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Exchange Market Pressure and Monetary Policies in ASEAN5

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Abstract

The aim of this research is to analyze the relationship between Exchange Market Pressure (EMP) and monetary policies in ASEAN5 (Indonesia, Malaysia, the Philippines, Thailand, and Singapore). This research applies Vector Error Correction Model (VECM) and monthly data for the periods January 2006 – December 2016 for individual country estimation. The results show that the ASEAN5 monetary authorities have responded the increase of EMP by contracting domestic credit in the non-crisis periods, and by providing more liquidity to the bank system in the crisis periods. In addition, in the case of ASEAN5 the increase in interest rate differential has reduced the EMP.

Keywords: Exchange Market Pressure, Domestic Credit, Interest Rates Differential, Monetary Policy
JEL: F31, F33, F37

1. Introduction

Most of the ASEAN countries are small open economy ones; it means that the international policy shocks will influence the economies of ASEAN countries. International fluctuation such as changes in interest rates, increase in money supply, and international monetary policies will create economic shocks for ASEAN countries. The monetary authorities to stabilize through some monetary policy instruments will respond the economic shocks. Moreover, the crisis in foreign country will have an effect on other countries, although the impact is different in each country. It is a good example like contagion effect during Asian financial crisis 1997 that suffered some ASEAN countries. However, since ASEAN does not consists of totally integrated countries, each country has the authority to set monetary policy according to its economic condition.

One of the most frequent economic shock is exchange rate shock, which is not only responded by the monetary authorities but by also government investors, exporters, importers as well as other decision makers. Similarly, during the crisis the exchange rate volatility is as early indication. In fixed exchange regime, if there is shock in exchange rate, the monetary authority will intervene to make the exchange rate return to its equilibrium, in order to achieve exchange rate stability. "A currency crisis occurs when there is an abnormally large international excess demand for a currency which forces monetary authorities to take strong counter measures, often at the expense of other policy objectives" (Weymark,1998:106). Monetary authorities intervene exchange rate through the international reserves changes in international reserves in a substantial amount can be used for exchange rate intervention. Meanwhile, in a floating exchange rate system the monetary authority should not intervene in exchange rate, since its equilibrium follows the market equilibrium (Dornbusch, et al, 2011:287-289).

Under the crisis period, exchange rate continuously depreciated and it will be followed by inflation. In this case, government is responsible for returning the economy to stable conditions. The monetary authorities should create and implement monetary policies that appropriate to economic conditions. Likewise, when appreciated, the authority also creates and implements monetary policy to maintain exchange rate stability. Moreover, emerging countries prefer to depreciate rather than appreciate their currency, because while depreciation occurs it means that domestic prices are cheaper than foreign prices, it have an impact on increasing of export. Therefore, the monetary authorities will response appreciation faster than depreciation.

The intervention of monetary authorities in exchange rates can be seen by analyzing exchange rate changes and reserve outflows, which is called Exchange Market Pressure (EMP). Tanner (2001:311) defined EMP as "The sum of exchange rate depreciation and reserve outflows (scaled by base money), summarizes the flow excess supply of money in a managed exchange rate regime". In other words, there is a relationship between exchange rate and money supply. Shock in EMP as a respond of exchange rate shock can be used to analyze monetary authority responds to EMP. Nevertheless, the influence of EMP on monetary policy in each country can be different, so through the analysis of EMP is expected to be a consideration of monetary authorities in choosing policies to reduce the EMP. The responses between EMP and monetary policy differ in each country. Some countries quickly respond to EMP increases by sterilizing it, but others may not quickly respond to EMP increases.

The purpose of this paper is analyzing the EMP changes to monetary policy response in ASEAN-5 (Indonesia, Singapore, Malaysia, Thailand, and Philippines). This paper is addressed to answer some crucial questions. First, does Monetary Policy affect EMP in ASEAN-5 countries (Indonesia, Singapore, Malaysia, Thailand, Philippines) in the long run and short-run over the observation period? *Second*, how is the influence of Monetary Policy on EMP in ASEAN-5 countries (Indonesia, Singapore, Malaysia, Thailand, Philippines) over the observation period? *Third,* how is the Monetary Policy response to the EMP shock in ASEAN-

5 countries (Indonesia, Singapore, Malaysia, Thailand, Philippines) over the observation period? The rest of this paper is organized as follows. Part 2 describes theoretical basis of EMP, exchange rate system and intervention, and the relationship between EMP and monetary policy, as well as the previous empirical studies. Part 3 discusses research methodology consisting of types and sources of the data, operational variable definitions, analysis methods, data processing steps, and research model. Part 4 shows the results and discussion. Finally, concluding remarks and recommendations are in Part 5.

2. Literature Review

Exchange rate is the price of country's currency against another currency. Types of exchange rate are divided into nominal exchange rate and real exchange rate. Nominal exchange rate is a currency ratio between two countries, while real exchange rate is nominal exchange rate that has been adjusted to the price level or inflation rate. Meanwhile, exchange rate system is distinguished into fixed and floating exchange rate. In fixed exchange rate system, central banks ready to buy and sell their currencies at a fixed price in terms of dollars to make market prices equal to the fixed rates. Either central banks as the monetary authorities hold reserve in dollars, other currencies, or gold that can be used when they need to intervene in the foreign exchange market. Monetary authorities must maintain the price fix by ensuring that there is no excess demand and supply in exchange rates market. As long as monetary authorities have enough reserves they can continue intervene exchange rate to keep it constant (Dornbusch, et al , 2011: 287-288).

Under flexible floating exchange rate system, central banks allow the exchange rate following the supply and demand equilibrium for foreign currency. Exchange rate system is clean when monetary authorities are clear from intervene in the foreign exchange markets, means that reserves transactions for it are zero. In practice, the flexible rate system has not been clean floating recently, the systems change to managed or dirty, floating. In managed floating, monetary authorities intervene exchange rate by buying and selling foreign currencies, reserves transactions are not equal to zero under managed floating (Dornbusch, et al, 2011: 289). Monetary authorities will intervene when exchange rate over the limit that already set, some of the intervention doing through stabilizing daily fluctuation, leaning against the wind, and setting unofficial pegging.

Based on Weymark (1998), Exchange Market Pressure (EMP) formula consists of excess demand measurement for currency that was first introduced by Girton and Roper (1977). EMP refers to the magnitude of money market disequilibrium that must be reduced through reserve or exchange rates changes. Their article assumes that monetary authorities must not use domestic credit changes to influence exchange rate levels, because exchange rate intervention is unsterilized. Intervention causes equivalent amounts of base money changes, because percentage changes in base money causing equivalent changes in prices. EMP under Girton and Roper approach is measured from the sum of percentage changes in exchange rates and in foreign exchange reserves.

Later article which explains about EMP written by Roper and Turnovsky (1980) permitted intervention on the model to take the form of domestic credit changes as good as reserve changes. They find that excess demand for money was equal to linear combination in exchange rate changes and monetary base changes. Both Girton and Roper (1977) and Roper and Turnovsky (1980) employ EMP as the dependent variable in their estimation to capture changes in intervention policy during the sample period. However, they did not concern to develop a general measure of EMP for economies. After that, Weymark (1998) developed a general model to measure EMP that derived from Girton and Roper (1977) and Roper and Turnovsky (1980). The new model can deliver relationship between EMP and changes in exchange rate and monetary base, which is used to implement intervention policy. Moreover, this model can apply to measuring the magnitude of speculative pressure against a currency, studying the characteristic of exchange rate crises, and testing external imbalance determinants.

Weymark (1998) defines that, “Exchange market pressure measures the total excess demand for a currency in international markets as the exchange rate change that would have been required to remove this excess demand in the absence of exchange market intervention, given the expectations generated by the exchange rate policy actually implemented” (Weymark, 1998: 109). Equation for measuring EMP by Weymark that is consistent with the definition is:

$$EMP_t = = \frac{-EDC_t}{b_2\{c_1+(c_1+\alpha)(1-a)\}+(1-a)(c_1+c_2)(1+\alpha b_1)} \quad (1)$$

Where: EDC_t is the excess demand for domestic currency that occur period t, then $\beta = b_2\{c_1 + (c_1 + \alpha)(1 - a)\} + (1 - a)(c_1 + c_2)(1 + \alpha b_1)$ is representation of expectations under a pure float. This expectation may differ from basis actual policy undertaken by the policy authority. This EMP model only valid in small open economy and should not be used in larger, interdependent economies research.

In other article, Tanner (2000) assumes that EMP evidences the difference between growth rates of domestic credit money supply and money demand, which is represented in both exchange rate and reserve movements. On the demand side, the growth of real base money (m_t) is:

$$m_t = \frac{\Delta M_t}{M_{t-1}} - \pi_t \qquad (2)$$

where M_t is nominal base money at time t, and π_t is the inflation rate which is measured from $\frac{\Delta P_t}{P_{t-1}}$ (where P_t is the price level at time t). The inflation rate connected to world inflation π_t* through the nominal exchange rate growth e_t (country's currency units per U.S. dollar), that can be formulating as follows:

$$e_t = \pi_t - \pi_t * + z_t$$

(3)

where z_t is the deviation from purchasing power parity. While, on the supply side nominal base money consists of international reserves R_t and net domestic assets D_t, which is formulated as follows:

$$\frac{\Delta M_t}{M_{t-1}} = \frac{(\Delta R_t + \Delta D_t)}{M_{t-1}} = r_t + \delta_t \qquad (4)$$

Where $r_t = \frac{\Delta R_t}{M_{t-1}}$ and $\delta_t = \frac{\Delta D_t}{M_{t-1}}$. Tanner assumes that purchasing power parity and world inflation equals zero ($z_t = \pi_t * = 0$), so the EMP index is obtained by rearranging and substituting equations (3) and (4) into (2):

$$m_t = \frac{\Delta M_t}{M_{t-1}} - \pi_t \qquad (2)$$

$$m_t = \frac{\Delta R_t}{M_{t-1}} + \frac{\Delta D_t}{M_{t-1}} - e_t \quad (5)$$

$$\frac{\Delta D_t}{M_{t-1}} - m_t = e_t - \frac{\Delta R_t}{M_{t-1}} \quad (6)$$

$$EMP_t \equiv e_t - r_t = \delta_t - m_t \quad (7)$$

Under equation (7), EMP measured by exchange rate depreciation plus reserve outflows (scaled by base money) that equals the difference between the growth rates of the domestic component of the monetary base (δ_t) and money demand (m_t). This research uses the equation to obtain EMP index.

The amount of reserves changes, exchange rate changes, and differential between domestic and world interest rate to easing foreign exchange market disequilibrium depend on economic structure, because volatilities in these variables depend on economic structure that will be responded by intervention activities of policy authorities (Weymark 1998, 118). When domestic currency depreciation occurs, it can be repelled through raising interest rates or running foreign exchange reserves. So in doing that, measure of EMP index can be develop from weighting average of the changes in exchange rate, in foreign exchange reserves, and in interest rates (Pontines and Siregar, 2008:347). EMP appears as the respond of exchange rate fluctuations. Moreover, calculations EMP and intervention can be defined as absorbing pressure in foreign exchange market through monetary authorities' intervention.

The EMP equation that expressed by Tanner (2001) also shows that there is relationship between EMP and monetary policy that can be provided from monetary base uses by domestic policy makers. If real money demand is constant, EMP and monetary base move together, but central banks must to set interest rates to control monetary base. In that condition, contradictive monetary policy will raise differential between domestic and world interest rate, encourage capital inflows, and will reduce EMP. Even though differential between domestic and world interest rate may be a noisy indicator of monetary policy because it is consists of depreciation and risk premium (Tanner 2001, 315). Nevertheless, Tanner finds that there are differences responses to higher EMP, some monetary authorities will loosen by increasing domestic credit growth (as EMP rose, domestic credit rose, while interest rate differential fell). But others will tightened by increasing interest rates (as EMP rose, domestic credit fell, and interest rate differential rose), or both of them (as EMP rose, so do domestic credit and interest rate differential fell) (Tanner 2001, 318).

Several previous researches in some countries provide inconclusive results about the relationship between EMP and monetary authority intervention in each country. Tanner (2001) analyzes whether monetary policy effects EMP during 1990s in Brazil, Chile, Mexico, Indonesia, Korea, and Thailand as generally expected that contractive monetary policy helped to reduce EMP. This paper uses vector autoregressive (VAR) model to regress the EMP, credit growth, and interest differential variables for each country, and uses pooled estimates to regress all of the observation countries. The results show that a reduction in the domestic credit helped to reduce EMP both individual country and pooled estimates, positive interest differential shocks also helped to reduce EMP in some evidence from some individual countries, EMP shocks positively affected interest rates both from individual country and pooled estimates. Domestic credit shocks positively affected interest differential for higher inflation countries, but negatively for lower inflation countries. To increase EMP, monetary authorities prefer used expanding rather than contracting domestic credit in some evidence both individual country and pooled estimates.

Tanner (2001) and Jeisman (2005) used two stage least squares to estimate EMP indices for the Australian dollar against the US dollar exchange rate. The aim of these researches was to measure EMP on the Australian dollar over the post-float period by using quarterly data series. It is found that both EMP and degree of intervention possible to describe Australian dollar pressure. During the periods, Australian dollar was generally under pressure to depreciate, and some evidence suggested that Reserve Bank of Australia (RBA) intervention applied higher pressure to depreciate the Australian dollar and lower pressure to appreciate the Australian dollar. Moreover, this paper also suggested that RBA contributed to the large Australian dollar depreciation between 1997 and 2001.

Bautista and Bautista (2005) examined the respond of monetary authorities on EMP, and the traditional monetary prescription of contracting money to lend strength to a currency on Philippines peso. Methodology of the research applied VAR framework by using monthly data from 1990:1–2000:4. The results if the authorities had difference respond in crisis periods compared to non-crisis periods. In non-crisis period, authorities tended to sterilize the effects of EMP, but in crisis periods authorities tended not to sterilize and tighten domestic credit growth. The effect of differential interest rates on EMP was raising differential interest rate reduce EMP in non-crisis periods, while in crisis periods differential interest rates had an positive effect on EMP, these findings suggested that the prescriptions of the traditional theory were followed.

Different results were found by Ahmed (2013) who analyzed disequilibrium foreign exchange rate in Pakistan using EMP by VAR model from 1975:Q2 to 2009:Q1. The results suggested that foreign exchange markets significantly extended disequilibrium in domestic money market. Monetary authorities had limit control on exchange rate over the domestic money supply, any effort to increasing domestic credit would not work because it lead to the drainage foreign reserves, and sterilization would be ineffective to maintain the monetary effects. Hossain and Ahmed (2009), who analyzed whether the exchange rate policy in Bangladesh in line with the free floating exchange rate for the period 2000 – 2008, also found the similar result with Ahmed (2013). This paper used Girton-Roper approach to determine EMP variable. The results showed that monetary policy transmission on interest rates was almost ineffective and sterilized intervention led to increase foreign exchange market pressure, increased of domestic credit effect on exchange rate depreciation, decreasing reserves, or both of them, which led to EMP. This paper also provided that the policies of Bangladesh monetary authority were not consistent with free-floating regime characteristic.

Garcia and Malet (2007) used economic growth as one of the variables to estimate EMP. This research analyzed the interactions between EMP and monetary policy, and the usual omission of output growth in empirical investigations. The investigation focused on Argentina case over the period January 1993 to March

2004 by using VAR model. There was a negative affect between both US and Argentina interest rates and EMP, increase of Argentina interest rates would not reduce EMP, but increase of US interest rates would reduce foreign capital inflows, which would eventually affect the EMP. Moreover, increase in domestic credit also had negatively influence on economic growth. Economic growth in Argentina was not depend on internal generates liquidity, but on foreign capital inflows. Output growth could determine EMP more than domestic credit or interest rates. Meanwhile, Hegerty (2009) examined capital inflows and domestic credit growth effect on EMP in Estonia, Latvia, Lithuania, and Bulgaria that maintain fixed exchange rate regime by VAR approach. The model formed from EMP, domestic credit growth, and capital inflows as primary variables, and input real GDP and inflation rate as additional variables in quarterly data from 1995 to 2008. The results if these countries had different respond to increased capital inflows due to differences over a range of economic and non-economic criteria in each country. Capital inflows would be responsible for devaluation pressure. The capital inflows consisting of FDI and non-FDI evidence could accelerate the growth of domestic credit in Bulgaria, but not the Baltics. Relatively volatile flows, especially non-FDI, reduce EMP in three of the four countries.

Unlike other researches, Mathur (1999) used the random walk model, the Box-Jenkins methodology, and the VAR (Vector Autoregressive) techniques to forecast exchange rate, and used Girton-Roper (G-R) model and Modified Girton-Roper (M-G-R) model to estimate EMP. The results indicated that M-G-R model better than G-R model in explaining EMP, from estimation suggested that general equilibrium approach more relating to explain EMP than partial equilibrium approach, and the data could be improved by using appropriate data for the foreign variables. The observation data was monthly data from January 1980 to July 1988 in India. In addition, Hall et al (2013) investigated the Japanese Yen, the Chinese Yuan, and the UK Pound pressures against the US dollar during the period 2001:1 to 2009:4 quarterly data series. Time Varying Coefficient is used to estimate the value of EMP underlying Girton-Roper model structural coefficients and to eliminate specification biases. The results suggested that yen was undervalue during the initial part estimation period, Yuan also suggested undervaluation over the period that the undervaluation peaking in 2004 and 2007, and the pound was suggesting a mainly free-floating currency over period.

3. Methodology

3.1.Data

This research is quantitative research that uses secondary data from several resources, which refers to Tanner's paper. Variables, model, and methods that are used to form and estimate EMP are similar with those used in Tanner's paper. The Data, which are used in this research, are monthly time series data during January 2006 – December 2016 periods for individual country estimation, and January 2007 – December 2009 for panel estimation in the case of Indonesia, Singapore, Malaysia, Thailand, and the Philippines. All of the data are secondary data from CEIC.

Exchange Market Pressure

As defined before, EMP is “sum of exchange rate depreciation and reserve outflows (scaled by base money), summarizes the flow excess supply of money in a managed exchange rate regime” (Tanner 2001:311). EMP is a summary of differences of money demand and money supply growth rates under managed exchange rate regimes. EMP calculated from Tanner’s EMP model (2001), with the following equation:

$$EMP = \left(\frac{e_t - e_{t-1}}{e_{t-1}} + \frac{r_t - r_{t-1}}{M0_{t-1}}\right) \times 100 \qquad (8)$$

EMP = Exchange Market Pressure
e_t = Nominal exchange rate period t
e_{t-1} = Nominal exchange rate period t – 1
r_t = International reserves period t
r_{t-1} = International reserves period t – 1
$M0_{t-1}$ = Monetary base period t-1 (where M0 = reserves + domestic credit)

Economic domestic credit growth

Domestic credit consists of the monetary authority’s holdings of claims on the public-government debt, and on the private sector-usually loans to bank (Dornbusch, et al, 2011:532). Domestic credit is used by the central banks to raise interest rates or government budget deficit. In other words, domestic credit is one of the monetary policy instrument, because monetary authorities can control it. Therefore, domestic credit can be used to measure monetary policy. Domestic credit growth calculation is as follows:

$$Dt = \frac{DC_t - DC_{t-1}}{M0_{t-1}} \qquad (9)$$

Dt = Domestic credit growth

DC_t = Domestic cresit period t
DC_{t-1} = Domestic cresit period t – 1
$M0_{t-1}$ = Monetary base period t – 1 (where M0 = reserves + domestic credit)

Interest rates differential

Interest rates differential is the differential between domestic and foreign interest rates. Domestic interest rates are taken from deposit rate in each country. Meanwhile, foreign interest rate is taken from US LIBOR 3-months deposit rate. Calculation of interest rate differential is domestic deposit rate minus US 3.months deposit rate.

3.2. Model

Error Correction Model (VECM)

Vector Autoregressive model (VAR) is often used to analyze the relationships between domestic and foreign interest rates and domestic credit growth effect on EMP. Nevertheless, VAR can be applied if all variables are stationary in level, but if not then VAR, method cannot be applied to estimate the model. However, if all variables are stationary in first difference and have co-integration on the model then Error Correction Model (VECM) method can be used to estimates. Based on these requirements, this study uses VECM method, because not all variables stationary in level, but stationary in first difference. Another reason is the presence of co-integration on the model. This model uses to determine the effect among the monetary policy represented by domestic credit growth variable (D_t) and differential interest rates variable (Ir), and EMP variable. This model is adopted from Tanner's VAR model (2001), where monetary policy explained by using differential between domestic and foreign interest rates variable (δ) and domestic credit growth variable (φ).

Tanner's VAR model:

$$X_1 = a_0 + a_1 X_{t-1} + a_2 X_{t-2} + \cdots + v_t \quad (11)$$

X = matrix of the variables (δ, EMP, φ)
a_1 = vector of coefficients
v_t = vector of error terms (v_φ, v_E, v_δ)

Because this study using VECM framework, then the model converted to VECM equation, which is as follows:

$$\Delta EMP_t = \beta_0 + \sum_{i=1}^{p} \beta_{i1} \Delta Dt_{t-i} + \sum_{i=1}^{p} \alpha_{i1} \Delta Ir_{t-i} + ECT + \varepsilon_t \quad (12)$$

EMP = Exchange Market Pressure (in percent)
Dt = Domestic credit growth scaled by base money (in percent)
Ir = Interest rates differential, domestic minus US deposit rate (in percent)

Non-structural VAR which not stationary in level, but stationary in the first difference and has error term of the cointegrating equation; it becomes Vector Error Correction Model (Ullah, et al., 2012: 128). This model can be used to analyze the short-run behavior of a variable against the long-run behavior due to the permanent shock. The short-run to long-run relationship is influenced by long-run equilibrium distortion, called Error Correction Term (ECT). If ECT value is negative and significant, means that there is distortion that will be gradually corrected through short-run adjustment. Other VECM analysis will be described on Impulse Response Function (IRF) and Forecast Error Decomposition Variance (FEVD).

Impulse Response Function (IRF)

Because the coefficients in VAR and VECM model are difficult to interpret, so the next step after getting VECM model is analyzing the Impulse Response Function (IRF). Impulse response is useful to perceive the endogenous variable response towards error term shock. Moreover, impulse response analysis can be applied to simulate the shocks of independent variables to other dependent variables in the future, so respond of a variable to other variables can be explained. The IRF can identify the impact of such shocks for several periods in the future (Gujarati and Porter 2009, 789).

Forecast Error Variance Decomposition (FEVD)

The aims of Forecast Error Variance Decomposition (FEVD) or Variance Decomposition (VDCs) used to show the effect for each variable by innovations to all variables in the system (Younus, 2005:10). Moreover, VDCs evidence the portion (percentage contribution) of the shifting effect shock of a variable towards shock of variable itself or the other variables on the VAR equation.

4. Results and Discussion

4.1. Unit Root Test

The first step in this research is to conduct unit root test using Augmented Dickey-Fuller (ADF) with trend and intercept test. Table 1 shows that in all of the countries, EMP and Dt are stationary in level, but Ir is nonstationary in level since value of t-statistic is less than critical value. All of the variables are stationary in first difference at level of significance (α) 1 percent.

Table 1. Unit Root Test

Countries	ADF-STAT I(0)			ADF-STAT (1)		
	Exchange Market Pressure (EMP)	Domestic Credit (Dt)	Interest Differential (Ir)	First Difference of Exchange Market Pressure (ΔEMP)	First Difference of Domestic Credit (ΔDt)	First Difference of Interest Differential (ΔIr)
Indonesia	-9.16*** (-4.03)	-10.67*** (-4.03)	-2.79 (-4.03)	-11.53*** (-4.03)	-12.11*** (-4.03)	-4.31*** (-4.03)
Malaysia	-8.95*** (-4.03)	-9.07*** (-4.03)	-0.52 (-4.03)	-10.14*** (-4.03)	-9.49*** (-4.03)	-10.24*** (-4.03)
Philippines	-8.20*** (-4.03)	-12.23*** (-4.03)	-1.60 (-4.03)	-10.42*** (-4.03)	-9.31*** (-4.03)	-9.66*** (-4.03)
Thailand	-8.99*** (-4.03)	-9.40*** (-4.03)	-1.30 (-4.03)	-10.83*** (-4.03)	-10.01*** (-4.03)	-12.25*** (-4.03)
Singapore	-6.56*** (-4.03)	-10.10*** (-4.03)	-0.60 (-4.03)	-9.61*** (-4.03)	-9.12*** (-4.03)	-10.02*** (-4.03)

Note: (***) denotes the value is significant at the 0.01 level
Source: CEIC (2017), Authors' calculation.

4.2. Choosing optimum lag and stability test

The second step is to choose the optimum lag of the model. This test is doing by find the smallest and stable value that among the lags filed by FPE, LR, AIC, SC, and HQ. Each country has a different optimum lag, Malaysia and Singapore are optimum in lag 1, the Philippines and Thailand are optimum in lag 2, while Indonesia are optimum in lag 3. After choosing optimum lag, the next step are view the stability of the VAR model in each country, because unstable VAR model will result invalid Impulse Response Function (IRF). Model called stable if the modulus from the AR roots of the model less than one, or by looks the position of the modulus value if no root lies outside the unit-circle, it means that VAR model satisfies the stability condition. Table 2 shows that all countries satisfy the stability condition. The result of lag length criteria, AR roots, modulus value, and unit-circle can be seen in the appendix.

Table 2. Optimum lag and Stability test

Countries	Optimum Lag	Stability Test
Indonesia	3	Stable
Malaysia	1	Stable
Philippines	2	Stable
Thailand	2	Stable
Singapore	1	Stable

Source: CEIC (2017), Authors' calculation.

4.3. Cointegration test

The presence of cointegration is indicated if max eigenvalue test statistic greater than critical value 5 percent (max-eigen value stat > critical value 5%), or if trace test statistic greater than critical value 5 percent (trace test stat > critical value 5%). Table 3 represents the summary of cointegration test results of all countries by Akaike Information Criterion (AIC) that there are two cointegrations in the model proved by the presence of two max eigenvalue and trace test statistic greater than the critical value 5 percent in each country.

So it can be concluded that all of the countries have long-run relationships between model-forming variables. It means that there are stability and similarity of movement in the long-run, and tend to adjust to each other in the short-run to achieve long-run equilibrium. Due to all of the countries are stable and have cointegration so it can proceed to Vector Error Correction Model (VECM) estimation.

Table 3. Cointegration Test

Countries	Hypo Thesis	Eigen value	Trace Test		Max Eigen Test	
			Stat	Crit.Val5%	Stat	Crit.Val5%
Indonesia ρ = 3	None	0.27	77.20*	35.19	40.19*	22.30
	at most 1	0.21	37.01*	20.26	31.07*	15.89
	at most 2	0.04	5.93	9.16	5.93	9.16
Malaysia ρ = 1	None	0.33	102.40*	35.01	51.86*	24.25
	at most 1	0.32	50.53*	18.40	50.17*	17.15
	at most 2	0.00	0.36	3.84	0.36	3.84
Philippines ρ = 1	None	0.33	95.86*	35.19	52.54*	22.30
	at most 1	0.27	43.32*	20.26	41.15*	15.89
	at most 2	0.02	2.17	9.16	2.17	9.16
Thailand ρ = 1	None	0.24	61.75*	35.19	35.59*	22.30
	at most 1	0.17	26.15*	20.26	23.50*	15.89
	at most 2	0.02	2.66	9.16	2.66	9.16
Singapore ρ = 1	None	0.48	132.62*	35.19	86.42*	22.30
	at most 1	0.28	46.20*	20.26	42.13*	15.89
	at most 2	0.03	4.07	9.16	4.07	9.16

Note: (*) denotes cointegration and significant at the 0.05 level
(ρ) denotes optimum lag on the model
Source: CEIC (2017), Authors' calculation.

4.4. VECM estimation

VECM analysis is needed to presence of short-run and long run relationship among the variables by view model significance. Long-rung is condition that describing theory. So analysis is done by looking at the matching marks in coefficient with the theory. Meanwhile, short-run coefficients represent the variables in the past or called Error Correction Term (ECT). ECT indicates speed adjustment of the variable to return to its equilibrium after shock. Both long-run and short-run are significant if t-statistic are greater than t-table (df = n-k-1, after adjustment).

Table 4. Long-run coefficient VECM estimation results

Countries	Cointegrating EQ	EMP	Dt	Ir
Indonesia	cointEq1	1.00	0.00	0.12
	t-statistic			[1.12]
	cointEq2	0.00	1.00	-0.00
	t-statistic			[-1.02]
Malaysia	cointEq1	1.00	0.00	0.14
	t-statistic			[0.85]
	cointEq2	0.00	1.00	-0.00
	t-statistic			[-1.04]
Philippines	cointEq1	1.00	0.00	-0.12
	t-statistic			[-1.28]
	cointEq2	0.00	1.00	0.00
	t-statistic			[1.69]
Thailand	cointEq1	1.00	0.00	-0.01
	t-statistic			[0.13]
	cointEq2	0.00	1.00	0.00
	t-statistic			[-0.50]
Singapore	cointEq1	1.00	0.00	0.22
	t-statistic			[3.15]
	cointEq2	0.00	1.00	0.00
	t-statistic			[1.41]

Source: CEIC (2017), Authors' calculation.

Table 4 shows that most of the countries (except Singapore) are insignificant at the long-run relationships. Only in Singapore whose long-run relationship is significant in cointegration 1. It means that only in Singapore, whose variables show the similar movement, and there are adjustments to achieve long-run equilibrium. On the other hand, insignificant cointegration in the other countries means there are no similar movements in the long run. In general there is no long-run relationship among EMP, Dt and Ir variable.

Table 5. Speed of adjustment coefficient VECM estimation results

Countries	Cointegrating EQ	EMP	Dt	Ir
Indonesia	cointEq1	-0.99	-0.00	0.06
	t-statistic	[-3.02]	[-1.43]	[1.31]
	cointEq2	5.91	-1.37	8.37
	t-statistic	[0.15]	[-4.28]	(1.57)
Malaysia	cointEq1	-0.75	-0.00	-0.06
	t-statistic	[-3.28]	[-0.72]	[-1.90]
	cointEq2	15.31	-1.03	-7.01
	t-statistic	[0.54]	[-4.38]	[-1.73]
Philippines	cointEq1	-0.83	-0.00	-0.02
	t-statistic	[-4.86]	[-1.86]	[-0.37]
	cointEq2	-3.12	-1.30	-2.67
	t-statistic	[-0.15]	[-6.39]	[-0.40]
Thailand	cointEq1	-0.71	0.00	0.05
	t-statistic	[-3.07]	[0.15]	[0.99]
	cointEq2	6.22	-0.65	3.18
	t-statistic	[0.30]	[-2.91]	[0.63]
Singapore	cointEq1	-1.40	0.00	0.01
	t-statistic	[-9.89	[0.49]	[0.76]
	cointEq2	-0.42	-0.82	-0.60
	t-statistic	[0.05]	[-6.84]	[-0.64]

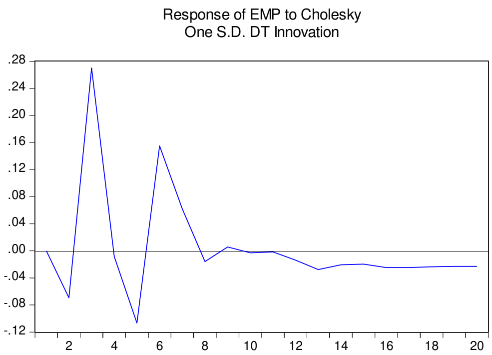
Source: CEIC (2017), Authors' calculation.

Table 5 shows the speed of adjustment coefficient. Results that show a significant and negative value indicates there are adjustment of the variables towards long-run equilibrium. From the table can be seen that in all countries, there are significant and negative value variables in EMP or DT, but there is no country whose Ir variable is significant. In all countries EMP have negative and significant in cointegrataion 1, while Dt in cointegration 2. Although EMP are significant, but its short-run adjustment to long-run equilibrium tend to be slow, because the coefficient values are high. Similar with EMP, significance Dt also have high value.

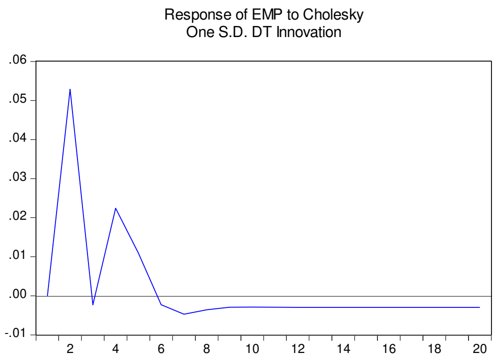
4.5. Impulse Response Function (IRF)

IRF can be used to analysis shock of each variables to endogenous variables whether positive or negative respond of the model. Such responses in the short-run are usually quite influential and tend to fluctuate, while in the long-rung tends to be consistent and continue to shrink. From graph 1 shown that in all the countries responses of EMP to shock to Dt and Ir begin to be seen in the second period. Almost in all countries shock of DT are positively effects EMP. This results in according to Tanner (2001) research, that lagged Dt are positive and significant for at least the current period. Garcia and Malet (2007) also evidence that domestic credit positively effect EMP, probably caused by monetary transmission could not compensate for the mechanism, so credit expansion will increasing EMP. However, it will be negative responses especially in Malaysia and Philippines, which started negative in the sixth periods, refer that monetary authorities reducing EMP by reducing reserves or depreciating exchange rates.

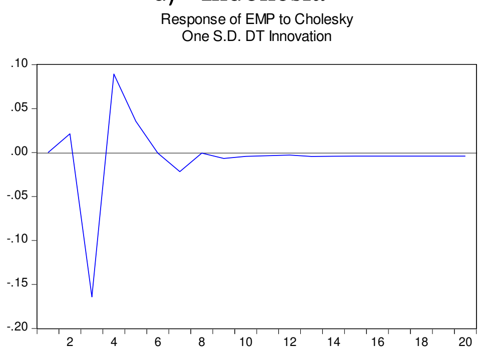
Graph 1 Responses of EMP to shocks to domestic credit (Dt)



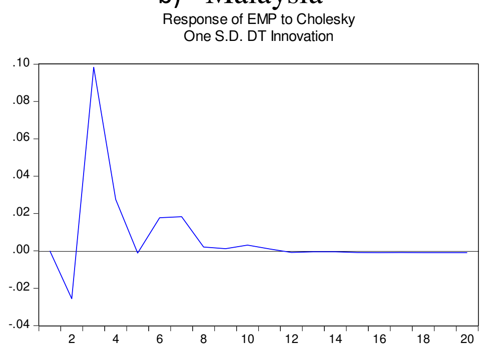
a) Indonesia



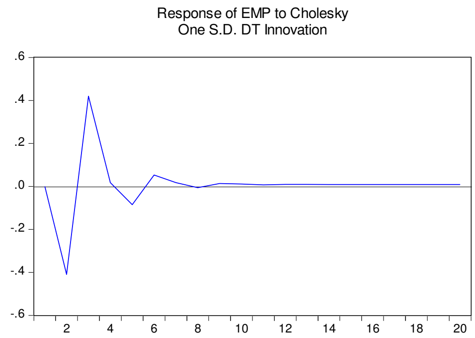
b) Malaysia



c) Philippines



d) Thailand

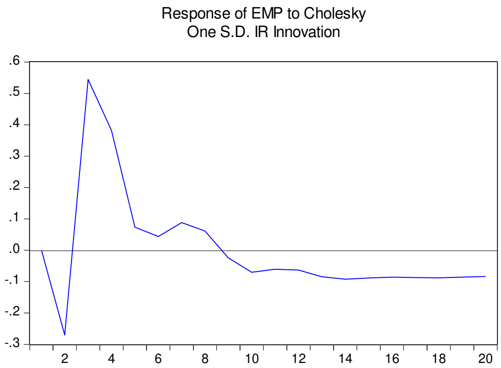


e) Singapore

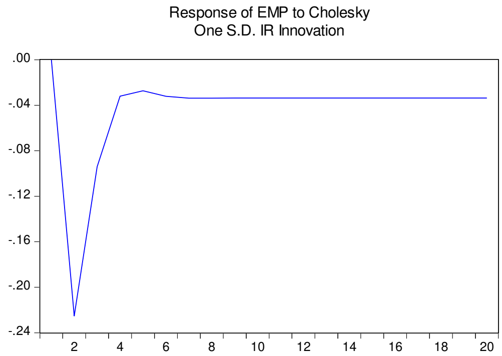
Source: CEIC (2017), Authors' calculation.

For two of the five countries shock of Ir are positively effects EMP in the early periods, as Graph 4.2 shows. This evidence in accordance with Bautista and Bautista (2003) research that raising in interest differential will reduce EMP, these findings according to traditional theory is that higher domestic interest rates could increase capital inflows, and then appreciate the currency, and leads to lower EMP. For Philippines, these response are negative only in second periods, while Indonesia negatively in the second periods then respond negatively again in ninth periods.

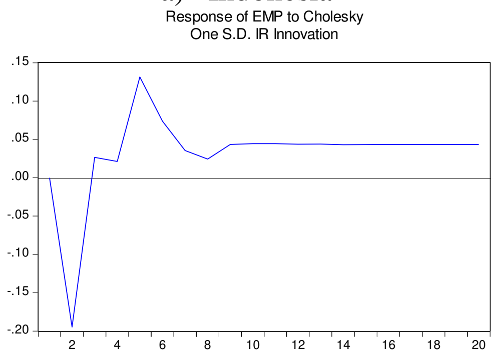
Graph 2 Responses of EMP to shocks to interest rates (Ir)



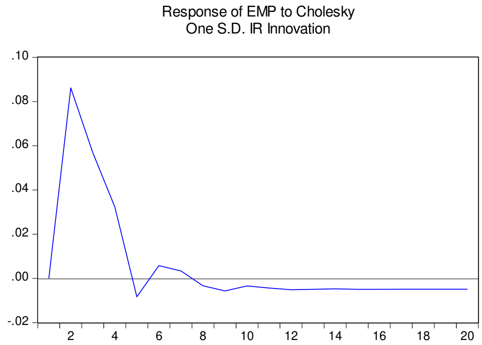
a) Indonesia



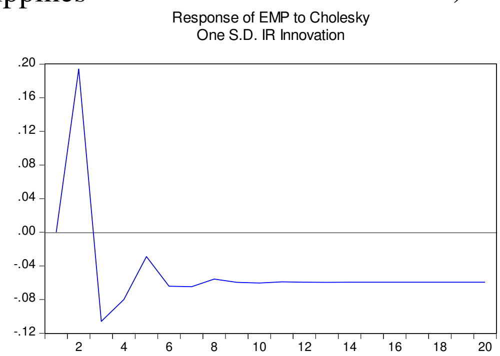
b) Malaysia



c) Philippines



d) Thailand

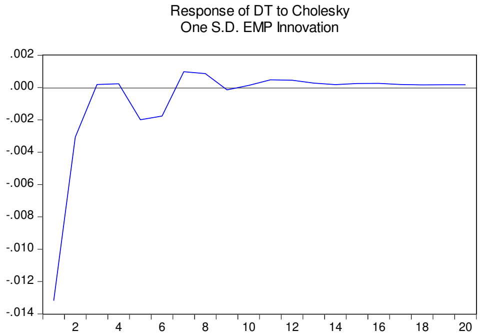


e) Singapore

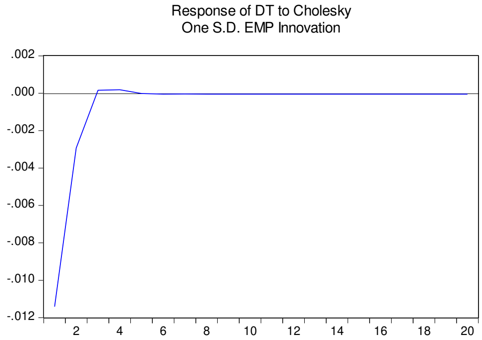
Source: CEIC (2017), Authors' calculation.

Unlike other countries, Malaysia has negative response over the periods. These responses have been discussed in the Garcia and Malet (2007) research that increasing domestic interest rates would not reduce EMP, but increasing foreign interest rates would reduce foreign capital inflows therefore rendering a higher EMP.

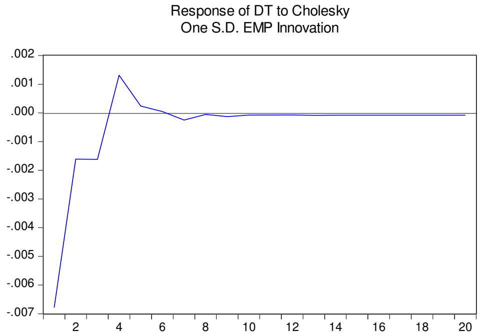
Graph 3 Responses of domestic credit (Dt) to shock to EMP



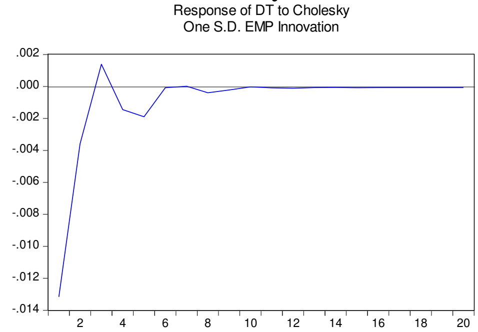
a) Indonesia



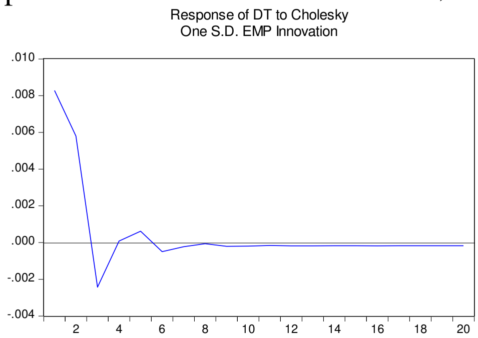
b) Malaysia



c) Philippines



d) Thailand

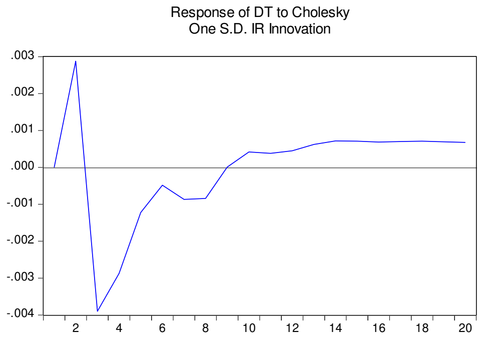


e) Singapore

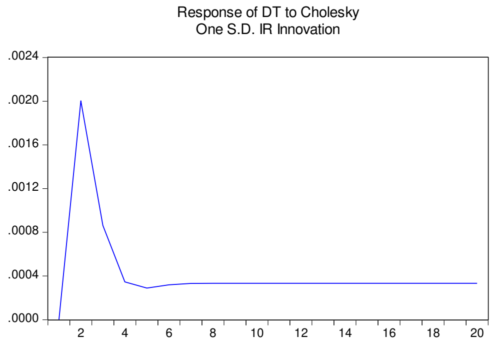
Source: CEIC (2017), Authors' calculation.

Response of Dt can be used as an analysis of policy reaction function, because Dt is as representing of monetary policy variable. Graph 4.3 shown that shock of EMP negatively response to Dt in at least in five periods but further leads to a positive response. It suggests that the authorities respond increasing EMP by contracting money supply rather than providing liquidity. These responses also provide that the authorities not sterilized higher EMP, because depreciation will encourage export. This results are different with Tanner (2001) which is most of the countries that researched proved that EMP shocks affect domestic credit positively, which mean authorities respond to increased EMP by providing additional liquidity to the bank system (Tanner 2001, 323). In other researches such as Khawaja (2007), Hossain and Ahmed (2009) also found the same results. Even though, there are positive IRFs for at least two periods in each country.

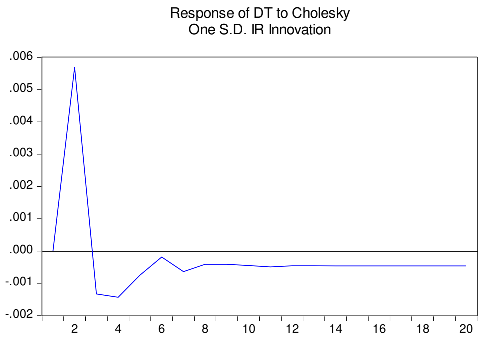
Graph 4, Responses of domestic credit (Dt) to shock to interest differential (Ir)



a) Indonesia

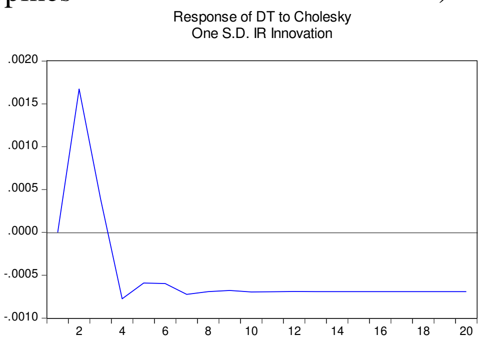


b) Malaysia



c) Philippines

d) Thailand



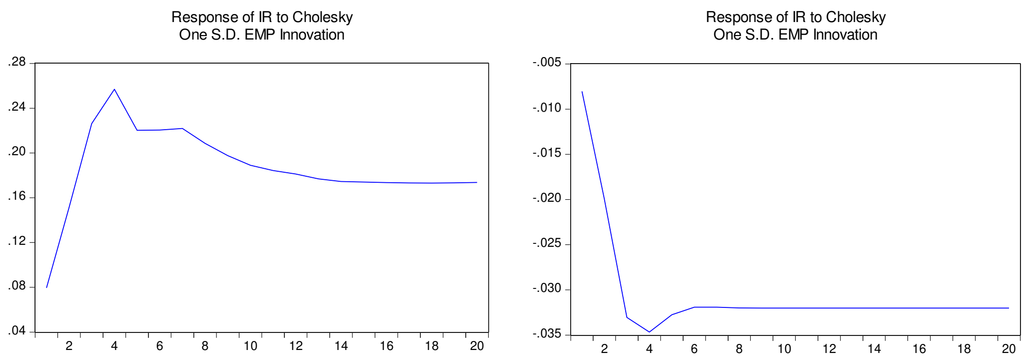
e) Singapore

Source: CEIC (2017), Authors' calculation.

Whilst, responses of Ir begin in the second period with positive response, then become negative after third periods in all countries except Malaysia. Malaysia are positively responses in over the periods, means that authorities respond to higher interest rates with higher growth to domestic credit. Negative effects in most of the country probably caused by parameters that may be unstable over time, and by varying exchange rates whether fixed or floating (Tanner 2001, 324). The statement supports that four of five countries are neither fixed nor free-floating exchange rate regimes.

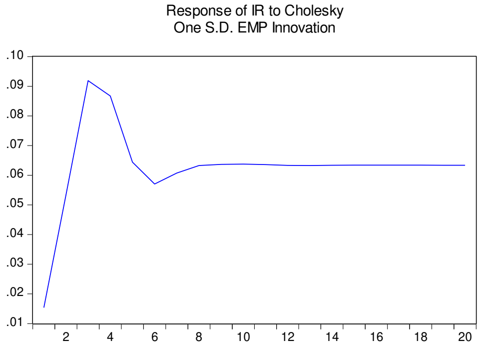
Graph 5 proved that EMP shock affect Ir positively for four of the five countries (except Malaysia). It occurs because increase in EMP will be followed by increase in expected exchange rate depreciation, risk, or both (Tanner 2001, 321). This finding is also similar with finding by Khawaja (2007) that found positive response of interest rate on EMP, because depreciation also contributed to inflation then the authorities had to control inflation by increasing the interest rate. This mechanism is an important piece in the cycle leading to the interest rate increase is the exchange rate depreciation, which is part of EMP (Khawaja 2007, 106). Meanwhile for Malaysia, the responses are negative over the periods.

Graph 5. Response of interest differential (Ir) to shock to EMP

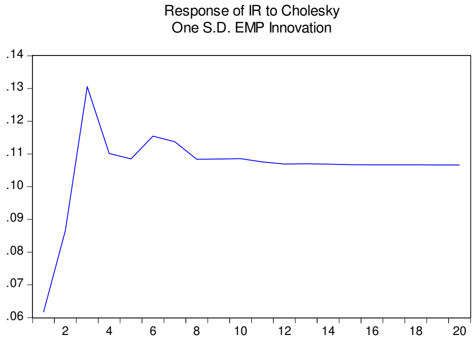


a) Indonesia

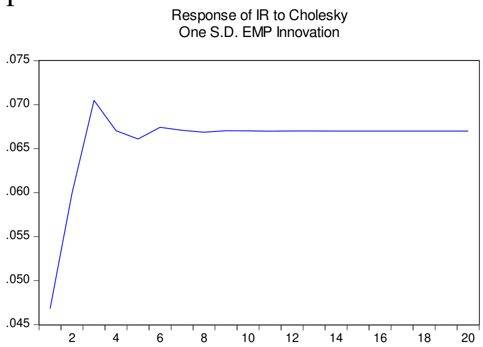
b) Malaysia



c) Philippines



d) Thailand

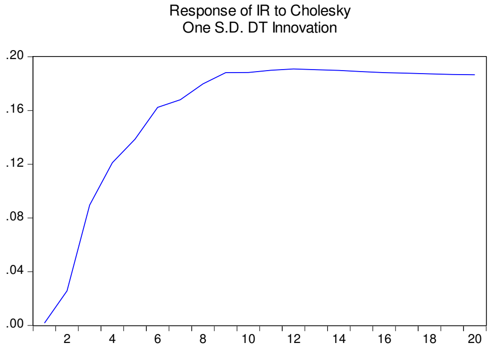


e) Singapore

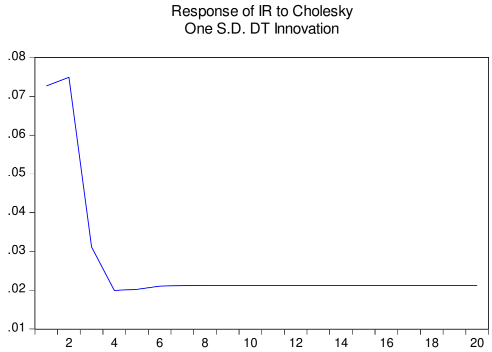
Source: CEIC (2017), Authors' calculation.

Responses Ir to Dt shock are differently in each country. For three of the five countries are positive, while in the cases of the Philippines and Singapore they are negative. Tanner (2001) has been explained if domestic credit affect interest differentials negative so it consistent with liquidity effect, but if affect positively so it consistent with Fisher effect (Tanner 2001, 321). For three of five countries (Indonesia, Malaysia, and Thailand) are positively responses. Tanner (2001) explained that such response is not surprising when the inflation rate is usually high.

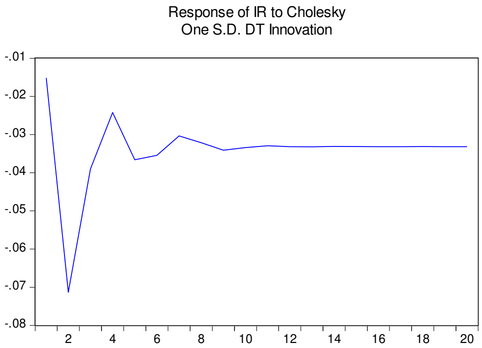
Graph 6. Response of interest differential (Ir) to shock to domestic credit (Dt)



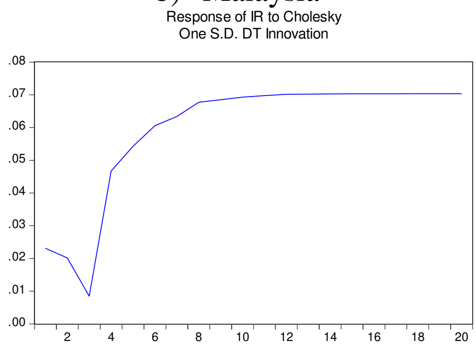
a) Indonesia



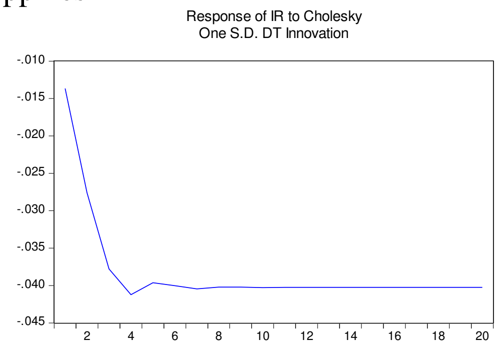
b) Malaysia



c) Philippines



d) Thailand



e) Singapore

Source: CEIC (2017), Authors' calculation.

4.6. Forecast Error Variance Decomposition (FEVD)

Variance Decomposition analysis or FEVD is used to explain how variant of a variable is determined by the role or contribution of other variables or own effect. The form of FEVD is the percentage of shocks over each variable.

Table 6. Variance Decomposition (VDCs) of EMP to Dt and Ir

Countries	Period	S.E.	EMP	Dt	Ir
Indonesia	1	2.152206	100.0000	0.000000	0.000000
	10	2.417388	88.75858	2.009206	9.232218
	20	2.434919	87.69322	2.058219	10.24856

Malaysia	1	1.615669	100.0000	0.000000	0.000000
	10	1.683103	97.51504	0.122925	2.362033
	20	1.686558	97.12290	0.125502	2.751600
Philippines	1	1.217869	100.0000	0.000000	0.000000
	10	1.346360	94.22381	2.050759	3.725430
	20	1.353672	93.23962	2.037115	4.723266
Thailand	1	1.420599	100.0000	0.000000	0.000000
	10	1.519719	98.97715	0.508743	0.514102
	20	1.519812	98.96677	0.509004	0.524225
Singapore	1	2.065650	100.0000	0.000000	0.000000
	10	2.255959	91.56649	6.966464	1.467046
	20	2.264425	90.92715	6.929876	2.142972

Source: CEIC (2017), Authors' calculation.

Table 6 shows that on the first period the largest contribution is dominated by own effects of EMP variable that is equal to 100 percent in each countries, but will begin to decrease in the next period. Proven in the tenth and twentieth periods own effects of EMP variable in Indonesia are decreasing, each of them are 88.76 percent in the tenth period and 87,69 percent in the twentieth period, and for Philippines amount 94.22 and 93.24 percent. For the others country decreased approximately 5 percent. Moreover, Dt contribution is smaller than Ir in all countries. Different from Dt, Ir contribution tend to increase in each period.

Table 7. Variance Decomposition (VDCs) of Dt to EMP and Ir

Countries	Period	S.E.	EMP	Dt	Ir
Indonesia	1	0.017924	54.09935	45.90065	0.000000
	10	0.019723	49.38828	41.58522	9.026498
	20	0.019855	48.93218	41.10594	9.961875
Malaysia	1	0.013299	73.65471	26.34529	0.000000
	10	0.013846	72.47265	24.65590	2.871455
	20	0.013887	72.05619	24.51522	3.428589
Philippines	1	0.012282	30.52997	69.47003	0.000000
	10	0.014165	26.48328	54.70096	18.81576
	20	0.014244	26.22385	54.10879	19.66736
Thailand	1	0.015464	72.44964	27.55036	0.000000
	10	0.016456	71.64666	26.90106	1.452275
	20	0.016475	71.49950	26.84553	1.654966
Singapore	1	0.030053	7.602450	92.39755	0.000000
	10	0.031025	11.31585	88.03992	0.644235
	20	0.031108	11.28638	87.57969	1.133929

Source: CEIC (2017), Authors' calculation.

Domination own effects of Dt variable in all countries are not larger than EMP own effects. Table 7 shows that if Dt own effects in each country are different, indeed Indonesia, Malaysia, and Thailand contribution EMP are greater than its own effects, each of 54.09 percent, 73.65 percent, and 72.45 percent, but in Philippines and Singapore Dt own effects still greater than EMP contribution. Even though, Dt own effect and EMP contribution will decreasing in the next periods. Meanwhile, contribution Ir in the first period in all countries are zero, but increasing in subsequent periods, the highest contribution Ir in Philippines (19,66 percent), and the lowest value in Singapore (1.13 percent).

Table 8. Variance Decomposition (VDCs) of Ir to EMP and Dt

Countries	Period	S.E.	EMP	Dt	Ir
Indonesia	1	0.298388	7.082545	0.003343	92.91411
	10	1.999187	10.28433	5.012365	84.70330
	20	3.080916	7.587137	5.860045	86.55282
Malaysia	1	0.229641	0.122044	10.02906	89.84889
	10	0.772161	1.499294	2.503360	95.99735
	20	1.093040	1.606081	1.626473	96.76745
Philippines	1	0.402311	0.146257	0.141750	99.71199
	10	1.183787	3.014756	1.017104	95.96814
	20	1.654680	3.010524	0.921546	96.06793
Thailand	1	0.349733	3.106186	0.436237	96.45758
	10	1.149391	8.613927	2.111898	89.27417
	20	1.646774	8.405770	2.847527	88.74670
Singapore	1	0.233234	4.027713	0.342377	95.62991
	10	0.857995	5.722145	1.866160	92.41170
	20	1.224342	5.805312	1.996919	92.19777

Source: Author calculations

Variable Ir own effects also has the largest contribution, table 8 shown that its contribution ranged between 89 percent – 99 percent in the first period, but decreasing in the next periods, except for Malaysia whose Ir own effects is getting higher. However, EMP and Dt contribution which are getting higher in general. The highest contribution of EMP and Dt variables is Indonesia, in the amount of 7.59 percent and 5.86 percent in the twentieth periods.

5. Concluding Remarks

Some conclusions are withdrawn. *First*, among domestic credit growth, interest rates differential, and EMP variable only Singapore where there is a long-run relationship. *Second*, Impulse Response Function results shows that domestic credit shock positively effects EMP, while interest rates differential shock negatively effects EMP, both in crisis and non-crisis periods. EMP shock negatively response to domestic credit in non-crisis periods, but positive in crisis periods. Meanwhile, shock of interest rates differential negatively response to domestic credit, both in crisis and non-crisis periods. Both EMP and domestic credit shock positively effects interest rates differential, both in crisis and non-crisis periods. *Third*, the authority's respond increasing EMP by contracting domestic credit growth and tending not sterilize the effects of EMP in non-crisis periods, but in crisis periods prefer to sterilize and providing liquidity to the bank system. Both in non-crisis and in crisis periods increasing interest rate will reduce EMP. Interest rates differential shock is negatively effects domestic credit growth, this response may be happens because neither fixed nor free floating exchange rate regimes are applied.

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