variable

μi = *error*

The advantage of this logit model compared to the signal model is that the results of the calculations of each variable directly contribute to the calculation of the probability of a financial crisis. So no conversion is required from the composite index as in the signal model.

2.4. Arbitrage Pricing Theory (APT) Multifactor

Ross in 1976 formulated a balanced model called Arbitrage Pricing Theory (APT), which states that two investment opportunities having identical properties cannot be sold at different prices. In this case, the law adopted by APT is the law of one price. An asset of the same (identical) characteristic if it is sold at a different price, then there will be an opportunity to arbitrage by purchasing a low-priced asset and at the same time selling it at a higher price to earn the profit without risk. In the economy of a country, there are four public markets: the capital market, money market, foreign exchange market and the goods market. Of the four markets that are strictly interconnected and which reflect the law of one price are generally three markets: the capital market, money market, and foreign exchange market. All three markets are equally balanced and identical so they can not be sold at different prices. If there is no equilibrium of these markets, there will be arbitrage proceedings from one market to another as described above.

The multi-factor model assumes that the stock pricing process involves several factors. It means there are several possibilities that more than one pervasive factor in the economy affects the stock price. The economic situation affects almost all companies. So the change of the forecast economy has a significant impact on the price of most stocks. For example, there are two sources of macroeconomic risk to GDP and an uncertain interest rate on stock prices. A simple multi-factor model equation can be expressed as follows:

$$R_i = E(r_i) + \beta_{iGDP}GDP + \beta_{iIR}IR + e_i$$

Two factors on the right side of the equation of the systematic factor in the recording. As a single factor model, these two macro factors have a zero expected value: indicates a change in this variable that was not previously anticipated. The coefficient on each factor has the equation above measuring the sensitivity of the stock return on that factor. For this reason, coefficients are often referred to as factor sensitivity, factor loading, or beta factor. Moreover, ei reflect the influence of company-specific factors. Here is a picture of the reciprocal relationship that occurs from ASEAN financial market integration formed from APT Multifaktor variable that is GDP and interest rate contagion theory that is fundamental and investor behavior, and early warning system that is exchange rate and foreign exchange reserve. The integration of ASIA financial market is the formation of Indonesia, India, Malaysia and China market. Based on previous research, factors such as interest, GDP, economic fundamentals, investor behavior, exchange rate and foreign exchange reserves significantly affect the probability of a financial crisis. Five significant variables in analyzing the relationship between fundamental economic variables and exchange rate crises are real interest rates, inflation rate, budget balance, real exchange rate, GDP growth, and M2 ratio to foreign exchange reserves. There was a decline for the Dow Jones Index, Hang Seng Index, and JCI at the end of 2007 as the impact of the global economic crisis that occurred mid-2007 in the United States. The hypothesis in this study is APT Multifaktor effectiveness in early detection of the financial crisis in Asian developing countries. Early Warning System effectiveness in early detection of the financial crisis in Asian developing countries.

3. METHODOLOGY

The approach of this research is quantitative with the support of Vector Autoregression (VAR) model, which is used as a prediction analysis tool. The material to be used in this research is related to Arbitrage Pricing Theory (APT) Multifactor, and early warning system in detecting the global financial crisis. This study uses secondary data types with time series. Secondary data derived from primary data that have been processed and presented as further information, either in the form of tables or not. While time series data is a collection of data from certain phenomena obtained within specified time interval such as weeks, months and years. Source of data obtained from Yahoo Finance Data, World Bank, and related institutions.

Vector Autoregression (VAR)

The test is performed to determine whether there is a simultaneous relationship between the variables, as exogenous variables and endogenous variables by incorporating the time element (lag). This model can make a predictive pattern of financial market integration in the short, medium and long-term of simultaneous effect between variables.

Testing VAR with the formula:

$$JKSE_t = \beta_{11}JKSE_{t-p} + \beta_{12}KLSE_{t-p} + \beta_{13}BSESN_{t-p} + \beta_{14}00000SS_{t-p} + \beta_{15}SBI_{t-p} + \beta_{16}GDP_{t-p} + \beta_{17}ER_{t-p} + \beta_{18}CD_{t-p} + e_{t1}$$

JKSE	=	The Value of Indonesian Stock Financial (Point)
KLSE	=	Malaysian Stock Exchange Value (Point)
00000SS	=	China Stock Financial Value (Point)
BSESN	=	Financial Value of Indian Stock (Point)
Interest	=	Interest Rate of SBI (%)
GDP	=	Dollar exchange rate per rupiah (Milyr Rpa)
et	=	Random disturbance (random disturbance)
p	=	length of lag

4. RESULT AND DISCUSSION

Unit root test developed by Dickey-Fuller can do a stationary test. The alternative of the Dickey-Fuller test is Augmented Dickey-Fuller (ADF) which attempts to minimize autocorrelation. This test contains the first differentiation of time series data against the lag of the variable, lagged difference terms, constants, and trend variables. To see stationarity using DF or ADF test is done by comparing the critical value of Mc Kinnon at a 1% significance level with Augmented Dickey-Fuller value. Non-stationary data can cause lanced regression, so it is necessary to test stationarity of the data. This study begins with stationary tests of the variables used in the study: interest (SB), GDP growth (GDP), exchange rate (ER), reserves foreign exchange (CD), and index (JKSE, KLSE, 00000.SS, BSESN).

Table 1 1st difference

Variable	Augmented Dickey Fuller	Mc Kinnon's Critical Value at Level of Significance of 1%	Prob	Result
INTEREST	-4,284157	-3,769597	0,0032	stationary
GDP	-6,404815	-3,769597	0,0000	stationary
EXCHANGE RATE	-4,970272	-3,769597	0,0007	stationary
CADANGAN DEVISA	-4,567924	-3,886751	0,0026	stationary
INDEKS	-5,581763	-3,769597	0,0002	stationary

If all variables are stationary, then the next step can be analyzed. After testing the assumptions, a stationary test, cointegration test, lag stability test structure and optimal lag rate determination, then the next step is to analyze the VAR. This analysis is conducted to determine whether there is a simultaneous relationship (interrelated or mutual contribution) between variables, as exogenous variables and endogenous variables by incorporating the time element (lag). Here are the results of VAR table analysis:

VAR Model - Substituted Coefficients:

==========

STOCK = 1.33699800428*STOCK (-1) + 0.313430542754*ER (-1) - 1410.14766782*INTEREST (-1) - 1027.63948189*GDP (-1) + 0.00259797049991*CD (-1) + 9655.41110414

ER = - 0.0191616688767*STOCK(-1) + 0.79063402157*ER(-1) - 22.4923791423*INTEREST(-1) + 293.511277198*GDP(-1) - 0.000311994343661*CD(-1) - 1120.5189365

INTEREST = 0.000111153589303*STOCK (-1) + 2.79589733955e-05*ER (-1) + 0.448142147526*INTEREST (-1) + 0.242037550011*GDP (-1) + 3.97050052869e-08*CD (-1) + 0.750512398285

GDP = 8.85831158311e-05*STOCK (-1) + 0.000132532720605*ER (-1) - 0.50349979487*INTEREST (-1) + 0.033820531078*GDP (-1) + 9.17140271994e-07*CD (-1) + 7.21164318453

CD = - 153.698257598*STOCK(-1) - 182.339195422*ER(-1) + 534717.538924*INTEREST(-1) + 112076.916685*GDP(-1) + 0.254172071023*CD(-1) - 1472758.15536

Based on the results of Vector Autoregression analysis it is known that the previous variables also contribute to the current variable as shown in the earlier table that the past variable (t-1) contributes to the variable itself and other variables. Using the basis of lag 1 it appears that the contribution of each variable to the variable itself and other variables, thus the interest variable (SB), GDP growth (GDP), exchange rate, foreign exchange reserves (CD), and index (JKSE, KLSE, 00000.SS, BSESN) in this study contributed to each other. The most significant contribution to the interest income is the previous period's foreign exchange reserves and the interest rate of the previous period. The amount of interest and an increase in foreign exchange reserves means the increase in national income and income per capita, while the increase in people's income will increase public consumption so it will increase purchasing power that ultimately impacts on interest. The most significant contribution to GDP is the foreign exchange reserves of the previous period and followed by the GDP itself in the previous period. An increase in GDP will increase production capacity, increased production capacity will increase people's income, increase in income society will increase. (Rusiadi; Novalina, 2018). The most significant contribution to investment is the gross domestic product of the previous period and followed by the investment itself the previous period. Rising gross domestic product will boost investment, as gross domestic product rises to boost public incomes, rising incomes will boost purchasing power and boost demand, rising demand will increase investment to meet the demands of the people (Rusiadi; Novalina & Sembiring, 2017). The most significant contribution to the exchange rate is the exchange rate itself in the previous period and followed by the government spending of the previous period (Rusiadi; Novalina, 2015). The exchange rate of the previous period significantly affected the exchange rate of the current period. High government spending will strengthen the position of the exchange rate, where government spending that tends to increase exports will increase foreign exchange and allow appreciation of the rupiah exchange rate to last long enough.

Analisis Impulse Response Function (IRF)

Based on the response result of one standard deviation from stock, it is concluded that there is a change of influence from each standard deviation of each variable which previously positive becomes negative and vice versa, either in short term, medium term or long term. These results indicate a different response from macroeconomic stability derived from stocks, both positive and negative responses.

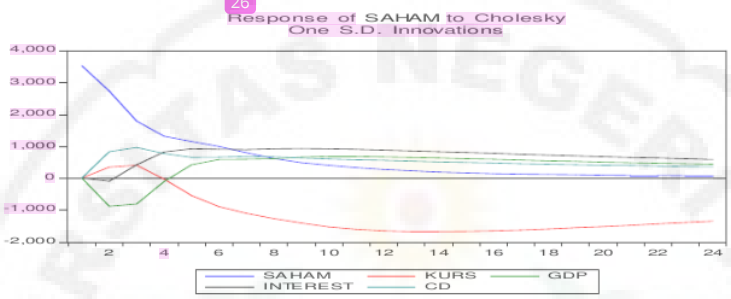

Figure 4 Response of Stock Variables to Other Variables

Based on the Figure above note that changes to one standard deviation of stock can be responded to by other variables, both fiscal, monetary and other macroeconomic variables. Based on the above picture the stability of responses of all variables formed during the 12 quarters or the medium and long-term. The stable stability response is due to the movement behavior of the INDEX that is responded by other variables almost equal to the movement in the short-term period.

Table 2 Summary of Impulse Response Function share results

No.	Variable	Short-term	Medium-term	Long-term
1	SB	+	+	+
2	GDP	+	-	-
3	ER	+	-	-
4	CD	+	+	+
5	STOCK	+	+	+

Based on the above table it is known that the increase of the index is responded negatively in the short, medium and long-term on by interest rate. While the negative response in the long term and only by inflation. While in the short, medium and long-term, the increase in the index is positively responded by the growth of GDP, current account, exchange rate, and foreign exchange reserves.

Variance Decomposition aims to know the presentation of the contribution of each variable to a variable in the short, medium and long-term, so it can be used as a recommendation for policy making for control of these variables. Based on the result of the research shown in Table 4.46, it is found that the stock itself explains stock in the short term (period 1), the estimated variance error of 100%. While the exchange rate, interest, GDP and CD variables do not respond. In the middle term (period 12) the estimated variance error of 47.9% is explained by the stock itself. Other variables that most influence stock as a policy variable other than the stock itself is GDP of 2.87%, CD of 9.01%, the interest of 17.11%, the exchange rate of 23.03%. In the long run (period 24) the estimated variance error of 28.57% is explained by the stock itself. Other variables that most influence the stock as policy variables other than the stock itself is a CD of 7.61%, GDP of 1.76, the interest of 19.72%, then ER of 42.31%.

Table 3 Policy Recommendation For SHARE

Period and Percentage	SHARE itself	Biggest 1	Biggest 2
Short-term (Period 1)	100%	STOCK 100%	STOCK 100%
Medium-term (Period 12)	47.9%	STOCK 47.9%	ER 23.03%
Long-term (Period 24)	28.57%	ER 42.31%	STOCK 28.57%

The stock controls are from the short-term, medium-term and long-term stocks [34]. Then another variable that can be used as a recommendation for stock control in the short, medium and long term is the exchange rate. Stocks can serve as a model for early detection of crisis keuanagn developing countries. In the medium term, the exchange rate was used as an early detection model of the developing country's financial crisis. Long-term foreign exchange reserves as an accurate detection model of the financial crisis of developing countries.

5. CONCLUSION

The result of Vector Autoregression Analysis using base lag 1 indicates that the contribution of each variable to the variable itself and other variables. The result of Vector Autoregression analysis also shows that the past variable (t-1) contributes to the current variable both to the variable itself and other variables. From the estimation result, there is a reciprocal relationship between one variable with other variables that contribute to each other. Results Analysis Impulse Response Function shows the response of other variables to the change of one variable in the short, medium and long-term, and it is known that the stability response of all variables formed in the period of 20 or medium term and long term. The response of other variables to the change of one variable indicates different variations either from positive to negative or vice versa, and there are variables whose responses remain positive or remain contrary from short to long-term. The Variance Decomposition Analysis results show that the variable has the most significant contribution to the variable itself either in short, medium and long-term. Moreover, as for the small contribution to the variable itself both in the short, medium and long-term.

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