Cendekia Niaga
Journal of Trade Development and Studies
p-ISSN 2548-3137, e-ISSN 2548-3145

Governance and Accountability of Macroeconomic Variables in Indonesia, Malaysia, Thailand and India using Three Models

Kumara Jati[1], Aziza Rahmaniar Salam[2]

[1)] Indonesian Trade Promotion Center-Chennai
[2)] Trade Analysis and Development Agency, Ministry of Trade

Email: kumara.jati@kemendag.go.id

Abstract

Fluctuation in macroeconomics variables has given a difficulty to interested parties to implement good governance and appropriate accountability. This is a research to understand how to maintain stability of macroeconomic variables and its relations with trade partner countries. This study takes the examples of 4 (four) major countries in Asia: Indonesia-Malaysia-Thailand (IMT), and India. Moreover, public sector openness and public administration need to facilitate information disclosure and increase cooperation between countries. Based on Vector Auto Regression (VAR) model, the shock effect of macroeconomic variables (exchange rates, interest rates and foreign exchange reserves) vary each other. The existence of shock indicates the transmission among variables indirectly through intermediate channel, such as: capital market, commodity market and money market between 4 (four) countries. Regression results using Model ARMA-ARCH/GARCH and Structural Time-Series Models (STSM) shows macroeconomic variables in IMT and India will be relatively maintained and stable in 2022. To support this result, good governance should be based on principles of accountability, innovation, integration, and collaboration. The similarity in economic structure and diplomatic relations that have established for decades have made IMT and India can help each other in facilitating information disclosure and enhancing cooperation between the countries. However, the presence of shock from outside still need to be watched out as the global changes can disrupt the sustainable development.

Keywords: Governance and Accountability, Indonesia-Malaysia-Thailand (IMT)-India, ARMA-ARCH/GARCH, Structural Time-Series Models (STSM), Vector Auto Regression (VAR).

Abstrak

Fluktuasi variable ekonomi makro telah memberikan kesulitan bagi pihak yang berkepentingan untuk menerapkan Tata Kelola yang baik dan Akuntabilitas yang tepat. Penelitian ini bertujuan untuk memahami bagaimana menjaga stabilitas variabel ekonomi makro dan hubungannya dengan negara-negara mitra dagang. Studi ini mengambil contoh 4 (empat) negara utama di Asia yaitu Indonesia-Malaysia-Thailand (IMT) dan India. Selain itu, keterbukaan sektor publik dan administrasi publik perlu memfasilitasi keterbukaan informasi dan peningkatan kerjasama antar negara. Berdasarkan model Vector Auto Regression (VAR), efek kejut variable ekonomi makro atau simulasi yang dilakukan terhadap ekonomi makro (nilai tukar, suku bunga dan cadangan devisa) bervariasi satu sama lain. Keberadaan kejutan menunjukkan adanya transmisi antar variabel secara tidak langsung melalui saluran perantara, seperti: pasar modal, pasar komoditas dan pasar uang antara 4 (empat) negara. Hasil regresi dengan menggunakan model ARMA-ARCH/GARCH dan Struktural Time-Series Model (STSM) menunjukkan bahwa variabel ekonomi makro di IMT dan India akan relatif dapat dipertahankan dan stabil pada tahun 2022. Untuk mendukung hasil ini, tata kelola yang baik harus didasarkan pada prinsip-prinsip akuntabilitas, inovasi, integrasi, dan kolaborasi. Kemiripan struktur ekonomi dan hubungan diplomatik yang dibangun selama beberapa dekade telah membuat IMT dan India dapat saling membantu untuk memfasilitasi pengungkapan informasi dan peningkatan kerjasama antar negara. Namun, keberadaan pengaruh kejutan dari luar masih harus diwaspadai karena perubahan global dapat mengganggu pembangunan berkelanjutan.

Keywords: Tata Kelola dan Akuntabilitas, Indonesia-Malaysia-Thailand (IMT) dan India, ARMA-ARCH/GARCH, Struktural Time-Series Model (STSM), Vector AutoRegression (VAR).

INTRODUCTION

The United Nations Development Program (UNDP) mentions that the characteristics of good governance, namely: (1) transparent and responsible, effective and fair; (2) ensuring the rule of law; (3) ensuring the political, social and economic priorities are based on community consensus; (4) pay great attention to the interests of the poorest and most vulnerable in the decision making process regarding the allocation of development resources (Sumarto, 2003; Pramono and Hendharto, 2017). The existence of the Act No.14 Year 2008 about the Openness of Public Information; Article 19 of Act No.15 Year 2004 about the Audit of Management and Responsibility of State Finances; and Article 7 of Act No.15 Year 2006 about the Audit Board of Republic of Indonesia (BPK RI) provides enlightenment in the implementation of public information is embodiment of good governance and it is guarantee of law towards human rights to get information needed (Retnowati, 2012; BPK, 2018). The Public Information Openness has a good impact because it will strengthen the independence, integrity, and accountability professional occupation both in government and in the private sector for good governance.

Moreover, the Government of Indonesia needs to maintain stability in macroeconomic conditions. Macroeconomics definition is a study of the performance and structure of national economies and the government policies that being used to affect the performance of the economic condition (Tsai, 2019). Besides Indonesia, Malaysia and Thailand also maintain the macroeconomic variables for their interests. Indonesia-Malaysia-Thailand (IMT) Growth Triangle was established in 1993 to give a regional framework for increasing the transformation of macroeconomic factors of its members. However, there is still a gap in these 3 (three) countries. The important role of IMT initiatives is to narrow down the diverged development within overall macroeconomic factors. On the other side, India is one of the IMT neighboring country that has good relation in terms of economic activities and histories. According to Exim Bank India (2018), it is essential for ASEAN-India (including these four countries) to cooperate each other in terms of economic relation. The good cooperation can reduce the trade costs, increase movement of persons and provide substantial benefits by giving low-cost access between countries. Also, refer to Bhogal (2018), it is important to get effective institutional connectivity by harmonizing investments, trade, and financial policies to deepen relations between India and ASEAN countries.

Furthermore, IMT and India relationship should based on Sustainable Development Goals (SDGs). It is necessary to shift the industry-based economy to a technology and information-based economy and computers or other technological devices as a medium of communication. The Public Information Openness Era begins, a time when there is wide, ready and easy access to sharing and using information and data that can be accessed electronically. Information and data related to macroeconomic variable retrieval is very dependent on the availability of internet networks. In its development, a new era of digital economy can be a major factor in realizing an increase in income, growth and economic prosperity in a country (Jati and Salam, 2018). Bridging the digital divide, promoting sustainable industries, and investing in scientific research, data, information and innovation are all important ways to facilitate sustainable development (UNDP, 2015).

LITERATURE REVIEW

According to BPK (2019), the government carries out budgeting by paying attention and revealing the macroeconomic variable basis, the components of its preparation and the underlying assumptions, similar condition also happening in the private sector. The greatest deviation in macroeconomic assumptions is usually 10% of the assumptions that have been set, if there is a change, then the relevant authorities must announce it officially (DPR, 2014; Kemenkeu, 2015). Budget documents have contained the realization of the past five years and medium-term estimations for the next three years BPK (2019). Three of the most important macroeconomic variables are exchange rates, interest rates and foreign exchange reserves (Jati and Salam, 2019; Oktavia, et.al., 2013). If these macroeconomic variables can be maintained, it will be easier to obtain high economic growth and manage inflation stability.

There are several researches in the area of macroeconomic variables analysis in Indonesia and other countries using econometric calculations. Jati and Salam (2019) examined the trade between Indonesia and India using Structural Time-Series Models (STSM). There were patterns of seasonal trade between two countries that can be anticipated by improving the trade agreement commitment and trade infrastructure.

Moreover, Muslim (2016) analyzed macroeconomic variables of Indonesia and other countries especially for trade and Foreign Direct Investment (FDI). He found that the trade characteristics of FDI in Indonesia was different from the ASEAN region. The industrialization process need to be upgraded especially those that are export-oriented so there will be improvement in the technology. In the trade sector for short-term, the government is expected to provide incentives in the form of policies that encourage/provide easy import of capital goods.

Wijoyo (2016) uses GARCH to forecast macroeconomic variable (exchange rate) in Indonesia. He found that the volatility shock was based on external factor. The volatility of exchange rate between 2008 until 2015 happened because of global economic crisis condition from stimulus tightening issues conducted by the USA. In this situation, it was difficult to predict the exchange rate between Rupiah against USD.

Moreover, Jati and Premaratne (2017) analyzed behavior of macroeconomic variables especially food price using GARCH model in Indonesia. They found that price volatility increased during food crisis and relatively difficult to predict because of the uncertainty and high price volatility. The recommendation was to have better trade agreement in commodity trade and get reliable system to minimize price volatility risks.

In this paper, three models are used to study the macroeconomics of IMT and India, namely using the VAR model (Gujarati, 1994; Jati, 2017), the ARMA-ARCH/GARCH model (Hamilton, 1994; Jati and Premaratne, 2017) and the STSM model (Harvey & Peter, 1993; Jati and Salam, 2019). To the best of authors' knowledge, there has been no study on macroeconomic variables of four countries that uses a combination of the three models. So, through this paper, it is expected to be able to contribute, estimate and prepare 3 (three) quantitative models in order to add new references in the academic literature and be useful for all stakeholders.

The contribution that can be made are macroeconomic studies with the VAR model make it possible to find certain relationships between various dynamic data or variables (Gujarati, 1994), then the ARMA-ARCH/GARCH model which allows to identify, compare and estimate whether the model used is sufficient or not (Box and Jenkins , 1976; Jati and Premaratne, 2017), as well as with the STSM model which makes it possible to model dynamic macroeconomic data and variables that fluctuate and are difficult to predict (Durbin & Koopman, 2001; Jati, 2017). These three economic models have their respective advantages that complement each other, so a study with three models on macroeconomics will be more complete and can contribute to relevant authorities.

Based on the explanation above, the purpose of this research is to see how the governance and accountability of macroeconomic variables (exchange rate, interest rate and foreign exchange reserves) in Indonesia, Malaysia, Thailand and India using 3 (three) models. This study will also give a description of macroeconomic variable estimations in the year 2021 and 2022.

RESEARCH METHODOLOGY

Autoregressive Moving Average (ARMA)-ARCH/GARCH Model

A common Autoregression and Moving Average model is ARMA (Hamilton, 1994; Jati, 2014), that can be presented as if:

$$\begin{aligned} Y_t - \varphi &= \beta_1(Y_{t-1} - \varphi) + e_t + \delta_1 e_{t-1} \\ d_t &= \beta_1 d_{t-1} + e_t + \delta_1 e_{t-1} \\ E(d_t) &= E(Y_t - \varphi) = 0 \\ Var(d_t) &= E(d_t^2) \end{aligned} \qquad (1)$$

Note: Y is macroeconomic variables; β_0, β_1, δ_1 are parameters; e_t is residual random; E is expected value; d_t is lag variable.

ARMA is a univariate modelling done by Box-Jenkins procedure (Box and Jenkins, 1976) with steps: (a) identification by observing and comparing correlogram from the combination of existing models, (b) estimation by Ordinary Least Square (OLS) or Maximum Likelihood (ML), (c) evaluation to check the estimated model if it is sufficient.

Model ARCH estimates a conditional variance. The OLS assumption uses Best Linear Unbiased Estimator (BLUE) assumptions, whereas ARCH sees that the residual variance at a point of time (t) is a function of residual variance at other points. This is the commonest of GARCH (1,1) model:

$$Y_t = X_t \theta + e_1 \qquad (2)$$

$$\sigma_t^2 = c + \alpha e_{t-1}^2 + \beta \sigma_{t-1}^2 \qquad (3)$$

Where: c = constant; e^2_{t-1} = ARCH parameter; σ^2_{t-1} = GARCH parameter

Equation (2) is a function of an exogenous variable with an error term (e). Equation (3) is a conditional variance by predicting a future period a variance based on information in the past (Engle, 1982).

Vector Autoregression (VAR) Model

The model of economic and econometric can be formed by the common simultaneous equations from a structural model in which there is a relationship between variables based on a particular theory or concept. Nevertheless, occasionally economic theories in general often have difficulties to provide a certain shape/form of specification of dynamic relationships between the suitable data/variables. This problem goes to the existence of an alternative models that are non-structural/non conceptual to find a good relationship between data/variables. Based on the explanation above, this part of research paper used a Vector Autoregression (VAR) model(Gujarati, 1994):

$$DER_t = \alpha_{A0} + \sum_{i=1}^{n} \alpha_{A1} DIR_{t-1} + \sum_{i=1}^{n} \alpha_{A2} DR_{t-1} + \varepsilon_{At} \qquad (4)$$

$$DIR_t = \alpha_{B0} + \sum_{i=1}^{n} \alpha_{B1} DR_{t-1} + \sum_{i=1}^{n} \alpha_{B2} DER_{t-1} + \varepsilon_{Bt} \qquad (5)$$

$$DR_t = \alpha_{C0} + \sum_{i=1}^{n} \alpha_{C1} DER_{t-1} + \sum_{i=1}^{n} \alpha_{C2} DIR_{t-1} + \varepsilon_{Ct} \qquad (6)$$

Notes:

DER = *The Difference of Exchange Rates (ER)*
DIR = *The Difference of Interest Rates (IR)*
DR = *The Difference of Foreign Exchange Reserve (R)*
i = *time lag*
n = *observation*
t = *time at t*
α_0, α_{B0}, *and* α_{C0} = *constant*
α_{A1}, α_{A2}, α_{B1}, α_{B2}, α_{C1}, α_{C2} = *regression coefficient*
ε_{At}, ε_{Bt}, *and* ε_{Ct} = *error term*

The 3 (three) macroeconomic variables (exchange rates, interest rates, and foreign exchange reserve) taken from four countries, namely Indonesia-Malaysia-Thailand (IMT) and India are endogenous and exogenous variables at the same time (Gujarati, 1994).

Structural Time Series Models (STSM)

Exchange rates, interest rates and foreign exchange reserve are macroeconomic variables that are defined as data that fluctuating and not easy to predict (Jati and Salam, 2017). So, a basic model is required to analyze the changes and dynamics of the variables. A simple solution with a basic model to get a better understanding (precise and accurate) for forecasts and predicts in an alternative model of the Structural Time Series Models (STSM).The superiority of STSM model compared to regular averages is more structured, can model trend, seasonal, cycle patterns and irregularity of macroeconomic variables and make their models more robust. STSM methodology (Durbin & Koopman, 2001) consists of 4 components:

i.) Trend Components (τ_t) that follow the random walk process.

$$\tau_t = \mu_t + \tau_{t-1} + n_t, n_t \sim N(0, \sigma_\eta^2) \qquad (7)$$

$$\mu_t = \mu_{t-1} + \upsilon_t \sim N(0, \sigma_\upsilon^2) \qquad (8)$$

Where τ_t is the trend component, μ_t is the slope that can be stochastic, and n_t is the error of τ_t, and υ_t is the error of μ_t.

ii.) The seasonal component of the specification (γ_t) follows the trigonometric model.

$$\begin{bmatrix} \gamma_{j,t} \\ \gamma_{j,t}^* \end{bmatrix} = \begin{bmatrix} \cos\lambda_j & \sin\lambda_j \\ -\sin\lambda_j & \cos\lambda_j \end{bmatrix} \begin{bmatrix} \gamma_{j,t-1} \\ \gamma_{j,t-1}^* \end{bmatrix} + \begin{bmatrix} \omega_t \\ \omega_t^* \end{bmatrix} \qquad (9)$$

for *j = 1,...,[s/2]*; *t = 1,...,T*. Where γ_t is a seasonal component, ω_t is an error of γ_t.

iii.) Cycle Component (ψ_t) whose models resembles Seasonal Components.

$$\begin{bmatrix} \psi_{j,t} \\ \psi_{j,t}^* \end{bmatrix} = \rho\psi \begin{bmatrix} \cos\lambda_c & \sin\lambda_c \\ -\sin\lambda_c & \cos\lambda_c \end{bmatrix} \begin{bmatrix} \psi_{j,t-1} \\ \psi_{j,t-1}^* \end{bmatrix} + \begin{bmatrix} K_t \\ K_t^* \end{bmatrix} \qquad 10)$$

for *t = 1,...,T*. Where ψ_t is the cycle component, ρ_ψ and λ_c are damping and frequency factors with values $0< \rho_\psi <1$ and $0< \lambda_c <\pi$ while K_t and K_t^* are not mutually correlated $N(0,\sigma k^2)$.

iv.) Irregularities Component/error terms (ε_t).
If all components are summed then it becomes:

$$y_t = \tau_t + \gamma_t + \psi_t + \varepsilon_t \qquad (11)$$

So, y_t is the price of the commodity predicted by the component of trend (τ_t), seasonal (γ_t), cycle (ψ_t) and irregularities (ε_t). This model is estimated using the method of Maximum Likelihood Estimation (MLE) and estimate components generated from Kalman filter (Harvey & Peters, 1993). The software used in this model is OxMetrics Stamp 7.

Type of Data

The data types used are 231 monthly macroeconomic data on the period M1-January 2000 until M3-March 2019 for four countries, Indonesia-Malaysia-Thailand (IMT) and India. The data taken are: International Financial Statistics (IFS)-International Monetary Fund (IMF) from the (IFS-IMF, 2019). The macroeconomic variables are: (1)Exchange rate (ER) is exchange rate for domestic currency per US dollar in the end of period; (2)Interest Rate (IR) is a lending interest rate (%) per annum; (3) Reserves (R) is international liquidity of total foreign exchange reserves (million) excluding gold. The macroeconomic data were analyzed using Eviews software for VAR and ARCH/GARCH models and OxMetrics Stamp 7 for STSM model.

RESULT AND DISCUSSION

Descriptive Analysis

Table 1, 2 and 3 show the monthly descriptive statistics of macroeconomic variables year of 2000-2019. Some of the skewness values are greater than zero indicates that the distribution is more to the right. The kurtosis value is greater than 3 (three) for interest rate. Thailand showed that the distribution square of this variable have a fat tail compared to normal distribution. This kurtosis value is higher than 3 also indicates of heteroscedasticity.

TABLE-1: Descriptive Quantitative Analysis of the Exchange Rates (ER)

	ER_INDONESIA	ER_MALAYSIA	ER_THAILAND	ER_INDIA
Mean	10,466	3.63	35.84	52.18
Median	9,530	3.76	34.62	47.97
Maximum	15,227	4.48	45.68	73.9
Minimum	7,425	2.95	29.3	39.3
Std. Dev.	1,939	0.37	4.44	9.2
Skewness	0.81	0.058	0.56	0.68
Kurtosis	2.23	2.26	2.05	1.99
Jarque-Bera	30	5.38	20.85	27.6
Probability	0.00	0.06	0.00	0.00
Sum	2,417,842	839	8281	12,055

Sum Sq. Dev.	8.65×10^8	32.08	4,544	19,736
Observations	231	231	231	231

Source: *researcher's calculation (2021)*

TABLE-2: Descriptive Quantitative Analysis of the Interest Rates (IR)

	IR_INDONESIA	IR_MALAYSIA	IR_THAILAND	IR_INDIA
Mean	13.98	5.58	5.31	10.9
Median	13.19	5.06	5.003	10.75
Maximum	20.08	7.81	8.00	14.00
Minimum	10.34	4.44	4.12	8.00
Std. Dev.	2.58	0.96	1.02	1.25
Skewness	0.74	0.55	1.05	0.18
Kurtosis	2.42	2.12	3.18	2.41
Jarque-Bera	24.39	19.11	43.52	4.62
Probability	0.000005	0.00007	0.000	0.09
Sum	3230	1290	1227	2539
Sum Sq. Dev.	1540	212.13	242.91	360.1
Observations	231	231	231	231

Source: *researcher's calculation (2021)*

TABLE-3: Descriptive Quantitative Analysis of the Reserves (R)

	RESERVES INDONESIA	RESERVES MALAYSIA	RESERVES THAILAND	RESERVES INDIA
Mean	70,624	87,040	112,484	222,206
Median	58,457	94,736	124,766	263,126
Maximum	128,498	139,561	209,062	403,750
Minimum	26,988	24,512	30,965	32,611
Std. Dev.	35,704	34,907	61,557	112,277
Skewness	0.11	-0.38	-0.087	-0.33
Kurtosis	1.31	2.04	1.36	1.8
Jarque-Bera	27.81	14.66	25.93	17.78
Probability	0.000001	0.0006	0.000002	0.0001
Sum	16,314,258	20,106,461	25,983,911	51,329,648
Sum Sq. Dev.	2.93×10^{11}	2.80×10^{11}	8.7×10^{11}	2.9×10^{11}
Observations	231	231	231	231

Source: *researcher's calculation (2021)*

Stationarity Test Result

Macroeconomic Variables were analyzed using Eviews economics software version 8. The stationarity data test should be performed before estimating Vector Autoregression (VAR) and ARCH/GARCH model. According to Gujarati (2003), time coherent data can be said to be stationary if the values of averages, variance and autocovariance for each lag are constant over time. The way to detect the stationarity of an existing variable is by using Augmented Dicky-Fuller (ADF) test. This ADF test is done at the first difference (1^{st} integration order). The result is all stationary variables at the level for all log natural (*ln*) of the variable data.

TABLE-4: Result of Stationarity Test using Augmented Dicky-Fuller (ADF)

No	Variable	Test ADF	MacKinnon Critical Value	Order Integration
1	Exchange Rates (ER) Indonesia	-13.65	-3.45***	1^{st} difference
2	Exchange Rates (ER) Malaysia	-14.03	-3.45***	1^{st} difference
3	Exchange Rates (ER) Thailand	-12.93	-3.45***	1^{st} difference
4	Exchange Rates (ER) India	-13.69	-3.45***	1^{st} difference
5	Interest Rates (IR) Indonesia	-24.52	-3.45***	1^{st} difference
6	Interest Rates (IR) Malaysia	-12.19	-3.45***	1^{st} difference
7	Interest Rates (IR) Thailand	-4.33	-3.45***	1^{st} difference
8	Interest Rates (IR) India	-14.61	-3.45***	1^{st} difference
9	Reserves (R) Indonesia	-12.95	-3.45***	1^{st} difference
10	Reserves (R) Malaysia	-8.59	-3.45***	1^{st} difference
11	Reserves (R) Thailand	-11.65	-3.45***	1^{st} difference
12	Reserves (R) India	-5.59	-3.45***	1^{st} difference

Note: **** represent the levels of significance of 1%*
Source: *researcher's calculation*

ARMA-ARCH/GARCH Analysis Result
ARMA Analysis

TABLE-5: The Best ARMA for All Variables

No.	Variables	The Best Model for ARMA (Lag Order)
1	Exchange Rates Indonesia (DER_INDO)	MA(1)
2	Exchange Rates India (DER_INDI)	ARMA(1,1)
3	Exchange Rates Malaysia (DER_MAL)	ARMA(1,1)

4	Exchange Rates Thailand (DER_THAI)	AR(1)
5	Interest Rates Indonesia (DIR_INDO)	ARMA(1,1)
6	Interest Rates India (DIR_INDI)	ARMA(1,1)
7	Interest Rates Malaysia (DIR_MAL)	ARMA(1,1)
8	Interest Rates Thailand (DIR_THAI)	ARMA(1,1)
9	Reserves Indonesia (DR_INDO)	ARMA(1,1)
10	Reserves India (DR_INDI)	ARMA(1,1)
11	Reserves Thailand (DR_THAI)	ARMA(1,1)
12	Reserves Malaysia (DR_MAL)	ARMA(1,1)

Source: *researcher's calculation (2021)*

Table 5 shows the best ARMA model for the macroeconomic variables varies. Most of the macroeconomics variables are known to have AutoRegressive (AR) and Moving Average (MA) in the first order, except exchange rate Indonesia that only has MA(1) (order of lag operation Moving Average 1) and exchange rates Thailand that only has AR(1) (order of lag operation AutoRegressive 1). The selection of the first order is common in the ARMA model because if the lag order is taken higher (second or third order) then the effect will be smaller in the ARMA model.

ARMA-ARCH/GARCH Analysis

The best ARMA-ARCH/GARCH model for the macroeconomic variables was calculated using Eviews software and the result varies. There are 10 macroeconomic variables (ER India, ER Malaysia, IR Indonesia, IR India, IR Malaysia, IR Thailand, R Indonesia, R India, R Thailand and R Malaysia) are known to have AutoRegressive (AR) and Moving Average (MA) in the first lag order operation. Same like in ARMA Analysis, the ARMA-ARCH/GARCH Analysis shows ER Indonesia only has MA(1) and ER Thailand only has AR(1). Therefore, this research paper uses ARCH/GARCH model based on ARMA model. The ARMA result shows that the clustering volatility indicates an ARCH effect. Furthermore, data is tested whether no ARCH effect or not on model then used ARCH-LM test.

The ARCH-LM test shows that 7 variables have probability above 10%/not significant (ER Thailand, IR Indonesia, IR India, IR Thailand, Reserves Indonesia, Reserves India, and Reserves Malaysia) and 5 variables have probability below 10%/significant (ER Indonesia, ER India, ER Malaysia, IR Malaysia, Reserves Thailand). This indicates that ARMA will be more effective for 7 variables and the ARMA-ARCH/GARCH model will be more effective to 5 variables that have probability below 10% (based on Eviews calculation). Then, further estimate is to simulate the ARCH/GARCH test by estimating the parameters using Quasi Maximum Likelihood (QML). This estimation is to get the ARCH/GARCH model from the lowest value presented in Akaike Info Criterion (AIC) and Schwarz Criterion (SC) values (Gujarati, 1994).

Table 6 and 7 show that *α* is the ARCH coefficients and β is the GARCH coefficient. This calculation takes the lowest values of AIC and SC. It also selected significant values of constant *(C)*, *α* and β. Therefore, based on the simulation comparison of some models, it is seen that the best model chosen is DER_INDO-MA (1)-GARCH (1,1) for exchange rates Indonesia, DER_INDI-ARMA (1,1)-GARCH (1,1) for exchange rates India, DER_MAL- ARMA (1,1)-GARCH (1,1) for exchange rate Malaysia, DIR_MAL- ARMA (1,1)-GARCH (1,1) for interest rates Malaysia, and DR_THAI- ARMA (1,1)-GARCH (1,1) for reserves Thailand.

TABLE-6: Test ARMA- GARCH(1,1) of the Exchange Rates (ER)

Coefficient	**Exchange Rates Indonesia (DER_INDO-MA(1)-GARCH(1,1))**	**Exchange Rates India (DER_INDI-ARMA(1,1)-GARCH(1,1))**	**Exchange Rates Malaysia (DER_MAL-ARMA(1,1)-GARCH(1,1))**
Constant (C)	0.023***	0.001	0.001**
ARCH (α)	0.83***	0.16***	0.12***
GARCH (β)	0.14***	0.76***	0.807***
AIC	0.48	1.47	0.907
SC	0.55	1.42	2.44

Note: ****,**,* represent the levels of significance of 1%,5%, and 10% respectively*
Source: *researcher's calculation (2021)*

TABLE-7: Test ARMA- GARCH(1,1) of the Interest Rates and Reserves

Coefficient	**Interest Rates**	**Reserves Thailand**

	Malaysia (DIR_MAL-ARMA(1,1)-GARCH(1,1))	(DR_THAI- ARMA(1,1)-GARCH(1,1))
Constant (C)	0.14***	0.089*
ARCH (α)	0.36***	0.085
GARCH (β)	0.404***	0.78***
AIC	2.12	2.505
SC	2.21	2.45

Note: ****,**,* represent the levels of significance of 1%,5%, and 10% respectively*
Source: *researcher's calculation (2021)*

Vector Autoregression (VAR) Model Analysis

Determination of lag length in VAR is important because VAR model is sensitive to lag length. The optimal determination of lag is one of the important procedures that must be done in the formation of models (Enders, 1995). In addition to determining the optimal lag, it also must be considered the possibility of serial correlation caused by the selection or the selection of a lag that is too long which causes a decrease in the degree of freedom produced and the estimated number of parameters becomes more inefficient. There is a way to determine the optimal lag length such as see the smallest Likelihood Ratio (LR) value.

TABLE-8: VAR Lag Order Selection Criteria

Lag	LogL	LR	AIC
0	-1588	NA	14.03
1	-1381	390	13.48*
2	-1267	203*	13.74

** indicates lag order selected by the criterion.*
Source: *researcher's calculation (2021)*

Based on the lag order selection, The LR shows that the lag should be choose is 2, but the AIC shows that the lag should be choose is 1. It is better to choose lag 2 for LR because lag 1 is assumed to be short and more variables can make the explanations better than less variables.

TABLE-9: VAR Estimation Result for Exchange Rates

	DER_INDO	DER_THAI	DER_INDI	DER_MAL
DER_INDO(-1)	0.11	0.13	0.06	-0.04
DER_INDO(-2)	-0.15***	-0.02	-0.08	-0.35
DER_THAI(-1)	-0.12	-0.01	-0.09	0.21
DER_THAI(-2)	0.06	0.05	0.12	0.26
DER_INDI(-1)	0.12***	0.17***	0.09	0.46
DER_INDI(-2)	-0.009	-0.007	-0.15	-0.59***
DER_MAL(-1)	-0.035	-0.04	-0.05	-0.11
DER_MAL(-2)	0.01	-0.006	0.009	0.09
DIR_INDO(-1)	0.03	0.099	0.11	0.18
DIR_INDO(-2)	-0.007	-0.002	0.09	0.27
DIR_THAI(-1)	0.02	-0.04	0.06	0.103
DIR_THAI(-2)	-0.02	-0.007	-0.01	-0.22
DIR_INDI(-1)	-0.004	0.051***	-0.0004	0.08
DIR_INDI(-2)	0.02	0.023	0.055	0.05
DIR_MAL(-1)	-0.007	-0.03	-0.054	-0.05
DIR_MAL(-2)	0.01	0.005	0.014	0.02
DR_INDO(-1)	-0.17	-0.04	-0.351***	-0.105
DR_INDO(-2)	0.03	0.107	0.03	0.41
DR_THAI(-1)	-0.02	-0.21	-0.206	-0.609
DR_THAI(-2)	0.051	-0.09	-0.136	-0.36
DR_INDI(-1)	0.048	-0.01	0.024	0.209
DR_INDI(-2)	0.108	0.13	0.012	0.51
DR_MAL(-1)	-0.305***	-0.07	0.163	-0.04
DR_MAL(-2)	0.122	-0.006	-0.07	-0.54

Source: *researcher's calculation (2021)*

The VAR estimation result for exchange rates shows that not all lag variables are significant in each equation (Jati, 2017). The variable that significantly influences differences in exchange rate Indonesia are: the differences of exchange rates Indonesia two months before time *t*, the differences of exchange rates India one month before time *t*, and the differences of reserves Malaysia one month before time *t*. The variable that significantly influences differences in Thailand are: the differences of exchange rates India one month before time *t* and the differences of interest rates India one month before time *t*. The variable that significantly influences differences in India is the differences of reserves Indonesia one month before time *t*. The variable that significantly influences differences in Malaysia is the differences of exchange rates India two months before time *t*.

TABLE-10: VAR Estimation Result for Interest Rates

	DIR INDONESIA	DIR THAILAND	DIR INDIA	DIR MALAYSIA
DER_INDO(-1)	-0.001	-0.21	0.03	-0.04
DER_INDO(-2)	-0.046	-0.02	0.019	-0.01
DER_THAI(-1)	0.006	0.48***	0.22	-0.17
DER_THAI(-2)	0.11	-0.15	0.46	-0.22
DER_INDI(-1)	-0.016	-0.11	-0.07	0.02
DER_INDI(-2)	-0.003	-0.15	-0.23	0.16
DER_MAL(-1)	0.018	-0.03	-0.05	-0.08
DER_MAL(-2)	-0.03	0.07	-0.051	0.03

DIR_INDO(-1)	0.38***	0.12	0.067	-0.1
DIR_INDO(-2)	0.28***	0.06	0.05	-0.07
DIR_THAI(-1)	0.035	0.39***	-0.09	0.2***
DIR_THAI(-2)	0.023	0.25***	0.27***	0.05
DIR_INDI(-1)	0.026	0.03	-0.019	0.008
DIR_INDI(-2)	-0.027	-0.0004	0.046	0.05
DIR_MAL(-1)	0.013	0.06	-0.11	0.04
DIR_MAL(-2)	-0.03	0.03	-0.21	0.07
DR_INDO(-1)	0.048	-0.27	0.24	-0.22
DR_INDO(-2)	-0.162	-0.06	0.7	0.1
DR_THAI(-1)	-0.097	-0.29	-0.5	-0.77***
DR_THAI(-2)	-0.24	0.53	0.26	0.12
DR_INDI(-1)	-0.084	0.18	-0.29	0.18
DR_INDI(-2)	0.15	-0.34	0.21	0.07
DR_MAL(-1)	-0.009	0.07	0.8	-0.26
DR_MAL(-2)	0.28***	0.63***	-0.06	-0.16

***Source**: researcher's calculation (2021)*

The VAR estimation result for interest rates also shows some lag variables are significant in each equation. The variable that significantly influences differences in interest rates Indonesia are: the differences of interest rates Indonesia one month and two months before time *t*, and the differences of reserves Malaysia two months before time *t*. The variable that significantly influences differences in interest rates Thailand are: the differences of exchange rates Thailand one month before time *t*, the differences of interest rates Thailand one month and two months before time *t*, and the differences of reserves Malaysia two months before time *t*. The variable that significantly influences differences in interest rates India is: the differences of interest rates Thailand two months before time *t*. The variable that significantly influences differences in interest rates Malaysia are: the differences of interest rates Thailand one month before time *t*, and reserves Thailand one month before time *t*.

TABLE-11: VAR Estimation Result for Reserves

	DR_INDONESIA	DR_THAILAND	DR_INDIA	DR_MALAYSIA
DER_INDO(-1)	-0.06	-0.01	-0.01	-0.05
DER_INDO(-2)	0.02	-0.01	0.07	-0.08***
DER_THAI(-1)	0.05	-0.02	0.05	-0.02
DER_THAI(-2)	-0.16***	-0.02	-0.05	-0.01
DER_INDI(-1)	-0.07	0.03	-0.08***	-0.05
DER_INDI(-2)	-0.002	0.02	-0.02	0.07***
DER_MAL(-1)	0.007	0.01	0.01	-0.004
DER_MAL(-2)	0.005	-0.007	-0.003	-0.01
DIR_INDO(-1)	-0.02	-0.03	-0.06	-0.06
DIR_INDO(-2)	-0.07	-0.01	0.02	-0.1***
DIR_THAI(-1)	0.03	0.01	0.01	0.03
DIR_THAI(-2)	0.03	-0.003	-0.02	0.001
DIR_INDI(-1)	-0.01	-0.005	0.007	-0.001
DIR_INDI(-2)	-0.04***	-0.007	-0.01	-0.01
DIR_MAL(-1)	-0.01	0.001	0.01	0.009
DIR_MAL(-2)	-0.01	-0.001	-0.009	0.005
DR_INDO(-1)	0.000	-0.01	-0.02	-0.04
DR_INDO(-2)	-0.05	-0.02	-0.12***	-0.1
DR_THAI(-1)	0.05	0.2***	0.01	0.02
DR_THAI(-2)	0.103	0.12	0.1	0.1
DR_INDI(-1)	0.19	0.07	0.2***	0.03
DR_INDI(-2)	-0.18	-0.08	0.09	0.05
DR_MAL(-1)	-0.06	0.02	0.05	0.27***
DR_MAL(-2)	-0.009	-0.06	0.002	0.05

***Source:** researcher's calculation (2021)*

The VAR estimation result for reserves shows that some lag variables are significant in each equation. The variable that significantly influences differences in reserves Indonesia are: the differences of exchange rate Thailand two months before time *t*, and the differences of interest rates India two months before time *t*. The variable that significantly influences differences in reserves Thailand is: the differences of reserves Thailand one month before time *t*. The variable that significantly influences differences in reserves India are: the differences of exchange rates Thailand one month before time *t*, the differences of reserves Indonesia two months before time *t*, and the differences of reserves India one month before time *t*. The variable that significantly influences differences in reserves Malaysia are: the differences of exchange rates Indonesia two months before time *t*, the differences of exchange rates India two months before time *t*, the differences of interest rates Indonesia two months before time *t*, and the differences of reserves of Malaysia one month before time *t*.

The VAR estimation result indicates that super cycle commodity phenomenon and shock of macroeconomic variables that need to be considered to make estimation what will happen in the future. Similar with research from Jati and Salam (2017) that wrote about the behavior of stock index, macroeconomic variables and commercial bank stock prices. They found that there is evidence of shock from exchange rate and crude oil price to stock prices. This result also supported by the research from Hussin (2012) and Agbetsiafa (2010) which explains the existence of regional integration and openness. According to UNDP (2014), openness and transparency are very important to achieve sustainable development.

Analysis Result from Estimation of Structural Time-Series Models (STSM) using Software OxMetrices

Estimation of Exchange Rate Indonesia (USD/IDR) with STSM using Software OxMetrices

STSM methodology to estimate the Exchange Rate (ER) Indonesia shows: (1) ER Indonesia trend derived from high seasonal and irregularity components associated with supply and demand from domestic and foreign for exchange rate USD/IDR as well as fundamentally changing Indonesia over time. According to Sugeng et al. (2010), foreign exchange currency market is dominating in Indonesia. (2) Seasonal component declined in the beginning of the year up to June and then increased from July to December. The declined in the exchange rate IDR/USD (appreciation of Rupiah) is predicted because usually early of the year the corporate/government debt in the form of USD not yet due, also the government budget not yet settle. The increased in the exchange rate IDR/USD (depreciation of Rupiah) can be happened on month of July until end of the year. (3) The cycle component that rise: (a) in the year 2001 happened because the highest development of money supply occurred about 10.5% (Oktavia, et.al., 2013), (b) in the year 2007-2008 because of global economic crisis. (4) There are irregularities components in Exchange Rate Indonesia, it reflects that the model is relatively more difficult to predict.

Estimation of the Exchange rate Indonesia with STSM using software OxMetrices from April 2019 to February 2022 increased by 4.75% (Rupiah depreciated against USD). The exchange rate depreciation would stimulate exports and curtail imports. This can be happened if the external factors do not become a major factor in exchange rate irregularities. In addition, other macroeconomic indicators such as economic growth and inflation should be well maintained. The exchange rate estimation accuracy mostly caused by short-term components, namely seasonal, which can be occur due to changes in demand and supply of USD currency notes every month.

The result of Coefficient of Variation (CV) calculation from exchange rates Indonesia is 1.57. This shows that the exchange rates Indonesia movements from April 2019 to February 2022 is estimated to increase (depreciate) with a stable tendency because it is still below the 9% threshold (Kemendag, 2015). According to Warjiyo (2013), the increase of exchange rate volatility happens because of volatility in capital flows, market influence abroad, the microstructure conditions of the market and irrational behavior of market players. So, in the next 2 (two) years estimation will be less shock from abroad to exchange rates Indonesia.

Estimation of Exchange Rate Thailand (USD/Bath) with STSM using Software OxMetrices

STSM methodology to estimate the Exchange Rates (ER) Thailand shows: (1) Dynamics of exchange rate Thailand trend is derived from components associated with transaction from financial and banking sectors related to the foreign currency Bath/USD as well as fundamentally changing Thailand economy over time. (2) Seasonal component declined in the beginning of the year up to March/April and then increased from May-December. There is indication that the exchange rate Thai Bath appreciate in the early of the year, then depreciate in the middle until the end of the year against USD. (3) Different with seasonal, cycle in exchange rate Thailand is relatively difficult to be estimated because of the pattern unstable. (4) No irregularity for exchange rate Thailand.

Estimation of the Exchange Rate (ER) Thailand with STSM using software OxMetrices from April 2019 to February 2022 decreased by 1.64% (Thai Bath appreciated against USD). The exchange rate appreciation helps lower producers' import costs of raw materials and intermediate goods as well as delaying an increase in consumers' living costs (Bank of Thailand, 2018). This condition is possible to happen if the other external shocks do not become a big factor in Thailand exchange rate irregularities. The

Coefficient of Variation (CV) calculation result is 0.88. This number indicates that the Thailand Bath exchange rate against USD movements from April 2019 to February 2022 is estimated to stable due to the number is lower than 9% threshold (Kemendag, 2015).

Estimation of Exchange Rate India (INR/USD) with STSM using Software OxMetrices

STSM methodology approach to estimates the Exchange Rates India: (1) trend of exchange rate is derived from relatively high seasonal and cycle components associated with buying and selling for Indian Rupees currency against USD from stakeholders as well as fundamentally changing of Indian economy over time. (2) Seasonal component declined in the beginning of the year (the value of ER India bigger than ER Thailand and smaller than ER Indonesia), then increased again in the middle of the year until end of the year. This indicates that there is a seasonal pattern of the Indian Rupees (appreciation and depreciation) similar with the pattern of Thailand Bath currency against USD. (3) The existence of cycle component occurs over a longer period of time (approximately 3 years) than seasonal components. (4) There is no irregularity components.

Estimation of the Exchange Rate (ER) India (INR/USD) with STSM using software OxMetrices from April 2019 to February 2022 increased by 1.13% (Indian Rupees depreciated against USD). The exchange rate depreciation can help to stimulate exports and maintain imports. This condition will be possible to happen if the external shocks do not become a major influence to exchange rate irregularities. Furthermore, inflation rate in India should be well maintained because the condition right now is higher than Indonesia and Thailand. The accuracy of exchange rate India estimation is caused by a short-term component (seasonal) and long-term component (cycle), that can be occur due to dynamic of selling and buying USD notes every month. There are also micro variables that should be considered such as: bid-ask spread, order flows, private and public information and volume transaction in India foreign exchange market (Bhanumurthy, 2002). The coefficient of variation (CV) calculation result is 0.67 lower than Thailand and Indonesia. This number indicates that the Reserve Bank of India intervenes occasionally to maintain excessive volatility Rupees against the USD (Tripathy, 2013).

Estimation of Exchange Rate Malaysia (USD/Ringgit) with STSM using Software OxMetrices

STSM methodology approach using software OxMetrices to estimates the Exchange Rates Malaysia shows: (1) trend of exchange rate Malaysia is derived from relatively high seasonal and increasing cycle components associated with demand and supply for foreign exchange market such as USD from stakeholders as well as fundamentally changing of Malaysian economy over time. (2) Seasonal component declined in the beginning of the year January-March/April, then increased again in the middle of the year until end of the year (similar like Seasonal components in Indonesian exchange rate). This indicates that there is a seasonal pattern of the Malaysian Ringgit (appreciation and depreciation). (3) The existence of cycle component occurs over a longer period of time (approximately 18 months) than seasonal components with a tendency to increase. (4) There are no irregularity components just like Thailand and India exchange rate.

Estimation of the Exchange Rate (ER) Malaysia with STSM using software OxMetrices increased by 0.77% (Malaysian Ringgit depreciated against USD). The exchange rate depreciation can help to increase exports and maintain imports. This condition will be possible if the external factors should be maintained and under control such as exchange rate irregularities. The result of Coefficient of Variation (CV) is 1.49. This number shows that the relevant monetary authorities of Malaysia success maintain the movements Malaysian Ringgit currency against the USD.

Estimation of Lending Interest Rate in Indonesia with STSM using Software OxMetrices

Based on STSM methodology using software OxMetrices, the estimation of lending Interest Rates (IR) Indonesia shows: (1) IR Indonesia has a decreasing trend. (2) Seasonal component declined in the beginning of the year up to June and then increased from July to December. The increased in seasonal component of lending interest rates Indonesia can be happened on month of July until end of the year. (3) The cycle component estimation has tendency to decrease. (4) There are no irregularities components in lending Interest Rates Indonesia, it reflects that the model is relatively easier to estimate compared with exchange rate in Indonesia.

Estimation of the Lending Interest Rates (IR) Indonesia with STSM using software OxMetrices from April 2019 to February 2022 decreased by 12.55%. The lower level of lending interest rate will help Indonesian economy. This is due to the fact that lending interest rates influence the economic activity such as flow of goods, financial assets and services within economy (Saunder, 1995). The Coefficient of Variation (CV) calculation result is 4.51. It shows that the lending interest rates in Indonesia relatively stable because still below the 9% threshold (Kemendag, 2015).

Estimation of Lending Interest Rate in Thailand with STSM using Software OxMetrices

Based on STSM methodology using software OxMetrices, the estimation of lending Interest Rates (IR) Thailand shows: (1) IR Thailand has a decreasing trend. (2) Seasonal component increased in the beginning of the year, declined in the middle of the year, then increased again in the end of the year. (3) The cycle component of Lending Interest Rates has tendency to decrease similar like Indonesian interest rate cycle component. (4) There are no irregularities components in lending Interest Rates Indonesia, it reflects that the model is relatively easier to estimate compared with exchange rate in Indonesia.

Estimation of the Lending Interest Rates (IR) Thailand with STSM using software OxMetrices from April 2019 to February 2022 decreased by 3.80 %. The lower level of lending interest rate will help Thailand economy. The Coefficient of Variation (CV) calculation result is 1.18. It shows that the lending interest rates in Thailand relatively stable because still below the 9% threshold.

Estimation of Lending Interest Rate in India with STSM using Software OxMetrices

Based on STSM methodology using software OxMetrices, the estimation of lending Interest Rates (IR) India shows: (1) IR India has a decreasing trend. (2) Seasonal component has increased the highest in the month of March/April and declined in the lowest level in the end of the year. (3) The cycle component is relatively difficult to see the pattern. (4) There are no irregularities components in lending Interest Rates India, it reflects that the model is relatively easier to estimate compared with other variable that has irregularities.

Estimation of the Lending Interest Rates (IR) India with STSM using software OxMetrices from April 2019 to February 2022 decreased by 2.94%. The lower level of lending interest rate may help India economy. The Coefficient of Variation (CV) calculation result is 1.06. It shows that the lending interest rates in India will be relatively stable and lower than Indonesia.

Estimation of Lending Interest Rate in Malaysia with STSM using Software OxMetrices

Based on STSM methodology using software OxMetrices, the estimation of lending Interest Rates (IR) Malaysia shows: (1) IR Malaysia has a decreasing trend. (2) Seasonal component declined in the beginning of the year up to June and then increased from July to December. The increased in seasonal component of lending interest rates Indonesia can be happened on month of July until end of the year. (3) The cycle component estimation has fluctuated over time in range of 0.5 and it has a tendency to increase from 2010 to 2019. (4) There are no irregularities components in lending Interest Rates Malaysia, it reflects that the model is relatively easy to estimate similar with exchange rate in Indonesia.

Estimation of the Lending Interest Rates (IR) Malaysia with STSM using software OxMetrices from April 2019 to February 2022 decreased by 15.25%. The lower level of lending interest rate can help Malaysia economy. The Coefficient of

Variation (CV) calculation result is 5.16. It shows that the lending interest rates in Malaysia will be relatively more fluctuated than Indonesia, India and Thailand.

Last but not least, the estimation of Foreign Exchange Reserves (R) for Indonesia, Malaysia, Thailand (IMT) and India with STSM using software OxMetrices increased in February 2022. The estimation changes for Reserves (R) with STSM using software OxMetrices from April 2019 to February 2022 are: 10.7% for Indonesia, 8.8% for Malaysia, 12.5% for Thailand, and 8.4% for India. The Coefficient of Variation (CV) calculation results are: 3.7 for Indonesia, 3.1 for Malaysia, 3.8 for Thailand, and 1.9 for India. It indicates that India reserves will be relatively more stable and less changes because already in the highest position among other countries. Maintaining the good position of international reserves for foreign exchange is a first line of defense in response to growing global uncertainty (Bank Indonesia, 2015).

Governance and Accountability of Macroeconomic Variables in Indonesia, Malaysia, Thailand and India using 3 (three models)

The era of information disclosure has changed all forms of organizational transformation to be better with a good governance and accountable system. Trade in goods and services, investments, tourism and other international cooperation relationship, including (ASEAN-India FTA) between Indonesia-Malaysia-Thailand (IMT) and India is expected to accelerate sustainable development (Sankaran, 2018).

The similarity of economic structure and diplomatic relations established for decades have made IMT and India can help each other to facilitated information disclosure and increased cooperation between the countries. However, the presence of shock from outside remains to be watched out as the global changes can disrupt the sustainable development. It is important for relevant authorities to developing, maintaining, and promoting better governance related to the transparency and public accountability of macroeconomic variables estimation published, so everyone can overcome the problem of asymmetric information. The good governance and accountability of macroeconomic variable assumptions in Indonesia based on Public Expenditure and Financial Accountability (PEFA) under Ministry of Finance of Republic of Indonesia, in Malaysia based on Book of Budget under Ministry of Finance Malaysia (Treasury Malaysia, 2021), in Thailand based on the National Economic and Social Development and Ministry of Finance Thailand (Bank of Thailand, 2018), and in India based on Union Budget-Ministry of Finance-Government of India (Government of India, 2021). The Central Bank and the National Statistics Agency are government institutions that also give big contributions for better governance and accountability of macroeconomic variable availability to make a good research using ARMA-ARCH/GARCH, VAR and STSM analysis (see table 12).

TABLE-12: Summarize of the Analysis

Exchange Rates (ER) (Local Currency /USD)	Interest Rates (IR)	Foreign Exchange Reserves (FER)	Governance and Accountability
Descriptive Analysis			
-Period January 2000-March 2019, ER Indonesia/USD has the lowest value on October 2018 about Rp.15,227/USD. This nominal number was the biggest compared to ER for Malaysia (MYR 4.4/USD on December 2016), Thailand (THB 45.6/USD on July 2001), India (INR 73.9/USD October 2018).	- Period January 2000-March 2019, IR in Indonesia has the highest about 20.08% on January 2000. This number was the biggest compared to IR in Malaysia (7.81% on January 2000), Thailand (8% on January-August 2000), India (14% on August-October) 2008).	- Period January 2000-March 2019, FER in Indonesia has the highest about USD 128,498 million on January 2018. This nominal number was the smallest compared to India has about USD 403,751 million FER on March 2018, Thailand has the FER about USD 209,062 million, and Malaysia has the FER about USD 139,561 million.	- The good governance and accountability of macroeconomic variables assumptions in Indonesia based on Public Expenditure and Financial Accountability (PEFA) under Ministry of Finance of Republic of Indonesia, in Malaysia based on Book of Budget, in Thailand based on the National Economic and Social Development and Ministry of Finance Thailand, in India based on Union Budget-Ministry of Finance-Government of India (Treasury Malaysia, 2021; Bank of Thailand, 2018; Government of India, 2021).
Research Method: ARMA-ARCH/GARCH and VAR Analysis			
- ER for India and Malaysia have AutoRegressive (AR) and Moving Average (MA) in the first order, ER Indonesia that only has MA (1) and ER Thailand that only has AR(1). -ER for Indonesia, Malaysia and India estimations better to used combination of ARMA-ARCH/GARCH analysis. - VAR analysis	-All IR variables are known to have AutoRegressive (AR) and Moving Average (MA) in the first order. -IR for Malaysia estimations better to used combinations of ARMA-ARCH/GARCH. -VAR Analysis shows that IR Indonesia month *t* can be significantly influenced by IR Indonesia one	-All reserves variables are known to have AutoRegressive (AR) and Moving Average (MA) in the first order. -Reserves for Thailand estimations better to used combinations of ARMA-ARCH/GARCH. -VAR Analysis shows that FER Indonesia month *t* can be significantly influenced by ER	- Central Bank and National Statistics Agency are government institutions that give contribution for better governance and accountability of macroeconomic variable availability to make a good research using ARMA-ARCH/GARCH and VAR analysis. - Estiko and Wahyuddin (2019) using ARIMA. -Jati, Kumara (2014) using ARMA-ARCH/GARCH for

shows that ER Indonesia month *t* can be significantly influenced by ER Indonesia two months before, ER India one month before, and ER Malaysia one month before time *t*.	month and two months before, and reserves Malaysia two months before time *t*.	Thailand two months, IR India two months before time *t*.	sugar prices. - Jati, Kumara (2018) using ARMA-ARCH/GARCH and dummy variable for food commodity variable. -Jati, Kumara (2017) using VAR for commodity price variables.
Research Method: Structural Time-Series Models			
-ER Indonesia (IDR/USD) estimation increased by 4.75% (Rupiah depreciated against USD) from April 2019 to February 2022. -ER Malaysia (MYR/USD) estimation increased by 0.77% (Ringgit depreciated against USD). -ER Thailand (THB/USD) estimation decreased by 1.64% (Thai Bath appreciated against USD). -ER India (INR/USD) estimation increased by 1.13% (Rupees depreciate against USD).	- IR Indonesia estimation decreased by 12.55% from April 2019 to February 2022. - IR Thailand estimation decreased by 3.8%. - IR India estimation decreased by 2.94%. - IR Malaysia estimation decreased by 15.25%.	- The estimation of Foreign Exchange Reserves (R) for Indonesia, Malaysia, Thailand (IMT) and India increased in February 2022. The changes for this Reserves (R) from April 2019 to February 2022 were: 10.7% for Indonesia, 8.8% for Malaysia, 12.5% for Thailand, and 8.4% for India.	- The exchange rate depreciation would stimulate exports and curtail imports. - The exchange rate appreciation helps lower producers' import costs of raw materials and intermediate goods as well as delaying an increase in consumers' living costs. - The lower level of lending interest rate will help economy because influence flow of goods, financial assets and services. - Maintaining the good position of international reserves for foreign exchange is a first line of defense in response to growing global uncertainty and accelerate sustainable development.

Source: *researcher's compilation (2021)*

CONCLUSION AND RECOMMENDATION

ARCH / GARCH model is used based on the ARMA model. The ARMA result indicates that the clustering volatility indicates an ARCH effect. Data is tested whether no ARCH effect or not on model then used ARCH-LM test. This indicates that ARMA will be more effective for 7 variables (Exchange Rates Thailand, Interest Rates Indonesia, Interest Rates India, Interest Rates Thailand, Reserves Indonesia, Reserves India, and Reserves Malaysia) and the ARMA-ARCH/GARCH model will be more effective to 5 variables (Exchange Rates Indonesia, Exchange Rates India, Exchange Rates Malaysia, Interest Rates Malaysia, and Reserves Thailand). The ARMA-ARCH/GARCH model shows that the variables in the past can predict macroeconomic variables in the future. Vector Autoregression (VAR) model shows shock effect of macroeconomic variables (exchange rate, interest rate and foreign exchange reserves) varies each other. The existence of shock indicates the transmission among variables indirectly through intermediate channel, such as: capital, commodity and money market between 4 (four) countries.

Structural Time-Series Models (STSM) shows that macroeconomic variables such as exchange rates, interest rates and foreign exchange reserves in Indonesia-Malaysia-Thailand (IMT) and India will be relatively maintained and stable in 2021 and early 2022. Estimation of the Exchange rate Indonesia, Thailand, India, and Malaysia from April 2019 to February 2022 are 4.75%, -1.64%, 1.13%, and 0.77%. The result of Coefficient of Variation (CV) calculation from exchange rates Indonesia, Thailand, India, and Malaysia from April 2019 to February 2022 are 1.57, 0.88, 0.67, 1.49. Those numbers indicate that the exchange rate against USD movements from April 2019 to February 2022 is estimated to stable due to the number is lower than 9% threshold. Estimation of the Lending Interest Rates (IR) Indonesia, Thailand, India, and Malaysia from April 2019 to February 2022 are -12.55, -3.80, -2.94, and -15.25. The lower level of lending interest rate will help country economy. The Coefficient of Variation (CV) calculation of Indonesia, Thailand, India, and Malaysia from April 2019 to February 2022 are 4.51, 1.18, 1.06, and 5.16. It shows that the lending interest rates relatively stable because still below the 9% threshold.

The similarity of economic structure and diplomatic relations established for decades have made Indonesia-Malaysia-Thailand (IMT) and India can help each other – maintain exchange rates, interest rates and foreign reserves together. Moreover, the good governance has also facilitated information disclosure and increased cooperation between the countries. However, the presence of shock from outside remains to be watched out as the global changes in the digital era will be very dynamic. Also, it is important for relevant authorities to regularly give explanations to the stakeholder related to official macroeconomic variables estimation published by the central government so everyone can be prepared what will happen in the future, especially if there is an indication that a crisis period will occur.

The good governance should be based on the principles of accountability, innovation, integration, collaboration, openness and transparency. This can help in order to: (1) prevent and deal with problems/external shocks, (2) guidance and direction for performance improvement, (3) periodic arrangements and checks, (4) institutional reforms, (5) increasing cooperation between countries, (6) safeguarding the interest of stakeholders, (7) accelerating sustainable development. The availability of macroeconomic variable data that accurate can be greatly helped in making decisions in the future. New innovations are needed in presenting good data, information and research results related to the estimation of macroeconomic variable in encouraging investment and healthy competition among stakeholders. It is essential to apply good governance and accountability of macroeconomic variables to accelerate sustainable development in Indonesia, Malaysia, Thailand (IMT) and India.

REFERENCES

Agbetsiafa, D.K. (2010). Regional Integration, Trade Openness, and Economic Growth: Causality Evidence from UEMOA Countries. *International Business and Economic Research Journal*, 9(10).

Bank Indonesia. (2015). Maintaining Stability and Stimulating Growth With Policy Mix: Part III Policy Response. *2015 Economic Report on Indonesia*, Bank Indonesia.

Bank of Thailand. (2018). The Impact of Exchange Rates on the Thai Economy. *Monetary Policy Report* June 2018.

Bhanumurthy, N.R. (2002). Microstructures in the Indian Foreign Exchange Market. *WP*, Institute of Economic Growth, Delhi Uni.

Bhogal, Preety. (2018). India-ASEAN Economic Relations: Examining Future Possibilities. *ORF Issue Brief*, January 2018, No.221.

Box, G.E.P., G.M. Jenkins. (1976). *Time Series Analysis: Forecasting and Control*. Rev. ed. San Francisco: Holden-Day.

BPK. (2018). *Laporan Tahunan Badan Pemeriksa Keuangan.* BPK, Jakarta.

BPK. (2019). *Laporan Hasil Pemeriksaan Atas LK Pemerintah Pusat 2018.* BPK.

DPR. (2014). *Pengaruh Perubahan Asumsi Makro Terhadap Defisit APBN*. DPR RI.

Durbin, J., & Koopman, S. J. (2001). *Time Series Analysis by State Space Methods*. Oxford University Press.

Engle, R.F. (1982). Autoregressive Conditional Heteroskedasticity with Estimates of U.K. Inflation. *Econometrica* 64, 813-836.

Estiko, F.I., and Wahyuddin. (2019). Analysis of Indonesia's Inflation using ARIMA and Artificial Neural Network. *Economics Development Analysis Journal* 8 (2).

Exim Bank India. (2018). Strengthening ASEAN-India Partnership: Trends and Future Prospects. *Working Paper*, Bank of India.

Government of India. (2021). *Key to the Budget Documents 2021-2022*. Ministry of Finance.

Gujarati, D.N. (1994). *Basic Econometrics: 4th Edition*. Mc Graw Hill, USA.

Hamilton, J.D. (1994). *Time Series Analysis*. Princeton University Press, New Jersey.

Harvey, A., & Peters, S. (1993). Structural Time Series Models. *Handbook of Statistics*, 11(2).

Hussin, Fauzi. (2012). Economic Growth in ASEAN-4 Countries: A Panel Data Analysis. *International Journal of Economic and Finance*, No.9: 2012.

IFS-IMF. (2019). Macroeconomic & Financial Data. *Data* of IFS -IMF.

Jati, Kumara. (2014). Analysis of Sugar Prices Volatility using ARMA and ARCH/GARCH. *International Journal of Trade, Economics and Finance*, Vol.5, 2, 136-141.

Jati, Kumara., and Premaratne, G. (2017). Analysis of Staple Food Price Behaviour: Multivariate BEKK-GARCH Model. *JAFEB* 4(4).

Jati, Kumara., and Salam, A. R. (2017). Examining The Behavior of Indonesian Stock Index, Macroeconomic Variables and Commercial Bank Stock Prices. *Proceeding* 3rd Sriwijaya University.

Jati, Kumara. (2017). Analisis Hubungan Antara Harga Minyak Mentah, Emas, dan Timah. *Jurnal Analisis Kebijakan*, Vol. 1, LAN.

Jati, Kumara., and Salam, A.R. (2018). Input-Output Tables Analysis in APEC Digital Economy Data for Manufacture of Rubber and Plastic Products. *Prosiding The 2nd ICOT,* Kemendag.

Jati, Kumara. (2018). Analisis Efek Musim Hujan dan Kemarau terhadap Harga Beras. *Jurnal Manajemen Industri dan Logistik*, Vol. 2, Issue 1, 40-51, PoltekAPP.

Jati, Kumara., and Salam, A.R. (2019). Trade Estimation of Indonesia and India. *Ikra-Ith Ekonomika*, Vol.2, Issue 2, UP-YAI.

Kemendag. (2015). R*enstra Kementerian Perdagangan Tahun 2015-2019*. Kemendag.

Kemenkeu. (2015). *Pedoman Proses, Perencanaan, Penganggaran, Dan Pelaksanaan APBN*. DJA, Kemenkeu.

Muslim, A. (2016). Apakah Perdagangan Menjadi Pertimbangan Investasi? *Kajian Ekonomi & Keuangan*, Vol. 20,No.2 BKF.

Oktavia, A.L., Sentosa, S.U., and Aimon, H. (2013). Analisis Kurs dan Money Supply di Indonesia. *Jurnal Kajian Ekonomi*.

Pramono, A.J., & Hendharto, H. (2017). Transformation Model of The Audit Board of the Republic of Indonesia. *JTAKEN*, Vol.3.

Retnowati, Endang. (2012). Keterbukaan Informasi Publik dan *Good Governance*. *Perspektif*, Volume XVII No.1 Tahun 2012.

Sankaran, Kamla. (2018). *From Look East to Act East: India's Growing Engagement with ASEAN & Beyond*. MEA India Government.

Saunder, A. (1995). The Determinants of Bank Interest. *Journal of International Money and Finance*, 19, 813-832.

Sugeng, Nugroho, M.N., Ibrahim, and Yanfitri. (2010). Effects of Foreign Exchange Supply and Demand Dynamics to Rupiah Exchange Rate and Economic Performance. *Bulletin of Monetary, Economics and Banking*, Bank Indonesia.

Sumarto, H. Sj. (2003). *Inovasi, Partisipasi, and Good Governance: 20 Prakarsa Inovatif dan Partisipasi di Indonesia.* Yayasan Obor.

Treasury Malaysia. (2021). *Economic Outlook 2021*. Percetakan Nasional Malaysia Berhad.

Tripathy, R. (2013). Intervention in Foreign Exchange Markets. *BIS Paper*, RBI.

Tsai, Fai. (2019). An Overview on Macroeconomics: Ideas, Approaches and Importance. *International Journal of Tax Economics and Management*.

UNDP. (2014). Governance for Sustainable Development. *Discussion Paper* of UNDP.

UNDP. (2015). *Sustainable Development Goals.* SDGs Booklet UNDP.

Warjiyo, Perry. (2013). Indonesia: Stabilizing the Exchange Rate Along Its Fundamental. *Bank for International Settlements Papers*, Vol.73, pp 177-187. Bank Indonesia.

Wijoyo, N.A. (2016). Peramalan Nilai Tukar Rupiah Terhadap USD dengan Menggunakan Model GARCH. *Kajian Ekonomi & Keuangan*, Vol.20 No.2. BKF.