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Dynamic Interactions in Macroeconomic Activities

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ABSTRACT

This paper empirically investigates the dynamic interaction of macroeconomic activities for the ASEAN 5 (Indonesia, Malaysia, the Philippines, Singapore, and Thailand) with consideration of the asymmetric adjustment in this interaction. Both the short and long-run interactions were modelled during 1960-2014, and there were differences for each country based on data availability. The empirical results of the analysis were based on time series data and are summarized as follows: i) Indonesia and the Philippines had no evidence for cointegration; ii) among those countries, it was found that only Malaysia has asymmetric adjustment regarding cointegration; iii) money supply responded only to positive shocks while the interest rate responded only to negative shocks; iv) only unidirectional causal relationship was found in the long-run and short-run methods. Based on the results, the wisest operating target for Indonesia and Thailand is inflation targeting. Monetary aggregate targeting would be the recommended operating policy for the Philippines and Singapore. Malaysia should implement exchange rate targeting and intervene in the money supply (when there is a negative shock) and in the interest rates (when there is a positive shock).

Keywords: ASEAN 5, Asymmetric adjustment, intermediate targeting, operating targeting

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INTRODUCTION

For a long time, economists (e.g., Friedman, 1995; Poole, 1970; Mishkin & Savastano, 2001) were trying to find a variable that is easily controlled by monetary policy and related to economic activity on a stable basis. The greater the effect such a variable has on the behaviour of economic time series, the more effective a monetary policy is. To assist in the understanding of

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these issues, the literature was searched for a simple characterization of the policy reaction function to summarize the monetary authority's behaviour in setting a policy.

The study of Masih and Masih (1996) summarized the differences of opinions among economists, such as the Classical, the Keynesian, the Monetarist, the New Classical, the New Keynesian and the Real Business Cycle, which had led to different macroeconomic paradigms. Here, the Classical and Real Business Cycle schools believe that monetary expansion cannot increase real output. In contrast, the Keynesians believe that an increase in money supply would increase both production and price levels. On the other hand, the Monetarist, New Classical, and New Keynesian perspectives only agree that monetary expansion affects national output in certain circumstances. From the view of the Monetarists and the New Keynesians, money expansion only increases output in the short run. The New Classical view argues that monetary expansion affects the output due to "unanticipated" economic agents.

The causal chain is defined among money and other macroeconomic variables, such as real gross domestic product (Y), money supply (M2), exchange rates (EX), consumer price index (CPI), and interest rates (I). Therefore, the causal chain implies that the existing macroeconomic paradigms still remain ambiguous. Following the previous literatures (e.g., Chen et al., 1986; Dhakal et al., 1993; Mukherjee & Naka, 1995), the goods market variables considered are the Y and CPI. The money market variables considered are the M2 and I. The EX takes into account the foreign exchange market and the trade balance (Wongbangpo & Sharma, 2002).

Many macroeconomic variables incorporate nonlinear properties, especially in the area of business cycles (Falk, 1986; Neftci, 1984). We noted that testing for unit root and cointegration all have low power in the presence of asymmetric adjustment (Balke & Fomby 1997; Enders & Granger, 1998). However, previous studies did not capture the asymmetric adjustment in macroeconomic variables; hence, this study takes this a step further by examining the asymmetric behaviour of macroeconomics activities.

Figures 1 to 5 show the five macroeconomic variable series for the ASEAN-5. We find the goods market variables and money supply have linear increasing trends. However, we do not find any significant upward or downward trend in the interest rate and exchange rate series. These figures seem to exhibit some nonlinear adjustment patterns in the interaction of macroeconomic activities through money market or foreign exchange channels. This study contributes to the existing literature by improving and extending the previous related studies in two dimensions. First, this study takes research a step further by examining the asymmetric behaviour of macroeconomic activities by adopting threshold cointegration to capture asymmetric interaction among macroeconomics variables. Monetary

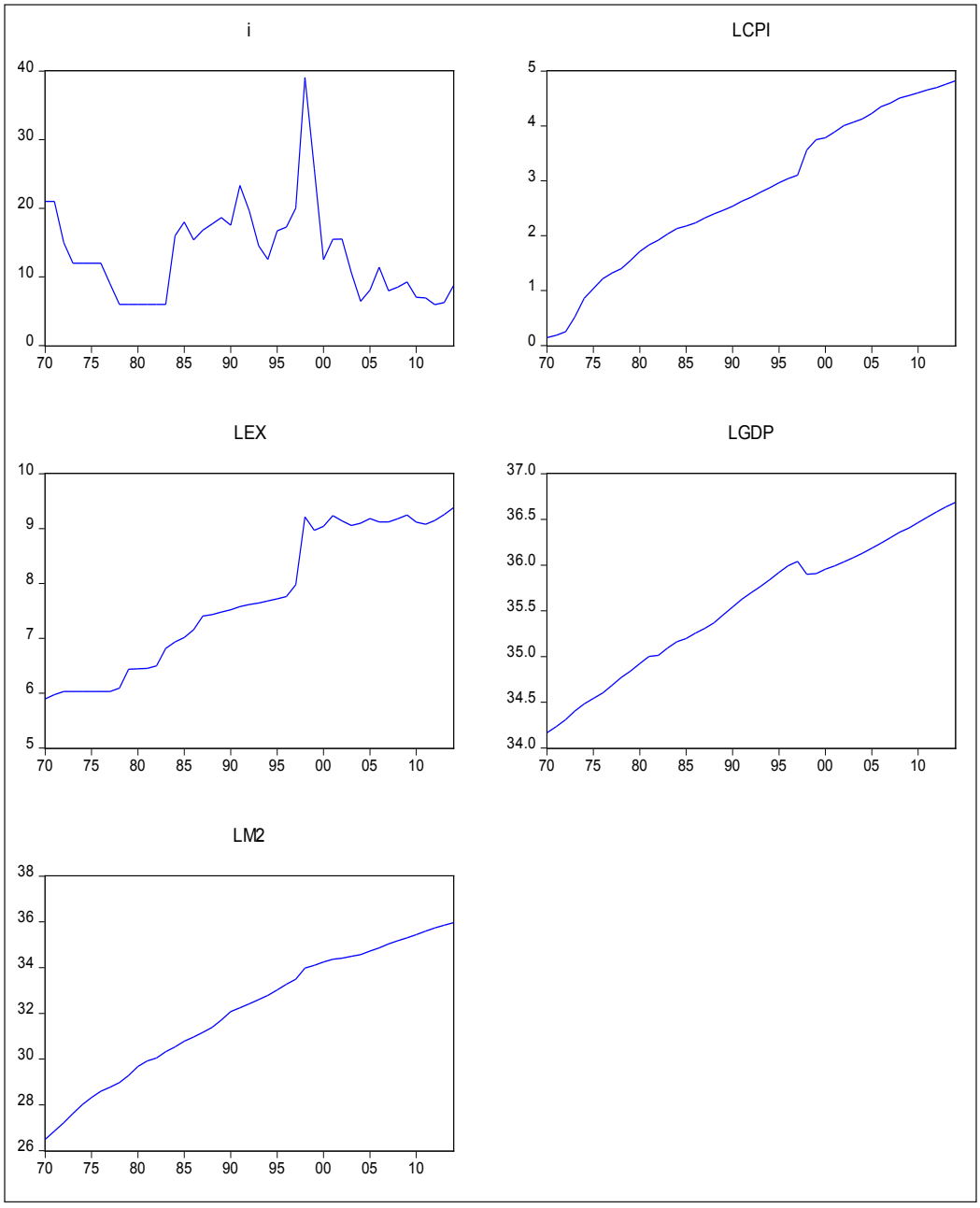

Figure 1. Behaviour of the macroeconomic variables in Indonesia

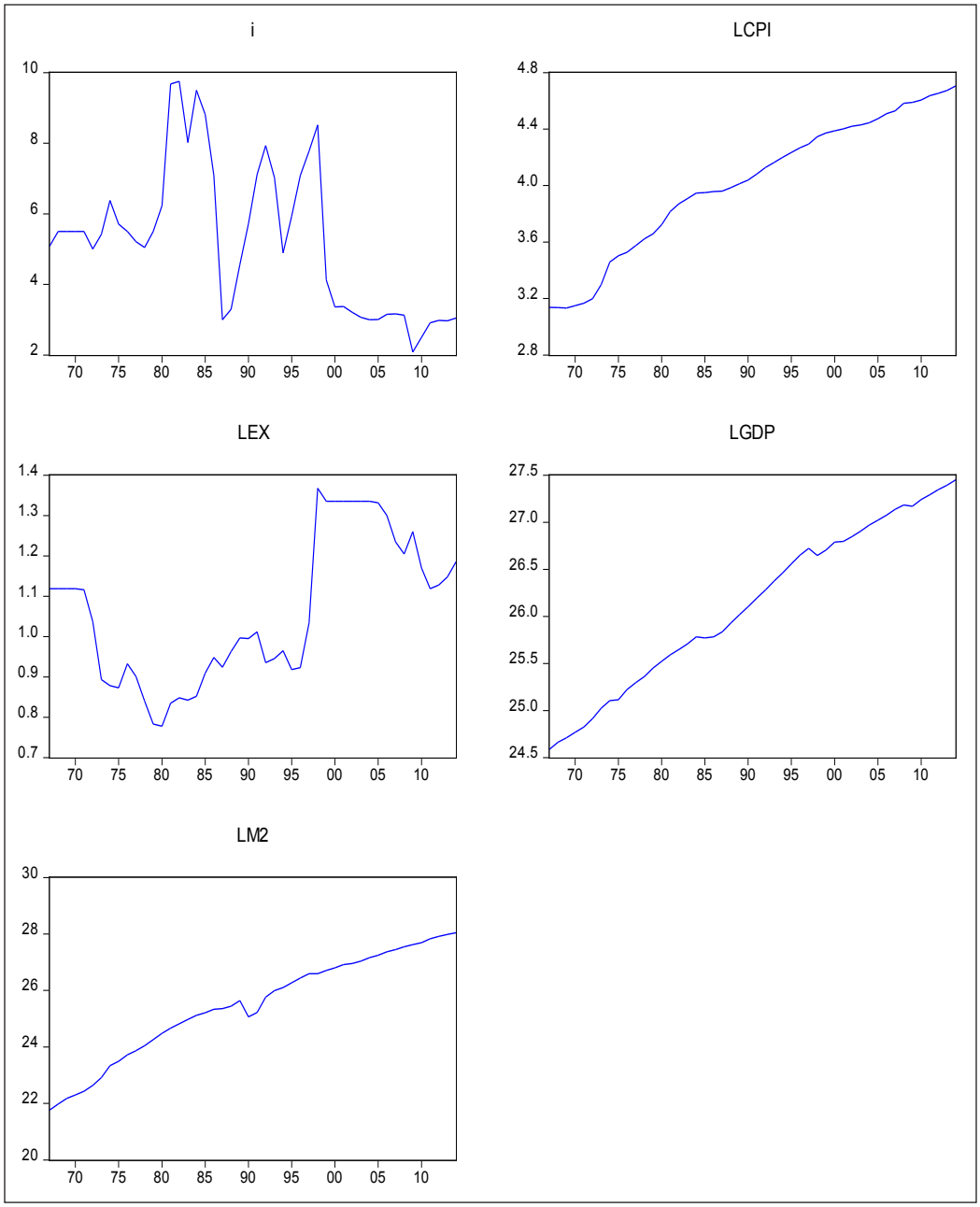

Figure 2. Behaviour of the macroeconomic variables in Malaysia

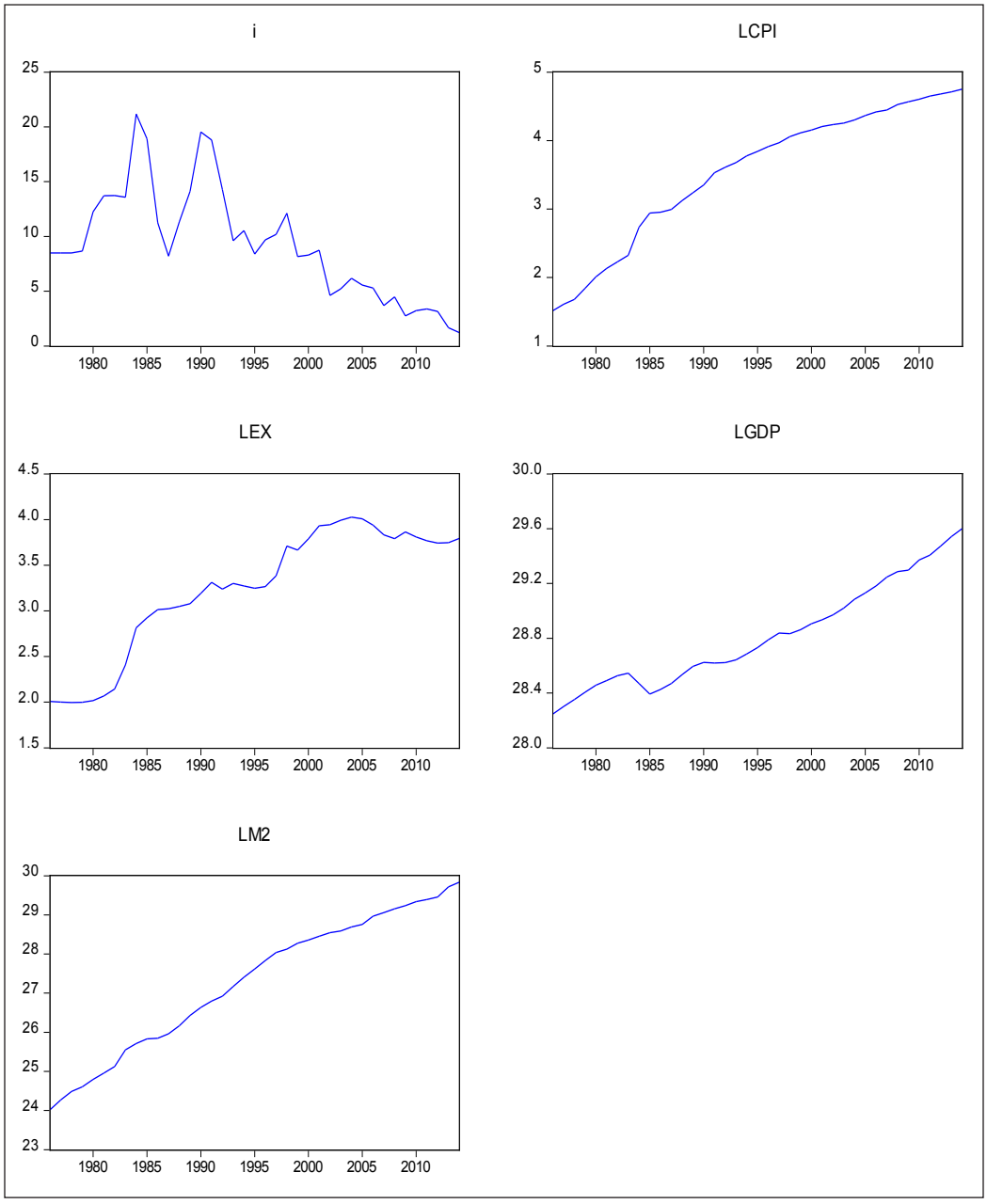

Figure 3. Behaviour of the macroeconomic variables in Philippines

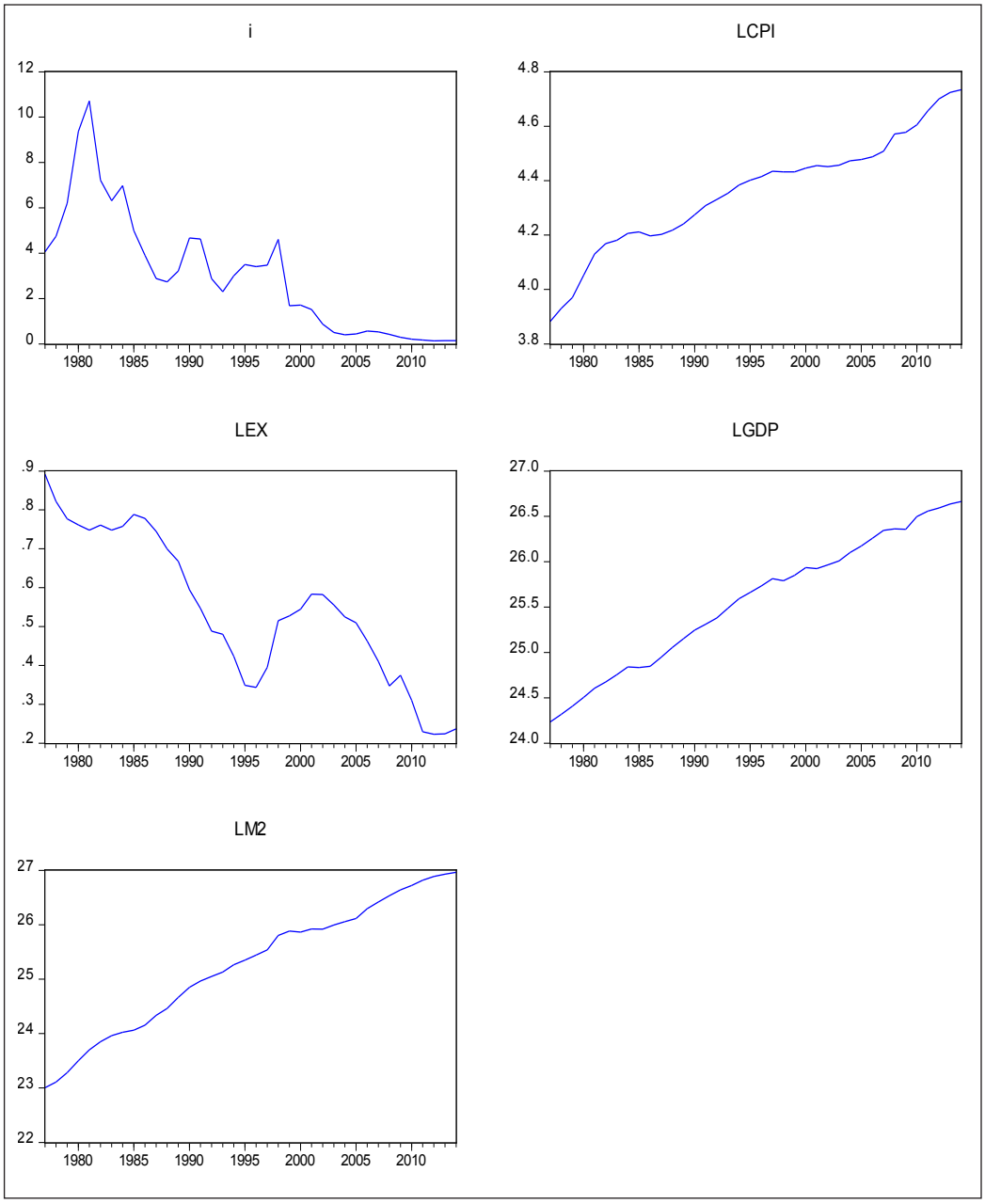

Figure 4. Behaviour of the macroeconomic variables in Singapore

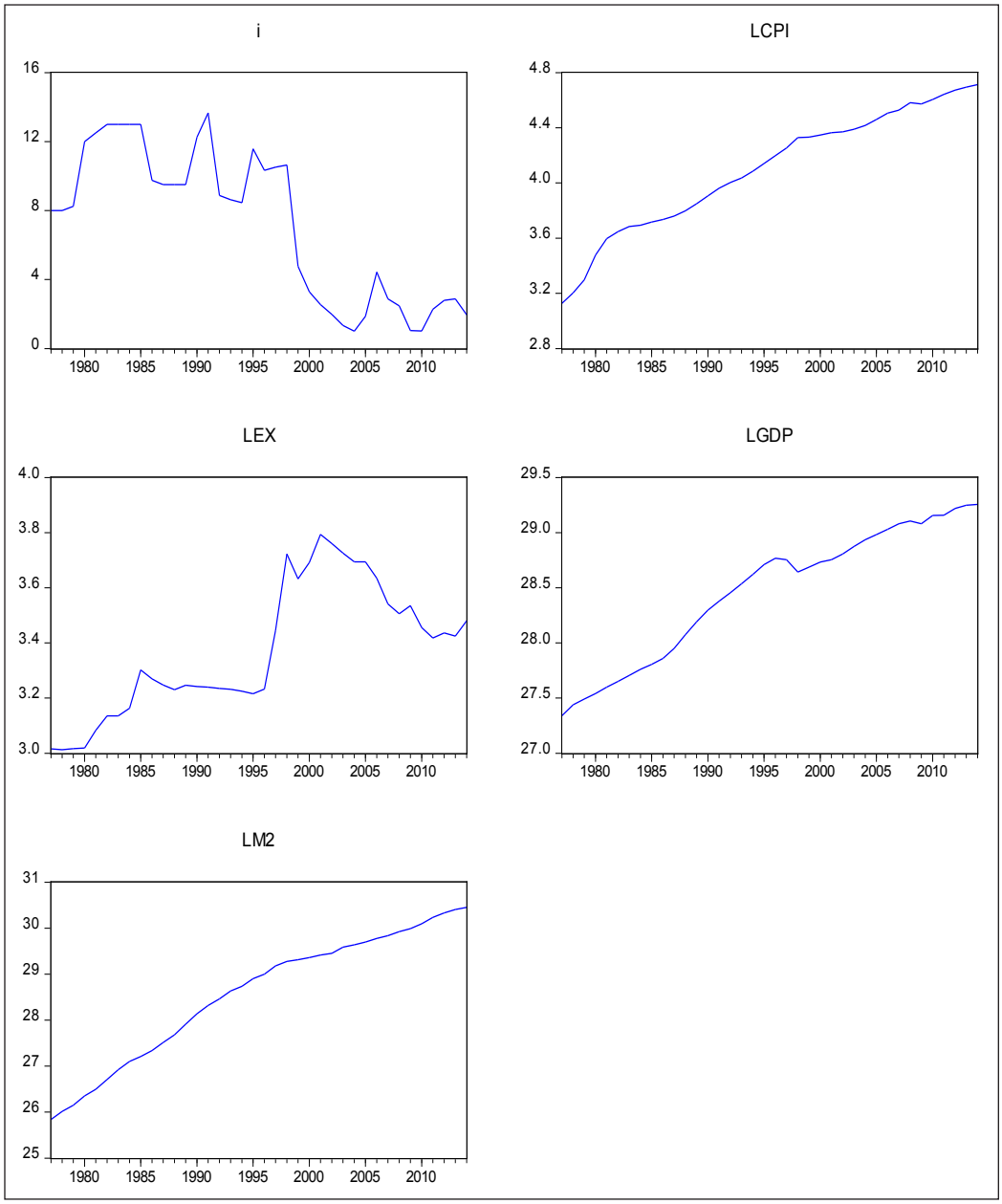

Figure 5. Behaviour of the macroeconomic variables in Thailand

channels may be symmetric or asymmetric. Therefore, we also apply the model specification proposed by Ibrahim and Chancharoenchai (2014) in order to capture the different characteristics of channels. Second, Masih and Masih (1996) pointed out that the causality test of macroeconomic variables could justify the leading variable (affecting other variables but not influenced by other variables, in order word no causality). Based on this idea, this study extends the use of causality results in monetary implications, which helps to select the optimal operating and intermediate target in monetary policy.

This study focuses on the five major economies among Southeast Asian countries, Indonesia, Thailand, Malaysia, Singapore, and the Philippines, which are also known as the ASEAN-5. Based on Klyuev and Dao (2016), the ASEAN-5 has a relatively open capital account, which makes it challenging to control domestic monetary conditions and exchange rates at the same time. The experience of the ASEAN-5 can provide guidance to other developing countries in monetary policy setting.

The objective of this study is to investigate symmetric and asymmetric behaviour among macroeconomics variables, such as real gross domestic product (Y), money supply (M2), exchange rates (EX), consumer price index (CPI), and interest rates (I). This study would help policy makers to select the best operating targeting that aims towards sustainable economic development, and capturing the response of macroeconomics to difference shock is helpful for better policy making.

This study investigates the interactions among macroeconomic activities that would help policymakers select the best monetary targeting that aims towards sustainable economic development. Specifically, it answers the two following questions: First, does the asymmetric behaviour occur among macroeconomics variables in the ASEAN-5? Second, which variable is the optimal operating target and intermediate target in the ASEAN-5?

The rest of the paper is structured as follows. The next section will provide an overview regarding the monetary policy of the ASEAN 5 and related literature of this study. Section 3 presents the methodology. Section 4 describes the data and estimation results. The last section concludes with the main findings and their implications.

LITERATURE REVIEW

Recently, the literature on the relationship between macroeconomics variables and money increased because of the functions of macroeconomics variables and money giving clashing evidence between macroeconomic variables and money. A few studies (e.g., Masih & Abdul Karim, 2014; Tan & Baharumshah, 1999) used the causality test in order to acquire a causal link between variables. Some studies (e.g., Hossain, 2012; Masih & Masih, 1996) were conducted in order to investigate the empirical evidence behind the relationship between money, interest rate, output, exchange rate and price. Otherwise, scant studies in the context of the ASEAN 5 were implementing symmetric and asymmetric

factors in the analysis. This part of the study is aimed to review some of the literature on the relationship of macroeconomics variables and money.

Monetary Target and Goal

According to McCallum (1999), the advancement of monetary policy setting had gone from "rules" and "discretion" and was different from the school of thoughts, which poses perennial issues to central banks and policymakers. Though now, interest rates have become the favoured policy variable of most central banks in response to economic circumstances changes. However, the academic and political side has never intermittently explored other economic variables in order to achieve the economics "goal". McCallum defines that the "goals" refer to the ultimate but typically non- operational objectives of the monetary authority, and the term target refers to an operational variable that takes precedence in the actual conduct of policy. The economics goal usually stands for major macroeconomic achievements such as a low unemployment rate, low inflation rate, financial market stability or monitored exchange rate. According to Handa (2009), the central bank uses its tools to hit its operating targets, with the intention of manipulating the intermediate targets, which were the final ones of the financial system, in order to achieve its goals.

Moreover, the implication of causality tests, as Masih and Masih (1996) studies, would enable us to distinguish exogenous variables (no causal relationship with others) and endogenous variables (at least unidirectional causal relationship with others) in decision making progress, which in our cases is monetary policy targeting variables. Other studies such as Cioran (2014) show the empirical results emphasize a significant direct relation between the monetary policy interest rate and inflation, which make interest rates an efficient instrument for central bank to prevent inflation. Because Romania's inflation is susceptible to unexpected changes in the interest rate, a good alternative for companies would be to make decisions based on interest rate evolution forecasts. The result can also state that protecting interest rates is a lever for inflation targeting strategies.

Developing Countries

Previous studies focused more on one period of analysis of the causality among the variables. Masih and AbdulKarim (2014) had a study about the causal link of money, price, interest rates and output in a Nigerian context using data from 1970 to 2012. The result shows that the price and interest rate were the main variables, while utilizing the business cycle theory.

In a Malaysian context, according to Tan and Baharumshah (1999), they found that price had a Granger cause M2 through the short run channel. Moreover, the error correction model provided proof that the real income, price, and interest rate does impact M2 in the long run, while the real output, interest rate and M2 jointly cause price. Nevertheless, rather than joining the

other variables, the study did not provide the causal relation between money and price.

Indonesia was used as a sample by Masih and Masih (1996), and this study covered the period from 1955 to 1991. The methodology applied various econometric tests to capture the relationship among the variables. The findings exposed that the real output leads the money supply and the other three endogenous variables, in such a way that it is in support of the real business cycle theory (RBC).

In contrast, a case study in India by Masih and Masih (1996) supports the monetarist view that changes in income lead to changes in the stock of money through the demand for money in the short run. They significantly initiate that during the pre-economic crisis period, there is a stable long run cointegration relationship between those chosen under studies. The combination of the monetary variables was found to be neutral in the long run. However, the result of the post-economic crisis period exposes a well-defined long run equilibrium relationship among the variables. Money supply and real output were found to be neutral in the long run.

Some studies on the stock market and macroeconomics variables, such as Wongbangpo and Sharma (2002), look at the relationship between stock price and a set of the macroeconomic variable in the ASEAN-5 countries and the result shows stock price is positively related to growth in output and negatively to the aggregate price level. Stock prices have a negative relationship with the interest rate in the Philippines, Singapore, and Thailand, however, a positive relationship in Indonesia and Malaysia.

Adusei and Gyapong (2017)'s study outcome suggests that financial managers of national and multinational companies should be interested in the movements of inflation, monetary policy rates, current account balance, money and quasi-money supply per GDP, annual GDP per capita growth rate and total external debt. These variables may be used among other factors as inputs in arriving at economic decisions during trade agreements to maximize shareholders' wealth because results support the conclusion that the macroeconomic variables (inflation, monetary policy rate, current account balance, money and quasi-money supply per GDP, annual GDP per capita growth rate and total external debt) contribute to the continuous depreciation of the Ghana cedi against the U.S. dollar.

Developed Countries

During the transition period, Kotlowski (2005) analysed the long run causality between money and price in the context of Poland. The study applied the monetary inflation model, also known as the P-star model that was established by the FED economist, which used seasonal cointegration developed by Hylleberg et al. (1990). Their outcome proves the existence of the long run causal relationship between price and money, and these results follow the assumption in the P-star model.

Nonetheless, the analysis did not provide any seasonal cointegration relationship in the P-star inflation model that can be interpreted as the money demand equation.

Hossain (2012), modelled the narrow money demand in Australia. The result suggests the presence of a long run equilibrium relationship between real narrow money balance, real income, a representative domestic interest rate, and the nominal effective exchange rate of the Australian dollar. The statistical test suggests no significant instability in the narrow money demand relationship despite financial deregulation innovation in Australia since the early 1980s.

Foresti and Napolitano (2013) investigated the presence of long run money demand in a selected group of nine developed OECD countries (G7 plus Australia and Switzerland) using quarterly data for the period of 1982 to 2008. They found the role of total wealth in the determination of money demand with positive elasticity. Moreover, a parameter stability analysis suggests that estimated money demand with the inclusion of wealth is more stable.

Nonparametric Approach

Bahmani-Oskooee and Bahmani (2015) did a study in an Iranian context by trying to obtain the failure to find a significant relationship between the demand for money and the exchange rate, which could be due to assuming a linear adjustment mechanism among the variable. In Iran, the researcher introduced nonlinearity in the short run as well as in the long run through a partial sum concept; they obtained that the dollar appreciation and dollar depreciation had an asymmetric impact on the demand for money.

In another study, Lim and Ho (2013) examined the relationship between GDP per capital and exports in ASEAN-5 countries using a nonparametric cointegration test and nonlinear causality by Ajmi et al. (2015). The result from the linear Granger causality gives no significant causality between export and GDP; however, the result in a nonlinear test showed evidence of significant bidirectional causality.

The limited studies on nonparametric approaches in interaction among macroeconomic activities give motivation for this study to explore whether nonparametric approaches will make a difference in results that would help policy makers to select the best intermediate targeting that aims towards sustainable economic growth.

METHODS

The research procedure of this study as shown below:

Unit Root Test

First, we utilized two asymptotically equivalent procedures for detecting unit roots in the data: the Augmented Dickey-Fuller (ADF) and the Phillip and Perron (PP) tests (Phillips and Perron, 1988; Said and Dickey, 1984). If studies' variables are non-stationary at level and integrated

in the same order, we further tested on the existence of a long run relationship using a relative cointegration test.

This paper does not adopt the residual-based test by Engle and Granger (1987) and the VAR-based test by Johansen (1988), and Johensen and Juselius (1990). As noted by Balke and Fomby (1997) as well as Enders and Granger (1998), 'conventional cointegration tests have low power in explaining the cointegrated systems when there is the presence of asymmetric adjustments.'

Threshold Co-integration Test

This empirical study adapts the threshold autoregressive (TAR) model developed by Enders and Granger (1998) and advanced by Enders and Siklos (2001), which was later on extended by Enders and Dibooglu (2001) to the momentum threshold autoregressive (M-TAR) model. The M-TAR model allows us to examine for a long run relationship even with the existence of asymmetric adjustments. The threshold approach can be represented as the following equation:

$$\Delta u_t = p_1 I_t u_{t-1} + p_2 (1 - I_t) u_{t-1} = + \sum_{i=1}^{k} n_i \Delta u_{t-1} + w_t \quad (1)$$

where u_t shows as an error term retrieved from the long run equation, which is $\Delta u_t = y_t - [B_0 + B_1 X_{1t} + B_2 X_{2t} \ldots B_n X_n]$; I_t stands for the Heaviside indicator, which relies on the level or changes of the last period error term, u_{t-1} which is 0 for negative shocks and 1 for positive shocks; k is the optimal lag length, which is determined by Schwarz's information criterion (SIC); and p_n is the speed adjustment for coefficients.

Regarding the Heaviside indicator as the function of u_t, we could specify it through the threshold autoregressive (TAR) model and momentum threshold (M-TAR) model. The TAR model would capture the adjustment of the u_t depending on u_{t-1}, such as:

$$I_t = \begin{cases} 1 \; if \; u_{t-1} \geq \tau \\ 0 \; if \; u_{t-1} < \tau \end{cases} \quad (2)$$

where τ is the value of the threshold, while the M-TAR model is able to capture properties such that the threshold depends on the change of the last period error term, Δu_{t-1}, whether it is increasing or decreasing.

$$I_t = \begin{cases} 1 \; if \; \Delta u_{t-1} \geq \tau \\ 0 \; if \; \Delta u_{t-1} < \tau \end{cases} \quad (3)$$

In general, there are two alternatives to define the value of τ. Firstly, the value could be set as zero, in which case the cointegrating vector coincides with the attractor. Therefore, the adjustment is $p_1 u_{t-1}$ if u_{t-1} is above its long run equilibrium value and $p_2 u_{t-1}$ if u_{t-1} is below its long

run equilibrium value. Moreover, the value could be set as unknown and estimated through the value of p_n. This view tends to disagree with the first alternative, since there are no good reasons to expect the threshold to coincide with the attractor. According to Chan (1993), searching over the potential threshold values minimized the sum of squared errors from the fitted model, which yielded a very consistent estimate of the threshold.

Based on theory, stationarity of u_t will be achieved when $-2 < (p_1, p_2) < 0$. In this study, we examine the stationarity of u_t by putting the null hypothesis, where $H_0 : p_1 = p_2 = 0$ stands as no cointegration. This can be tested by the F-statistics as tabulated in Enders and Siklos (2001).

When there is a cointegration relationship, we could also examine the hypothesis of presenting in the symmetric adjustment, which we set as, $H_0 : p_1 = p_2 = 0$. This hypothesis will be verified through standard F-statistics. If the null hypothesis is rejected, this stands for the existence of an asymmetric adjustment.

Fully Modified Ordinary Least Squares (FM-OLS)

Next, we adapt the Fully Modified OLS (FM-OLS) developed by Phillips and Hansen (1990), and Phillips (1995) in order to estimate the long run coefficients for the cointegrated systems. This estimation relies on the following equation:

$$\begin{aligned} Y_t &= \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} \ldots \beta_n X_{nt} \cdot \\ &= \sum_{i=-k}^{+k} \gamma_{1i} \Delta X_{1t-i} + \sum_{i=-k}^{+k} \gamma_{2i} \Delta X_{2t-i} \ldots \\ &= \sum_{i=-k}^{+k} \gamma_{ni} \Delta X_{nt-i} + u_t \end{aligned} \tag{4}$$

FM-OLS stands out among various estimation approaches with certain characteristics that are appropriate for this empirical study. For example, FM-OLS enables asymptotically eliminating the sample bias for small observation studies. It could solve the sample bias that would occur during our study with annual data as well as having below 50 observations for each studied nation. Moreover, FM-OLS is capable of correcting for endogeneity and serial correlation effects.

Model Specification

We offer the three alternative models that were built on the designed hypothesis. Model specifications below have put in the consideration of Ibrahim and Chancharoenchai (2014)'s study to capture asymmetric cointegration contrary to symmetric hypotheses. Alternative models are listed as follows:

Model 1:

$$\Delta Y_t = \mu + \sum_{i=1}^{k1} \delta_{1i} \Delta Y_{t-i} + \sum_{i=0}^{k2} \gamma_1 X_{1t-i} \ldots \sum_{i=0}^{k3} \gamma_{2i} X_{2t-i} \ldots \sum_{i=0}^{kn} \gamma_{ni} X_{nt-i} + v_t \quad (5)$$

Model 2:

$$\Delta Y_t = \mu + \sum_{i=1}^{k1} \delta_{1i} \Delta Y_{t-i} + \sum_{i=0}^{k2} \gamma_1 X_{1t-i} \ldots \sum_{i=0}^{k3} \gamma_{2i} X_{2t-i} \ldots \sum_{i=0}^{kn} \gamma_{ni} X_{nt-i} + \lambda u_{t-1} + v_t \quad (6)$$

Model 3:

$$\Delta Y_t = \mu + \sum_{i=1}^{k1} \delta_{1i} \Delta Y_{t-i} + \sum_{i=0}^{k2} \gamma_1 X_{1t-i} \ldots \sum_{i=0}^{k3} \gamma_{2i} X_{2t-i} \ldots \sum_{i=0}^{kn} \gamma_{ni} X_{nt-i} + \lambda_1 Z_{t-1}^{+} + \lambda_1 Z_{t-1}^{-} + v_t \quad (7)$$

where Δ is the first different operator, *Y* is the dependent variable, and *X* is the independent variable, k_i for $i = 1,\ldots,4$ stands as optimal lag orders that are determined by the SIC test, μ is the error term that shows the tendency of the dependent variable from the long run value and other variables, Z_{t-1}^{+} and Z_{t-1}^{-} are error terms that represent above the threshold value and below the threshold value, respectively. Alternatively, they represent positive and negative shock, respectively.

Model 1 will be used for explanations when variables are not cointegrated. It shows that there is only a short-run relationship among the studied variables. We will adopt Models 2 and 3 during the presence of long run cointegration. Model 2 will be put into explanation when studies' variables are symmetrically co-integrated. The u_{t-1} would take into account the past period shocks. For Model 3, it will be adopted in the presence of an asymmetric adjustment in a cointegrated system. In this case, u_{t-1} would divide to Z_{t-1}^{+} and Z_{t-1}^{-} in order to take into account the adjustment from different types of shocks in the market.

Granger Causality

According to Granger (1986, 1988), the hypothesis that the variable, say a, was influenced by b is equivalent to the test that all of the coefficients on the lagged values of b included in the regression are jointly equal to zero. The test statistic used is an F-statistic and rejection of the null hypothesis suggests that the causation runs from a to b. The hypothesis is rejected in both cases; it

suggests that a feedback relationship exists between the two variables. Whenever we are able to prove the existence of a causality relationship, the direction of the causality relationship among variables remains obscured. Upon this, the vector error correction model (VECM) would help us to derive the long run cointegrating vectors and determine the direction of the Granger causality.

However, the VECMs for asymmetric adjustment have not been developed. Therefore, we repeated the causality test for all variables by changing the dependent variables. Finally, we followed the study by Masih and Masih (1996), and determined the exogenous variable (or operating variable) using the rule of no long run relation (no error term or insignificant error term) and no short run impact from other independent variables. The reason is any feedback effect of operating targets with other variables will reduce the intensity of the policy adjustment as if there were no casual effect from other variables to intermediate targets. The endogenous variables would represent the intermediate targets affected by the exogenous variable and committed to the final goal.

EMPIRICAL RESULTS

Data

We focused our study on the ASEAN-5 nations, which consist of Indonesia, Malaysia, the Philippines, Singapore, and Thailand. The data source is the World Bank. This study will cover the annual data of studied nations from 1960 to 2014 and depend upon data availability. Variables involved would be the real gross domestic product (Y), money supply (M2), exchange rate (ER), consumer price index (CPI), and deposit interest rate (I). None of these variables is the fixed dependent variable since we tend to examine the causality relationship among variables. All variables exclude interest rate in the natural logarithm and first difference in order to get their growth rates. The numerical interest rate believed has a better reflection of economic activity compared to its growth. In applied research, some authors do not log the interest rate (Wongbangpo & Sharma, 2002).

Unit Root Test

We adopt ADF and PP to test the unit root on variables. Both unit root tests cannot reject the null hypothesis of a unit root for the levels of all of the variables, except for the CPI of Thailand (only for the ADF test). In addition, the null hypothesis of a unit root is readily rejected for their first difference at 10% or better in all except the CPI of Singapore, which is not significant. Obviously, the result shows a contradiction between the two tests, which guidance from previous studies suggests (Irz at el., 2013; Harris & Sollis, 2003) conclude a I (1) contradiction among the unit root test since treating a non-stationary variable is severe in statistics. Hence, we conclude that the five variables under investigation are candidates for a cointegration relationship in all of the sample countries.

Asymmetric Co-integration Test

Table 2 and 3 show the ES cointegration test outcomes. From the outcomes, the null of no cointegration cannot be rejected by all cointegration tests for the majority of cases that exclude interest rate, money supply or exchange rate as the independent variable in Malaysia; interest rate or price level as the independent variable in Singapore and real income or interest rate as the independent variable in Thailand. Therefore, Model 1 is suitably used for these cases. Meanwhile, Model 2 seems to be preferred for the interest rate or price level as the independent variable in Singapore; real income or interest rate as the independent variable in Thailand and exchange rate as the independent variable in Malaysia. These cases rejected the null of no cointegration. However, the null of symmetric adjustments cannot be rejected. Finally, the dynamics of a causal chain of macroeconomics when the money supply or interest rate is the dependent variable in Malaysia should be modelled using Model 3, which is the M-TAR asymmetric error-correction model.

Long-run Relations

Table 4 shows the estimated long run coefficients for the cointegrated systems using the FMOLS. First, we discuss the result of Malaysia, in which the money supply function shows a rise of the price level (as the cost of holding money), giving a positive impact to the money supply, while the interest rate generates reserve impact. On the other hand, the interest rate function shows that real income and price level have a positive and significant impact on interest rate, while money supply has a negative impact.

Second, in Singapore's case, the price level function passed the cointegration test; however, no evidence shows that other macroeconomic variables have a relationship with it. Moreover, the interest rate function's result shows a 1% increase in the price level, which will increase the interest rate by 0.12%. Finally, money supply had a positive relationship to real income, while exchange rate had a positive effect on the interest rate for Thailand's cases. This indicates that Thailand is in-line with the Keynesian theory, in which money supply is able to increase national income, but not follow the transmission channel that advocates interest rate and price level increases as well.

According to the IMF (2016), the common central bank mandate of the ASEAN-5 is promoting monetary stability conducive to sustainable economic growth. The long run relationship result helps policy makers identify the long run interaction of macroeconomics activities. This information is useful for policy-makers in designing appropriate monetary policies in order to achieve their central bank mandate. The results show no evidence that the monetary variables of the ASEAN-5 help to control the price level in long-run, however, only Thailand can promote long-run GDP growth through the increase of money supply. The finding on Thailand is in line with the result of Masih and Maish (1996).

Granger-causality Results based Symmetric and Asymmetric ECM

This section discusses the Granger-causation that accounts for the short run dynamic interactions among the five variables. Furthermore, we use these results to find leading or exogenous variables. All of the estimated equations results are reported in Table 5, while simplified results can be referred to in a summary in Table 6.

Importantly, the t-statistics in the ECMs are significant, suggesting the equation is cointegrated. A high value of (α) coefficient means that the given variables adjust faster towards equilibrium. The coefficient of the asymmetric ECM ranges from as high as 0.8 to as low as 0.49. These results suggest that the speed of adjustment back to equilibrium is fairly rapid. However, the coefficient of symmetric ECM ranges in between 0.21 to 0.67; this implies that the speed of adjustment towards equilibrium is moderately rapid.

Furthermore, asymmetric adjustment occurs in Malaysia only. Money supply responds to positive shocks but is insignificant to negative shocks, whereas interest rate made an adjustment to negative shocks only. These imply that without intervention, money supply and interest rate will not adjust towards equilibrium when facing negative shocks and positive shocks. This finding answers the first research question and suggests only the policymakers in Malaysia should take care and make an appropriate intervention for asymmetric adjustment.

In general, the only unidirectional causal relationship was found among the selected macroeconomic variable for the ASEAN 5. Test results confirm that economic growth and exchange rate growth cause interest rate growth, and inflation causes exchange rate growth for Indonesia. In Malaysia, we found only one causal relationship in which economic growth causes interest rates and inflation to grow. Next, with regard to the Philippines' cases, money supply growth has the most powerful causal effect, which causes all other variables. Second, exchange rate growth causes everything, excluding money supply growth. Additionally, economic growth causes interest rates.

For Singapore, the most powerful causal effect was from money supply growth as well, which causes all other variables to exclude interest rates. The second is the inflation rate, which causes economic growth and exchange rate growth. Then, exchange rate growth causes economic growth, while economic growth causes interest rates. Finally, we discuss the dynamic causal chain of Thailand, in which the result shows that money supply growth is highly dependent on other macroeconomic variables excluding exchange rate.

The findings of this paper contradict the study of Masih and Maish (1996), which found the leading variable of Thailand and Malaysia is money supply. On the other hand, our result shows the leading variables of Indonesia closely coincide with Masih and AbdulKarim (2014), who studied the casual chain of Nigeria. Two of the three leading variables are the same, Y and CPI.

The different findings of leading variables may due to the asymmetric model that was adopted by this study. The asymmetric result should be more accurate since the evidence of Katrakilidis and Trachanas (2012) suggests that ignoring the intrinsic nonlinearities may lead to misleading inferences.

Furthermore, the empirical finding of this study helps to answer the second research question by finding out the leading variable (no impact from other macroeconomic variables, no matter whether in the long run or short run) for each country. Excluding real income (as a monetary goal), all leading variables can be considered as an operating target in monetary policy while those relevant endogenous variables (influenced by the leading variable) should have considered an intermediate target. First, monetary aggregate operating targeting is the most common monetary policy that can be implemented by the ASEAN 5, excluding Thailand and Malaysia. Second, exchange rate operating targeting can be adopted in two countries, Malaysia and Thailand. Finally, Singapore and the Philippines found one leading variable only, money supply, whereas other countries had two options to setup their operating target.

In summary, Singapore and the Philippines should apply the money supply as their operating target, because the money supply of these two countries impacts other variables without being influenced by other macroeconomic variables. Moreover, Indonesia and Thailand have two options for operating targets. The operating target options are inflation and money supply for Indonesia, and inflation and exchange rate for Thailand. For both nations, we suggest that inflation applies to the operating target since it has the casual effect on exchange rate of Indonesia and money supply of Thailand. Meanwhile, the inflation of Indonesia and exchange rate of Thailand has no causal effect on other variables. Finally, the wisest operating target of Malaysia is the exchange rate.

The report of the IMF (2016) shows inflation is the current intermediate target for the ASEAN-5 excluding Singapore, targeting the exchange rate. The Philippines and Singapore can maintain their current intermediate target based on the suggested operating target. However, Indonesia and Thailand should set exchange rate and money supply as their intermediate targets, respectively. A stable exchange rate is a pivotal accelerator for Indonesia, which is a small open economy, while the persistent and slow increase of the money supply is proven to promote sustainable economic growth in Thailand. Unfortunately, we cannot suggest intermediate targets since there is no casual effect of exchange rates in Malaysia to other variables. Malaysia can keep the original intermediate target but needs to consider monetary instruments beyond this study.

CONCLUSION

The present paper assesses the symmetric and asymmetric dynamic interaction of macroeconomic activities for the ASEAN 5. Various interesting results emerged from the present analysis. First, we found that no long run relationship was evident for Indonesia and the Philippines. Second, among the three countries that passed the cointegration test, Malaysia was the only country found to have an asymmetric adjustment on the different shock. Additionally, the money supply of Malaysia responds only to positive shocks (good news), while the interest rate of Malaysia responds only to negative shocks (bad news). This finding shows that adjustment towards equilibrium for macroeconomic variables is imperfect, and policy makers in Malaysia should intervene in the money supply when there is a positive shock and intervene in interest rates when there is a negative shock.

According to the long-run coefficients and Ganger causality results, we found two leading variables for the Philippines and Singapore and suggest money supply should be set as an operating target. The reason is the money supply of these two countries has a strong impact on other macroeconomic variables compared to another leading variable; therefore, the best operating target is money aggregate targeting. Malaysia found only one leading variable, which is exchange rate; thus, exchange rate targeting is the most appropriate policy target. Finally, Indonesia and Thailand found two leading variables, which were based on the impact from the leading variables to other macroeconomic variables, suggesting that inflation targeting is the best for these two countries. This is because the alternative leading variable of these countries has no impact on other macroeconomic variables.

Based on the sensitiveness to the leading variable, we suggest Malaysia, the Philippines and Singapore can maintain their current intermediate target; however, policymakers in Malaysia need to find a policy instrument beyond the discussion of this paper. On the other hand, Indonesia and Thailand should change their intermediate targets to exchange rate and money supply, respectively. As a small open economy, Indonesia demands a stable exchange rate. The findings of Masih and Maish (1996) and our empirical result proved that Thailand is able to promote its economy through the money supply; therefore, inflation as the operating target and money supply as the intermediate is an optimal combination for Thailand's monetary policy.

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