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Monetary Policy and External Factors: Empirical Evidence for Association of Southeast Asian Nations 3

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ABSTRACT

The motivation for this paper is the external factors can be the important objectives of the monetary policy in a small open economy. This study will extend the standard Taylor rule that initially encompassed output and inflation by adding the exchange rate and terms of trade (TOT). By using the augmented Taylor rule, this paper examines exchange rates and TOT and determines its empirical validity based on a sample of Association of Southeast Asian Nations 3 countries. Using the technique of unrestricted error correction model, the findings provide some policy implications; the uncertain movements of the exchange rate and TOT can be fine-tuned by the central bank's interest rate instrument, and the inflation and output are useful policy indicators for monetary decision making of central bank, which eventually promotes the best economic outcomes.

Keywords: Exchange Rate, Monetary Policy, Taylor Rule, Terms of Trade
JEL Classifications: C61, E58, E61, F41

1. INTRODUCTION

Monetary authorities (hereafter, central banks) have the responsibility for achieving goals of monetary policy, for instance the sustainable economic growth, and low and stable inflation. Towards achieving these goals, the central bank relies on a series of choices regarding the information set used as a basis for short-term and longer-term policy adjustments, including the weights and specific roles attached to various economic variables. While most theoretical and empirical literatures on inflation targeting focus on the closed economies, only conventional variables such as the output gap and inflation from a specific target are accounted explicitly for monetary policy. The external factors (e.g., exchange rates and terms of trade [TOT]) have a secondary role, however, they are simply being ignored (Taylor, 1999; Bernanke et al., 1999); a more recent line of research explicitly considers the role of these variables for monetary policy decisions (Svensson, 2000; Ball, 2000; Clarida et al., 2001).

Exchange rate bears immense importance in the context of open economies. As argued by Svensson (2000), the exchange rates can affect the relative price between domestic and foreign goods, influence prices of goods and services through import prices, and shape the input prices of imports. Calvo and Reinhart (2002) find that the exchange rate in countries with fear of floating tends to stable via fine-tuning the interest rate. Ito and Hayashi (2004) suggest that majority Asian emerging countries tend to focus on exchange rate matter when designing their monetary policy. Undoubtedly, the exchange rate plays a prominent role in the transmission mechanism of monetary policy (Ball, 2000). In a similar vein, Disyatat and Galati (2005) and Wang and Wu (2012) suggest that it is useful to conceptualize the exchange rate as an asset price because it is more pronounced on the present and expected future economic events.

On the other hand, an additional channel of the transmission of monetary policy through the TOT cannot be overlooked, which the interest rate can be used to address the shocks of the changes in the TOT (Cordon, 1984; Edwards, 1989; Giorgio and Nistico, 2005). de Fiore and Liu (2002) suggest that higher real interest rates in the open economy may lead to an appreciation of the country's currency and an improvement of its TOT; Clarida et al. (2001) define this circumstance as expenditure switching effect. Using macroeconomic model, the results of the study by Jondeau and Sahuc (2008) corroborate the findings of de Fiore and Liu (2002). Jondeau and Sahuc (2008) conclude that the inclusion of the TOT variable in the monetary policy decision making enables the control of foreign prices disparities.

In line with the above discussion, the motivation for this paper is the external factors (i.e., exchange rates and TOT) can be the important objectives of the monetary policy in a small open economy. This study will extend the standard Taylor rule that initially encompassed output and inflation by adding the exchange rate and TOT. The objective of this paper is to examine the role of external factors (i.e., exchange rates and TOT) in central bank's monetary policy reaction, such that the uncertain movements of these external factors can be fine-tuned by the central bank's interest rate instrument. In doing so, the external variables, namely exchange rates and TOT, along with the policy variables, namely output and inflation should help facilitate achieving the best economic outcomes. This paper uses a sample of Association of Southeast Asian Nations (ASEAN-3) countries including Indonesia, Malaysia and Thailand. Using bounds test technique of co-integration proposed by Pesaran et al. (2001), the paper examines the external factors (i.e., exchange rates and TOT) in the standard Taylor rule.

The rest of the paper is organized as follows. Section 2 formally describes the theoretical model of the augmented Taylor rule and presents an empirical model of cointegration analysis. The data and empirical results are described in Section 3. The conclusion is presented in Section 4.

2. THEORETICAL MODEL

This study adopts the standard Taylor rule to examine the role of external factors (i.e., exchange rates and TOT)[1]. The input of the augmented Taylor rule is given as follows:

$$\Delta r_t = \beta_y y_{g_t} + \beta_\pi \pi_{g_t} + \delta \ \Delta e_t + \phi \ \overline{tot}_t \quad (1)$$

Consider the above model, with y_g as the output gap, π_g as the inflation gap, $\overline{tot}$ as the quarterly rate of change of the TOT, Δe as the changes in the real exchange rates/exchange rates gap and Δr as the changes in the real interest rates/interest rates gap, which is supposed to be the instrument of the central bank. The theoretical signs of the parameters are β_y and $\beta_\pi > 0$, and δ and $\varphi < 0$.

2.1. Methodology

This study applies the bounds test proposed by Pesaran et al. (2001) to determine the existence of long-run equilibrium relationship in a set of variables, which is based on the unrestricted error correction model (UECM). The strength of bounds test over the general practice of co-integration procedure (e.g., Engle and Granger, 1987; Johansen, 1988; Johansen and Juselius, 1990) is that the application of the test are not restricted to the condition of I(0) or I(1) with respect to the explanatory variables. The test is also not restricted to the problem of small sample size (Mah, 2000).

Because the UECM implies the simple re-parameterization of a model of common autoregressive distributed lag, by obtaining the ordinary least squares estimates, the UECM can help to relax the bounds test technique. The input of UECM for central bank's reaction function, i.e., Equation (1), can be written as follows:

$$\begin{aligned} d\Delta r_t = {} & b_0 + \sum_{i=0}^{n} b_{1i} dy_{g_{t-i}} + \sum_{i=0}^{n} b_{2i} d\pi_{g_{t-i}} \\ & + \sum_{i=o}^{n} b_{3i} d\Delta e_{t-i} + \sum_{i=0}^{n} b_{4i} d\overline{tot}_{t-i} + \sum_{i=1}^{n} b_{5i} d\Delta r_{t-i} + b_6 \Delta r_{t-1} \\ & + b_7 y_{g_{t-1}} + b_8 \pi_{g_{t-1}} + b_9 \Delta e_{t-1} + b_{10} \overline{tot}_{t-1} + e_t \end{aligned} \quad (2)$$

Where, $d\Delta r$, dy_g, $d\pi_g$, $d\Delta e$ and $d\overline{tot}$ are first differences of the interest rate gap, the output gap, the inflation gap, the exchange rate gap and the quarterly rate of change of the TOT, respectively. e represents an error term.

Pesaran et al. (2001) suggest that the Wald test (F-statistic) through the bounds test technique can determine the equilibrium relationship of co-integrating vector in the long-run; in relaxing the Wald test, the null hypothesis is that no co-integration relationship among the explanatory variables. The feature has no problem in the estimating process, which the test enables the examined variables are purely I(0) or I(1). From UECM, considering that the restricted error correction model that excludes the lagged variables, namely Δr_{t-1}, $y_{g_{t-1}}$, $\pi_{g_{t-1}}$, Δe_{t-1}, and $\overline{tot}_{t-1}$.

The WALD test is a joint significance test of null hypothesis, i.e., H_0: $b_6 = b_7 = b_8 = b_9 = b_{10} = 0$; this null hypothesis against H_A: $b_6 \neq b_7 \neq b_8 \neq b_9 \neq b_{10} \neq 0$. Towards the bounds test technique of co-integration analysis of Equation (1), uniqueness of the co-integrating vector is assumed. Furthermore, the hypothesis of co-integration relationship can be determined via asymptotic critical value bounds for the F-statistic proposed by Pesaran et al. (2001. p. 300-301, Table CI i-v), which suggests that the rejection null hypothesis of no co-integration is a condition that the calculated F-statistic surpasses the upper critical value, i.e., I(1), the fail to reject the null hypothesis of no co-integration is a condition that the calculated F-statistic falls below the lower critical value, i.e., I(0), and inconclusive cointegration inference is a condition that the computed F-statistic falls within the critical bounds. Moreover, the short-run elasticity can be obtained via the estimation of UECM, i.e., Equation (2); the short-run elasticity is the coefficient of the first differenced variable. To obtain the long-run elasticity from the UECM estimates, we can multiply one period lagged explanatory variable by a negative sign, and the measure is then divided by the one period lagged dependent variable. From Equation (2), the long-run elasticities of output

1 The standard Taylor rule (1993) is $\Delta r = f(y_g, \pi_g)$; Δr as the changes in the real interest rates/interest rates gap, y_g as the output gap and π_g as the inflation gap.

gap, inflation gap, the changes in the real exchange rates and the quarterly rate of change of the TOT are $-(\frac{b_7}{b_6})$, $-(\frac{b_8}{b_6})$, $-(\frac{b_9}{b_6})$, and $-(\frac{b_{10}}{b_6})$, respectively.

3. DATA AND EMPIRICAL RESULTS

3.1. Data

The data analyzed in this paper is quarterly from quarter one 1995 to quarter four 2014. This paper uses a sample of ASEAN-3 countries including Indonesia, Malaysia and Thailand. There are five variables encompassed in the study, namely the interest rate gap, the output gap, the inflation gap, the exchange rate gap and the change of the TOT. The gap is the difference between actual value and the equilibrium/potential value in which the potential value can be computed via the procedure of the Hodrick-Prescott (HP) filter; the HP filter uses the value of 1600 for the smoothing parameter. In this paper, the real exchange rate is used as a proxy of real effective exchange rate (REER), and the interest rate is used as a proxy of money market rate. The data are taken from Direction of Trade Statistics and International Financial Statistics published by International Monetary Fund.

The interest rate gap is calculated as the difference between actual real interest rate and the potential real interest rate. The output gap is calculated as the difference between logged actual real output and the logged potential real output, and then multiplied by 100. The inflation gap is calculated as the difference between actual inflation rate and the potential inflation rate. The exchange rate gap is calculated as the difference between actual REER and the potential REER, and then multiplied by 100. The change of the TOT is calculated as the quarterly rate of the change of the TOT. From Table 1, the unit root test of augmented Dickey-Fuller suggests that no conclusion can be made about the same order of integration across the variables for each country. Undoubtedly, as mentioned in subsection 2.1, the UECM technique can resolve the problem of different order of integration in a set of estimation.

3.2. Results and Discussion

The selection of the estimated UECM depends on appropriate lag lengths, for instance, Indonesia with lag length of four, four, zero, two and three, Malaysia with lag length of one, four, one, three and three, and Thailand with lag length of four, three, zero, four and three. These specifications are selected based on akaike information criterion criteria. The UECM is estimated and reported in Table 2. In selecting the specific model, all those first differenced variables that have relatively small t-value, i.e. (<1), were dropped sequentially (Tang, 2003. p. 427). Each estimated UECM satisfies diagnostic tests, for instance, the RESET tests of Ramsey suggest that the functional form is correct specified. Furthermore, from Figures 1-3, the recursive residual and the test of cumulative sum of squares of recursive residual indicate that the model is stable over the sample period. The UECM results and the bounds test for co-integration results for Indonesia, Malaysia and Thailand are summarized in Tables 2 and 3, respectively.

With respect to Indonesia, to determine the existence of long-run equilibrium relationship among exchange rates gap, inflation gap,

Table 1: Unit root test of ADF

Variable	Level	First difference	Decision
Indonesia			
Δ_{rt}	−3.840* [4]	−6.350** [0]	I(0)
π_{g_t}	−4.236** [2]	−4.927** [2]	I(0)
y_{g_t}	−4.377** [4]	−2.622* [3]	I(0)
Δ_{et}	−4.167* [2]	−5.109** [2]	I(0)
tot_t	−3.370 [4]	−4.480** [4]	I(1)
Malaysia			
Δ_{rt}	−2.878 [4]	−5.626** [1]	I(1)
π_{g_t}	−3.769* [4]	−4.176** [4]	I(0)
y_{g_t}	−4.950** [4]	−4.165** [4]	I(0)
Δ_{et}	−2.993 [1]	−4.927** [1]	I(1)
tot_t	−3.517* [4]	−4.586** [4]	I(0)
Thailand			
Δ_{rt}	−2.615 [0]	−6.850** [0]	I(1)
π_{g_t}	−4.626** [0]	−7.309** [1]	I(0)
y_{g_t}	−2.211 [4]	−2.654* [3]	I(1)
Δ_{et}	−4.161** [1]	−5.884** [2]	I(0)
tot_t	−3.503 [4]	−3.274* [4]	I(1)

*,**Statistically significant at the 5% and 1% levels respectively. [ ] is a lag order; it is determined using AIC criteria. AIC: Akaike information criterion

interest rates gap, output gap and the change of the TOT, Wald test is used to test the joint significance of H_0: $b_6 = b_7 = b_8 = b_9 = b_{10} = 0$. From Table 3, the calculated F-statistic is 5.767 in which surpasses the upper critical value I(1), at 1% level, thus showing that the exchange rates gap, inflation gap, interest rates gap, output gap and the change of the TOT are co-integrated or co-moving. From Table 2, the estimated long-run elasticities of output gap, inflation gap, exchange rates gap and the change of the TOT variables are 1.94, 4.01, 0.328 and −3.783, respectively. In short-run, the output gap (dy_g), inflation gap ($d\pi_g$), exchange rates gap ($d\Delta e$) and the change of the TOT ($dtot$) are statistically significant and have correct sign. In addition, the short run coefficient of output gap (dy_{g_t} = 0.463) is closed to the one proposed by Taylor (1993) – coefficient of output gap = 0.5. The short-run coefficient of inflation gap ($d\pi_{g_{t-3}}$ = 0.837) is less than one, which means that the central bank pro-cyclically responds to inflation deviation from the target.

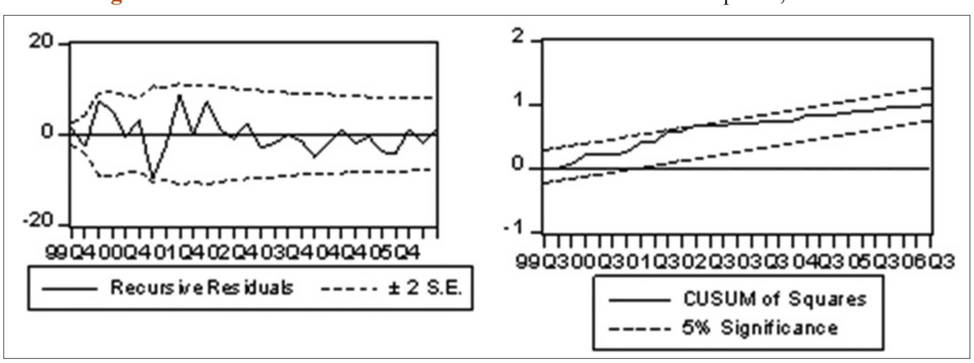
With respect to Malaysia, to determine the existence of long-run equilibrium relationship among exchange rates gap, inflation gap, interest rates gap, output gap and the change of the TOT, Wald test is used to test the joint significance of H_0: $b_6 = b_7 = b_8 = b_9 = b_{10} = 0$. From Table 3, the calculated F-statistic is 11.028 in which surpasses the upper critical value I(1), at 1% level, thus showing that the exchange rates gap, inflation gap, interest rates gap, output gap and the change of the TOT are co-integrated. From Table 2, the estimated long-run elasticities of output gap, inflation gap, exchange rates gap and the change of the TOT variables are 0.17, −0.72, 0.25 and −0.13, respectively. In short-run, the inflation gap

Table 2: Estimated preferred UECM for central bank's reaction function

Dependent variable: $d\Delta_{rt}$	Indonesia		Malaysia		Thailand	
Method: Least squares	ARDL (4,4,1,2,3)		ARDL (1,4,1,3,3)		ARDL (4,3,1,4,3)	
Regressor	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Constant	0.953	1.604	0.029	0.531	0.477	1.657
$d\Delta r_{t-1}$	−0.611	−2.340**				
$d\Delta r_{t-2}$	−0.665	−3.191**				
$d\Delta r_{t-3}$	−0.323	−1.973*			0.483	3.484***
$d\pi_{g_{t-3}}$	0.837	1.877*	0.317	2.220**		
dy_{g_t}	0.463	1.925*				
$d\Delta e_t$	−0.197	−1.985*			−0.182	−2.391**
$d\Delta e_{t-1}$					−0.220	−2.734**
$d\Delta e_{t-2}$			−0.065	−2.946***	−0.282	−3.573***
$d\overline{tot}_t$	−0.580	−1.918*				
$d\overline{tot}_{t-2}$			−0.305	−1.702*	−1.117	−2.606**
Δr_{t-1}	−0.290	−0.949	−0.217	−3.940***	−0.632	−3.764***
$\pi_{g_{t-1}}$	1.163	0.854	−0.156	−0.424	0.719	0.760
$y_{g_{t-1}}$	0.563	1.955*	0.037	2.139**	0.048	0.485
Δe_{t-1}	0.095	0.905	0.055	3.882***	0.185	2.193**
$\overline{tot}_{t-1}$	−1.097	−2.974***	−0.028	−0.219	0.391	1.196
R^2	0.751		0.858		0.759	
Adjusted R^2	0.605		0.791		0.595	
SE of regression	3.883		0.345		1.474	
Log likelihood	−119.106		−7.704		−73.794	
Durbin–Watson stat	2.347		2.618		1.999	
Heteroskedasticity test	0.459 (0.501)		0.272 (0.604)		0.169 (0.683)	
Ramsey RESET test [4]	0.010 (0.921)		0.404 (0.529)		1.003 (0.326)	
ARCH test [4]	1.890 (0.132)		1.627 (0.154)		0.417 (0.795)	
Jarque–Bera	56.46 (0.600)		1.310 (0.520)		0.423 (0.809)	
Breusch–Godfrey LM test [4]	0.986 (0.434)		2.804 (0.053)		0.318 (0.863)	
AIC	−137.106		−24.704		3.908	
Schwarz criterion	−153.758		−41.124		4.688	
F-statistic	6.243		12.799		4.636	
P (F-statistic)	0.000		0.000		0.000	

*,**,***Denotes statistical significance at the 10%, 5% and 1% levels respectively. ( ) and [ ] are P value and lag order, respectively. The insignificant and incorrect expected sign variables of dy_g, $d\pi_g$, $d\Delta e$ and $d\overline{tot}$ are not reported in the table. ARDL: Autoregressive distributed lag, UECM: Unrestricted error correction model, SE: Standard error

Figure 1: Recursive residuals and the test of cumulative sum of squares, Indonesia



($d\pi_g$), exchange rates gap ($d\Delta e$) and the change of the TOT ($d\overline{tot}$) are statistically significant and have correct sign. Although, there is no short-run relationship between output gap and the interest rates gap, long-run relationship exists when the coefficient is 0.17. It means that a positive output gap – overheating, which may induce higher than desired inflation. This should be offset through tightening monetary policy and *viz*. Furthermore, the short-run coefficient of inflation gap ($d\pi_{g_{t-3}}$ = 0.317) is <1, which means that the central bank pro-cyclically responds to inflation deviation from the target.

With respect to Thailand, to determine the existence of long-run equilibrium relationship among exchange rates gap, inflation gap,

Figure 2: Recursive residuals and the test of cumulative sum of squares, Malaysia

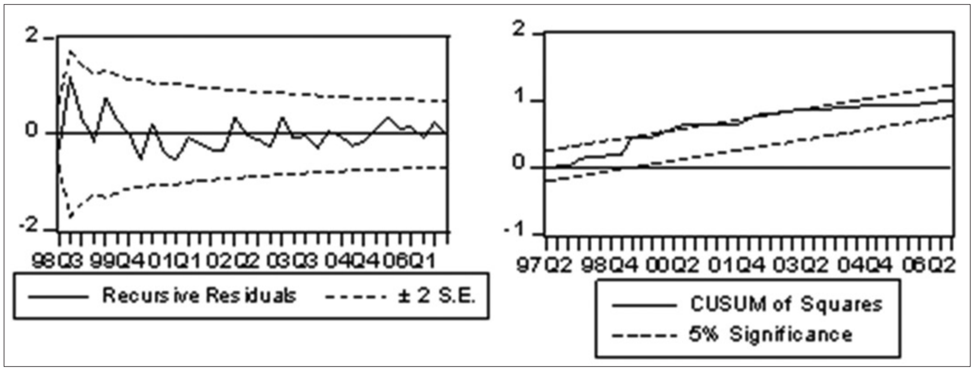


Figure 3: Recursive residuals and the test of cumulative sum of squares, Thailand

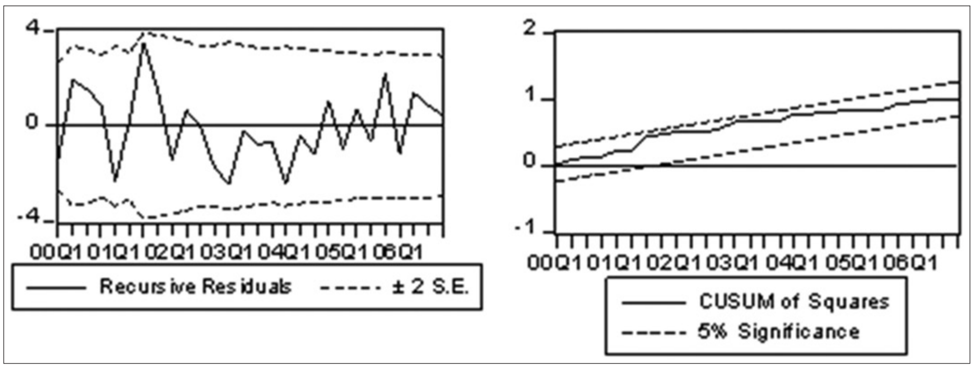


Table 3: Bounds test of co-integration analysis

The determination of long-run relationship	Indonesia	Malaysia	Thailand
Wald test for F-statistic			
H_0: b_6=b_7=b_8=b_9=b_{10}=0	5.767		
H_0: b_6=b_7=b_8=b_9=b_{10}=0		11.028	
H_0: b_6=b_7=b_8=b_9=b_{10}=0			5.989
Critical value bounds at 1% level[a]			
Lower bounds, I (0)	3.74	3.74	3.74
Upper bounds, I (1)	5.06	5.06	5.06

[a]From Pesaran et al. (2001. p. 300), Table CI. iii: Case III: Unrestricted intercept and no trend (four regressor k=4)

interest rates gap, output gap and the change of the TOT, Wald test is used to test the joint significance of H_0: $b_6 = b_7 = b_8 = b_9 = b_{10} = 0$. From Table 3, the calculated F-statistic is 5.989 in which surpasses the upper critical value I(1), at 1% level, thus showing that the exchange rates gap, inflation gap, interest rates gap, output gap and the change of the TOT are co-integrated. From Table 2, the estimated long-run output gap, inflation gap, exchange rates gap and the change of the TOT variables are 0.08, 1.14, 0.29 and 0.62, respectively. In short-run, the exchange rates gap ($d\Delta e$) and the change of the TOT ($d\overline{tot}$) are statistically significant and have correct sign.

Overall, the co-integration results confirm that the external factors significantly influence the behavior of central banks' interest rate instrument in the short-run, and that the central bank of Indonesia, Malaysia and Thailand did care on both exchange rates and TOT. The results also confirm that the central bank of Indonesia, Malaysia and Thailand did care on both inflation and output as the important monetary objectives in the long-run, and that the inflation and output are good economic indicators to support the domestic economic stability. Though the long-run coefficient of inflation of Malaysia is not in the correct sign, it does in the short-run and it is statistically significant. Such evidence may be due to inflation targeting in monetary policy, which is not adopted yet.

4. CONCLUSION

This paper examines the role of external factors (i.e., exchange rates and TOT) in central bank's monetary policy reaction via an augmented Taylor rule and determines its empirical validity based on a sample of ASEAN-3 countries, namely Indonesia, Malaysia and Thailand. By using the technique of UECM, a bound test method, the results support the hypothesis that external factors (namely, exchange rates and TOT) as well as policy variables (namely, output and inflation) can help central bank to achieve the best economic outcomes. Therefore, the uncertain movements of these external factors can be fine-tuned by the central bank's interest rate instrument. Furthermore, our study also suggests that the inflation and output are useful policy indicators for monetary decision making of central bank.

This paper has several limitations. First, the study is restricted to the variables of inflation, the output gap, the exchange rate and the TOT. Future research may include other variables to expend the scope of the analysis. Second, the specification testing procedure of Taylor rule is in partial model. Future research may determine the same issue by using the full macroeconomic model. The current sample of the study is restricted to Indonesia, Malaysia and Thailand. Future research may replicate the study to other countries.

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