SENIOR RESEARCH

Exchange Rate-Based VS Conventional Taylor Rule: A Comparison under DSGE model for Thailand

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Abstract

Using Beidas-Strom and Poghosyan (2011) DSGE model of a small open economy, this paper analyzes how the choice of monetary policy regimes could affect the efficiency of monetary transmission mechanism under different kinds of disturbances, including inflation targeting and exchange rate targeting. The analysis using Taylor curves shows that Conventional Inflation Targeting, which targets only inflation and output gap, outperforms other policies under internal shocks, domestic production and labor preference shock. Conversely, under external shocks, such as foreign inflation and foreign domestic commodity demand shock, adding exchange rate to the reaction function improves welfare. Moreover, utilizing exchange rate as the main policy tools instead of interest rate is not preferable for the small open economy with an intermediate level of openness as it is inferior to other regimes. Overall, there is no clear-cut evidence which regime performs best from the welfare perspective as it depends on the type of shocks.

JEL: E52, E58, F31, F41

Keywords: Monetary and exchange rate policies, Inflation targeting, DSGE model

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Kitin Pakdeesana

Content

I. Introduction

In the mist of the global financial crisis, numbers of economists and policymakers, both in advanced and emerging market economies, raise their doubts against the effectiveness of the monetary policy rule. As a result, a fundamental re-thinking of the appropriate tool and targets emerge. Traditionally, a large number of central banks flavor in employing inflation targeting (IT) and floating exchange rates as the main regime. However, there is a growing recognition that there may be greater scope for policy to countercyclical, especially in the face of external shocks such as volatile capital flows. Granted that the adequacy of conventional inflation targeting in the global stage was cast a doubt in the wake of the global financial crisis, it is natural for Thailand also to wonder whether inflation targeting remains appropriate.

On one end, Conventional Inflation Targeting (CIT) is supported as the optimal policy, especially by the early adopters of IT in advanced economies like the United Kingdom and New Zealand. According to Masson et al. (1997), a high degree of exchange rate flexibility is a crucial factor to successful inflation targeting, and the commitment to floating currency is a test to a credible IT regime. Moreover, they believe that uncovered interest parity holds, and exchange rate fluctuations are equilibrium price movements; therefore, exchange rate intervention is neither feasible nor desirable. For Thailand, the inflation rate is claimed to be influenced by not only unmanageable external supply shock, but also by the manageable domestic demand and supply shocks. Furthermore, due to the fact that less than 40% of the consumption basket is tradable goods, some argue that the world price then has no significant effect on the inflation rate of Thailand. As Chai-Anant et al. (2008) report in their research, the impact of exchange rate on inflation is short-lived compared to the impact from interest rate according to their impulse response analysis of a small model for Thailand. Hence, they believe that exchange rate can be used to complement the use of policy rate in curbing inflation when the inflation shock is considered temporary. However, when considering the retrospective performance of the Bank of Thailand, interest rate works well as a policy instrument combined with the transparency, accountability, and clear communication.

On the other end, Exchange rate-Based Inflation Targeting (EBT) is pushed forward as a better policy, backed by the outstanding case of Singapore. According to Chong Tee (2013), the choice of the exchange rate as the main instrument for the policy is appropriate for a small size economy with a high degree of openness to trade and capital flows. He is convinced that exchange rate bears a stable and predictable relationship to price stability. Furthermore, changes in the exchange rate are transmitted to the economy both directly in dampening imported inflationary pressures and indirectly tackle domestic sources of inflation. In the case of Thailand, we are also an export-based and small open economy, where the ratio of exports and imports to GDP is over 100%; hence, the domestic inflation is argued to have suffered from external supply shock with a high degree of openness. Saicheua (2012) subscribes to the idea that Thailand is merely a price taker, so the domestic inflation almost entirely depends on the world inflation.

Additionally, the larger gap between domestic interest rate and other countries' interest rate would inevitably increase the potential conflict between maintaining international competitiveness and IT framework, which in turn lower the ability to control interest rate of the central bank. Hence, exchange rate might be a better transmission mechanism while the interest rate is presumed to lose its effectiveness under this economic condition of Thailand.

There also exists the middle ground of the argument where some economists propose the Exchange rate and Inflation Targeting (EIT) policy. The interest rate remains as the policy instruments while the exchange rate targeting is added to the policy rule. As Ghosh et al. (2016) mentioned, with three characteristics, (1.) a large portion of foreign currency in borrowing (2.) relatively shallow financial market (3.) relatively thinner currency market, the result shows that EIT outperformed other policies. On the depreciation side, sharp exchange rate movements can lead to widespread bankruptcies. On the appreciation side, the loss of competitiveness can do lasting damage to the tradable sector. The consequences of over-exposure of the economy to exchange rate fluctuation can be clearly seen from the East Asian Crisis, where exchange rate movement can amplify the effect of the crisis (Korinek, 2011). In the East Asian Crisis, Thailand faced with a severe contraction of the economy because of the balance sheet exposure to unhedged borrowers. As mentioned before, the exports and imports of Thailand combined of more than 100% of GDP, so the large part of the economy is definitely influenced by the exchange rate volatility. Therefore, explicitly managing exchange rate within a reasonable range is likely to be optimal for emerging economic country like Thailand (Stone et al., 2009).

In this paper, we explore the optimal monetary policy under different disturbances in the economy. There exist three candidates in this policy debate, namely Conventional Inflation Targeting (CIT), Exchange rate and Inflation rate Targeting (EIT), and Exchange rate-Based Inflation Targeting (EBT). The objective of this research is to study the role of exchange rate in monetary policy, to test the effectiveness of each policy under alternative shocks by employing welfare analysis using Taylor Curve, impulse response function analysis, and the cyclical properties of macroeconomic variables analysis. The paper employs a small open economy model, a dynamic stochastic general equilibrium (DSGE) model with nominal and real rigidities, of Beidas-Strom and Poghosyan (2011) as a baseline throughout the study due to three major advantages. First, the model is not vulnerable to Lucas critique due to its micro-founded structure. Second, DSGE model gives an explicit welfare based analysis which is beneficial in ranking each policy regime by welfare. Third, we can explicitly analyze the impulse response function of different kinds of disturbances to fully understand the stochastic process.

The paper is organized as follow: Section II is started off with the literature review to acknowledge the previous study. Next in Section III, the small open economy model from Beidas-Strom and Poghosyan (2011) will be sketched, and the alternative monetary policy analyzed in this study will be mentioned. Moving on to Section IV, We perform a number of welfare analyzes using monetary efficiency frontier under several types of disturbances. Lastly, Section V concludes the study by presenting the results in a table and summarizes the founding.

II. Literature Review

Monetary authorities have been using monetary policy to achieve their objective, mainly the price level stability, and help economy in the time of crisis. Therefore it is essential for the policy makers to understand the fundamental mechanism of the policy. The nature of the policy which is suitable to each economic structure is different, so the best policy for advanced economy might not be superior for emerging economy.

According to Calvo and Mendoza (2000), providing monetary authority in emerging country with too much discretion under inflation targeting can lower it performance because of the low credibility and weak institutions. Mishkin (2004) agrees that institutional developments are crucial to the success of inflation targeting in emerging economy. Additionally, he points out that the emerging countries have greater concern about exchange rate volatility than advanced countries, and their intervention on exchange rate market is rational because emerging economies are more prone to currency fluctuation and capital flow. However, the extreme dampening on exchange rate movement runs the risk of transforming exchange rate into nominal anchor and take precedence over inflation target. Adolfson et al. (2007) points out that many emerging countries that officially announce themselves to be free floaters are in fact managed exchange rate regimes. This problem is known as “fear of floating.”

The relationship between inflation targeting and exchange rate can be discussed in three main topics as mentioned in Choudhri and Hakura (2006). These issues are (1) exchange rate pass-through and the role of exchange rate as shock absorber; (2) exchange rate volatility and IT and (3) exchange rate and policy reaction function, which is the main focus of this study. The study of the role of exchange rate in the design of monetary policy rules is essential to recognize whether the exchange rate matters to the extent that it is relevant for domestic inflation, or monetary authorities care about the exchange rate for reasons other than inflation.

Obstfeld and Rogoff (1995) claim that policy that react to exchange rate is not desirable whether short or long term deviations from purchasing power parity because some exchange rate misalignment should not be offset by interest rate. In doing so, the economy will be damaged from adverse effect on output and inflation, worse than solely from exchange rate movement itself. Taylor (2001) also claims that it is not efficient to offset the deviation of exchange rate from purchasing power parity through interest rate adjustments as the adjustment may induce negative impacts on real output and inflation. Furthermore, the central banks’ credibility will suffer if exchange rate is targeted under inflation targeting. In addition, Calvo and Reinhart (2002) point out that it is not necessary to include the exchange rate term in the policy reaction function because it already has indirect impact on inflation and output in the reaction function.

However, according to Amato and Gerlach (2002), with the low credibility monetary authority in emerging countries, exchange rate intuitively becomes the focal point for inflation expectation. Exchange rate misalignment tends to have large inflationary pressure in emerging economies with low inflation history. Eichengreen, Hausmann and Panizza (2003) propose three reasons to include the exchange rate in the monetary policy reaction function: (1) this augmented rule might affect the total effects of policy adjustment on economy; (2) policy rule with exchange rate enhance the effectiveness in the adjustment of interest rate and exchange rate effects on inflationary pressure; (3) it helps to balances out the effects of real shocks that occurred from the exchange rate misalignment. Moreover, Cavoli and Rajan (2006) empirically calibrated the model for small open economy and found that it is optimal to include weight of exchange rate into the reaction function; however, the optimal weight is very low.

A very unique policy that replaces the role of interest rate with exchange rate in controlling inflation is employed in Singapore, with the a small and highly open economic structure. As stated by the Monetary Authority of Singapore (MAS), "The primary objective of monetary policy is to ensure low inflation as a sound basis for sustained economic growth. In Singapore, monetary policy is centered on management of the exchange rate rather than money supply or interest rates. This reflects the fact that, in small and open Singapore economy, the exchange rate is the most effective tool in maintaining price stability." McCallum (2006) support the statement as he mention that for an extremely open economics structure like Singapore, it is optimal to conduct monetary policy using exchange rate as the main instrument.

III. The Model

In this section, I will describe a dynamic stochastic general equilibrium (DSGE) model with nominal rigidities. This micro-founded model follows the small open economy model of Beidas-Strom and Poghosyan (2011).

A. Households

The domestic economy is inhabited by a continuum of infinitely-live households indexed by $j \in [0,1]$. The expected present value of the utility of household j is given by:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \log\left[C_t(j) - h\left(1+g_y\right)C_{t-1}(j)\right] - \frac{\zeta_{L,t}}{1+\sigma_L}\left[l_{t+1}(j)\right]^{1+\sigma_L} + \frac{a}{\mu}\left(\frac{M_t(j)}{P_t}\right)^{\mu} \right\} \qquad (1)$$

The household maximize utility subject to budget constraints:

$$E_t\left[Q_{t,t+1}D_{t+1}(j)\right] + \frac{e_{t+1}B^*_{t+1}(j)}{\left[1+i^*_{t+1}\right]\Theta\left[\frac{e_{t+1}B^*_{t+1}}{P_{x,t+1}X_{t+1}}\right]} + M_{t+1}(j) + P_{c,t}C_t(j) =$$

$$W_t(j)l_t(j) + D_t(j) + e_tB^*_t(j) + M_t(j) + \Pi_t(j) + \mathrm{T}_t(j) \qquad (2)$$

where l_t denotes hours of labor; M_t corresponds to the total nominal balances held at the beginning of period t; $Q_{t,t+1}$ is the price of domestic contingent bonds in period t, normalized by the probability of the occurrence of the state; D_{t+1} is one period domestic contingent nominal bonds; i_t^* is the return on the international bond in the international market; e_t is the nominal exchange rate; W_t is the nominal wage set by household; Π_t are profits of domestic firms retained by households; T_t represents per capita lump-sum net transfers from the government; and C_t is the composite consumption index defined by

$$C_t \equiv \left\{(1-\alpha)^{\frac{1}{\eta}}\left[C_{H,t}(j)\right]^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}}\left[C_{F,t}(j)\right]^{\frac{\eta-1}{\eta}}\right\}^{\frac{\eta-1}{\eta}} \tag{3}$$

The term $\Theta\left[\frac{e_t B_t^*}{P_{x,t}X_t}\right]$ corresponds to the premium domestic households have to pay each time they borrow from abroad, where $B_t^* = \int_0^1 B_j^*(j)\, dj$ is the aggregate net foreign asset position of the economy and $P_{x,t}X_t$ is the nominal value of exports. In the steady state, it is parameterized as:

$$\Theta\left[\frac{eB^*}{P_x X}\right] = \Theta \text{ and } \frac{\Theta'\left(\frac{eB^*}{P_x X}\right)}{\Theta\left(\frac{eB^*}{P_x X}\right)}\frac{eB^*}{P_x X} = \varrho$$

when the country as a whole is a debtor, ϱ is the elasticity of the upward sloping supply of international funds.

Consumption and saving decisions

Aggregating the first-order condition on different contingent claims over all possible states yields the following Euler equation:

$$1 = \beta E_t[(1+i_t)]\frac{P_t}{P_{t+1}}\left(\frac{C_{t+1} - h(1+g_y)C_t}{C_t - h(1+g_y)C_{t-1}}\right) \tag{4}$$

where in equilibrium, it must be true that $1 + i_t = 1/E_t\left[\left(Q_{t,t+1}\right)\right]$, with i_t being the domestic risk-free interest rate.

The first order condition with respect to foreign bond holdings is:

$$1 = \beta E_t\left\{[(1+i_t)]\Theta\left(\frac{e_{t+1}}{e_t}\frac{P_t}{P_{t+1}}\right)\left[\frac{C_{t+1} - h(1+g_y)C_t}{C_t - h(1+g_y)C_{t-1}}\right]\right\} \tag{5}$$

Combining the two expressions above, we can obtain an expression for the uncovered interest parity condition.

Labor supply decisions and wage setting

A particular household j that is able to re-optimize its wages at time t solves the following problem:

$$\max_{W_t(j)} \; E_t \left\langle \sum_{i=0}^{\infty} \phi_L^i \Lambda_{t,t+i} \left\{ \frac{W_t(j)\Gamma_{W,t}^i}{P_{t+i}} - \zeta_t l_{t+i}(j)^{\sigma_L} \left[C_{t+i} - h\left(1+g_y\right) C_{t+i-1} \right] l_{t+i}(j) \right\} \right\rangle \tag{6}$$

subject to the labor demand. The variable $\Lambda_{t,t+i}$ is the relevant discount factor between periods t and $+i$, then it is given by:

$$\Lambda_{t,t+i} = \beta^i \frac{C_t - b\left(1+g_y\right)C_{t-1}}{C_{t+i} - b\left(1+g_y\right)C_{t+i-1}}$$

It is assumed that there is a *passive updating rule of thumb* for all households that cannot optimize their wages. In particular, if a household cannot optimize during i periods between t and $+i$, then its wage at time $t+i$ is given by:

$$W_{t+i}(j) = \Gamma_{W,t}^i W_t(j)$$

where $\Gamma_{W,t}^i$ describes a passive adjustment rule for wages, which is defined as:

$$\Gamma_{W,t}^i = \Pi_{j=1}^i \left(1+\pi_{t+j-1}\right)^{\xi_L} \left(1+\bar{\pi}_{t+j}\right)^{1-\xi_L} \left(1+g_y\right)$$

This “passive” adjustment rule implies that workers who do not optimally reset their wages update them by considering a geometric weighted average of past CPI inflation and the implicit inflation target set by the authority, $\bar{\pi}_t$. The parameter ξ_L captures the degree of wage indexation in the domestic economy, while the inclusion of $\left(1+g_y\right)$ prevents large real wage dispersion along the steady-state growth path.

Once a household has decided on a wage (whether through optimal or passive adjustment), it must supply any quantity of labor service that is demanded at that wage.

B. Domestic Production

Domestic firms use a CES technology to assemble home goods using domestic intermediate varieties. Intermediate varieties are produced by firms that have monopoly power. These firms maximize profits by choosing the prices of their differentiated good subject to the corresponding demands, and the available technology. Let $Y_{H,t}(Z_H)$ be the total quantity produced of a particular variety Z_H. The available technology is given by:

$$Y_{H,t}(Z_H) = A_{H,t} L_{H,t}(Z_H) \tag{7}$$

where $A_{H,t}$ represents a stationary productivity shock to the *home* goods sector that is common to all firms; $L_{H,t}$ is labor used.

Demand for input and marginal cost

The assumption is that firms adjust their prices infrequently. The adjustment occurs when they receive a signal. In every period, the probability of receiving such a signal (and thus adjusting prices) is 1 – ϕ for all firms, and is independent of their history. Thus, if a firm receives a signal in period *t*, then it will optimally adjust the price of its variety, $P_{H,t}(Z_H)$, so as to maximize the following expression:

$$\max_{P_{H,t}(Z_H)} E_t \langle \sum_{i=0}^{\infty} \phi^i \Lambda_{t,t+i} \left\{ \frac{\Gamma_{H,t}^i P_{H,t}(Z_H) - MC_{H,t+i}}{P_{t+i}} Y_{H,t}(Z_H) \right\} \rangle \tag{8}$$

subject to the restrictions imposed by the technology and considering the demand the firm faces for its variety Z_H given by:

$$C_{H,t}(Z_H) = \left(\frac{P_{H,t}(Z_H)}{P_{H,t}}\right)^{-\epsilon} \left(C_{H,t} + C_{H,t}^*\right) \tag{9}$$

In contrast, if the firm does not receive a signal, then it follows a simple *passive updating rule of thumb* defined by the function $\Gamma_{H,t}^i$. The passive updating rule—(i.e., not adjusting optimally)—is given by:

$$\Gamma_{W,t}^i = \Pi_{j=1}^i \left(1 + \pi_{t+j-1}\right)^{\xi_H} \left(1 + \bar{\pi}_{t+j}\right)^{1-\xi_H}$$

where $\pi_t = \left(P_{H,t}/P_{H,t-1}\right)$

Given the price charged by a firm producing variety Z_H, its profits are given by:

$$\Pi_t(Z_H) = P_{H,t}(Z_H) Y_{H,t}(Z_H) - W_t L_{H,t}(Z_H)$$

C. Foreign Sector

For simplicity it is assumed that the economy exports two types of goods: *home* goods and an exportable commodity. Foreign demand for *home* goods is given by the following expression:

$$C_{H,t}^* = \left(\frac{P_{H,t}^*}{P_{F,t}^*}\right)^{-\eta^*} C_t^* \tag{10}$$

Assuming further that the domestic firms cannot price discriminate across markets. Therefore, the law of one price holds for *home* goods sold abroad:

$$P_{H,t}^* = \frac{P_{H,t}}{e_t}$$

The real exchange rate is defined as the relative price of the foreign consumption basket, $P^*_{F,t}$, to the price of the domestic consumption basket:

$$RER_t \equiv \frac{e_t P^*_{F,t}}{P_t}$$

Commodity production is assumed to be completely elastic with respect to its international price, $p_{s,t} = e_t p^*_{s,t}$, and fully exported (i.e. not consumed domestically) and is determined by an exogenous endowment, Y_s, given by:

$$\frac{Y_{s,t}}{(1+g_y)^t Y_s} = \left[\left(\frac{Y_{s,t-1}}{(1+g_y)^{t-1} Y_s}\right)^{\rho_s}\right]^{\varepsilon_{s,t}} \tag{11}$$

D. Monetary Policy

There are three possible inflation targeting regimes being explored: Conventional inflation targeting, Exchange rate and inflation targeting, and Exchange rate-based inflation targeting.

The Conventional approach, practiced mostly in robust advanced economy, has interest rate responds systematically to inflation and output gap. Exchange rate does not appear explicitly in the reaction function. In Exchange rate and inflation targeting regime, practiced mostly in vulnerable emerging economy, interest rate responds to inflation and output gap. Exchange rate is now another argument in the reaction function. In Exchange rate-based regime, exchange rate is an operating instrument in place of interest rate, reacting to inflation and output gap.

Conventional Inflation Targeting (CIT, for short):

$$\frac{1+i_t}{1+i} = \left[\left\{\left(\frac{1+i_{t-1}}{1+i}\right)^{\rho}\left(\frac{Y_t}{Y_{t-1}}\frac{1}{1+g_y}\right)^{(1-\rho)\varpi_y}\left(\frac{1+\pi_t}{1+\bar{\pi}_t}\right)^{(1-\rho)\varpi_\pi}\right\}^{v_t^m}\right] \tag{12}$$

Exchange Rate and Inflation Targeting (EIT, for short):

$$\frac{1+i_t}{1+i} = \left[\left\{\left(\frac{1+i_{t-1}}{1+i}\right)^{\rho}\left(\frac{Y_t}{Y_{t-1}}\frac{1}{1+g_y}\right)^{(1-\rho)\varpi_y}\left(\frac{1+\pi_t}{1+\bar{\pi}_t}\right)^{(1-\rho)\varpi_\pi}\left(\frac{RER_t}{RER_{t-1}}\right)^{(1-\rho)\varpi_{\Delta e}}\right\}^{v_t^m}\right] \tag{13}$$

Exchange Rate-Based Inflation Targeting (EBT, for short):

$$\frac{RER_t}{RER_{t-1}} = \left[\left\{\left(\frac{RER_{t-1}}{RER_{t-2}}\right)^{\rho}\left(\frac{Y_t}{Y_{t-1}}\frac{1}{1+g_y}\right)^{(1-\rho)\varpi_y}\left(\frac{1+\pi_t}{1+\bar{\pi}_t}\right)^{(1-\rho)\varpi_\pi}\right\}^{v_t^m}\right] \tag{14}$$

E. Equilibrium

For simplicity we assume that there is no public spending. Therefore, the government budget constraint is simply given by:

$$\int \frac{M_{t+1}(j)-M_t(j)}{P_t}dj - \int T_t(j)dj - D_t = 0 \tag{15}$$

Aggregate equilibrium conditions in each market are as follows:

The labor market: $$l_t^s = \int_0^1 l_t(j)dj = L_{H,t} \tag{16}$$

The *home* goods market: $$C_{H,t} + C_{H,t}^* = Y_{H,t} \tag{17}$$

Letting $P_{Y,t}$ denote the implicit output deflator, then total GDP at current prices satisfies:

$$\frac{P_{Y,t}}{P_t}Y_t = C_t + \frac{P_{X,t}}{P_t}X_t - \frac{P_{IM,t}}{P_t}IM_t \tag{18}$$

Net foreign position is:

$$\frac{e_t B_t^*}{[1+i_t^*]\Theta\left[\frac{e_t B_t^*}{P_{X,t}X_t}\right]P_t} = \frac{e_t B_{t-1}^*}{P_t} + \frac{P_{X,t}}{P_t}X_t - \frac{P_{IM,t}}{P_t}IM_t \tag{19}$$

F. Stochastic Processes

The economy is subject to eight orthogonal AR(1) stochastic shocks representing log-linear deviation from the steady-state, denoted by lowercase variables with a symbol ˆ (see Appendix): a domestic productivity shock ($\hat{a}_t$); a labor supply preference shock ($\hat{\zeta}_{L,t}$); a foreign demand shock ($\hat{c}_t^*$); a foreign inflation shock ($\hat{\pi}_t^*$); a shock to foreign demand of the domestic commodity ($\hat{s}_t$); an international commodity price shock ($\hat{p}_{s,t}^*$); and a monetary policy shock ($\hat{v}_t^m$). See Tables A1 for baseline parameterization of shocks.

IV. The Analysis

A. The Analysis under Different Kinds of Disturbances

In this section, I start with the analysis of three alternative polices, namely Conventional inflation targeting (CIT), Exchange rate and inflation targeting (EIT), and Exchange rate-based inflation targeting (EBT) under eight kinds of shocks as mentioned in the previous section. Frist of all, the cyclical properties tables are introduced to compare the variability of some important variables under different regimes. The properties are extracted from the simulation of the optimal policy given the central bank response to the output and inflation variability equally. After that, I estimate the impulse response functions to show the dynamic overtime of the variables and how each policy steer the economy back to its steady state. Finally, the welfare analysis using Taylor curve, which is the focus of this study, follows. In conducting efficient monetary policy, the objective of the policy makers is to minimizing the welfare loss while facing a tradeoff between inflation variability and output gap variability. In constructing the Taylor Curve, I follow the approach of Taylor (1979) employing nonlinear optimization in minimizing the quadratic loss function, $[L = \lambda Var(y_t) + (1-\lambda)Var(\pi_t)]$, subject to constraints imposed by the structure of the small open economy. For each welfare loss, with a particular weight (λ) given to the variance of inflation and variance of output, the optimal path for reaction function and a point on the Taylor Curve are obtained. With λ = 0, policy makers give highest attention in minimizing inflation variability which produces the lowest point of the Taylor curve. With more attention in minimizing output gap variability and less attention in controlling inflation variability, λ increases from 0 to 1, inflation variability increases while output gap variability decreases; hence, result in the downward sloping Taylor curve. The further the curve from the origin point implies a decrease in the efficiency of the policy.

Domestic Productivity Shock

	CIT	EIT	EBT
Output	0.56	0.59	0.56
Domestic Inflation	2.29	2.23	2.61
CPI Inflation	2.57	2.50	2.59
Nominal Interest Rate	1.79	1.55	2.58
Exchange Rate (1st diff)	2.22	1.89	2.60
Real Exchange Rate	0.47	0.34	0.35

Table 1: cyclical properties from domestic productivity shock

From table 1, Adding exchange rate as another argument into the reaction function dampens exchange rate movement and domestic inflation variability. Utilizing exchange rate as an operating instrument gives central bank direct control in smoothing exchange rate movement, which make output variability decreased while domestic inflation increase significantly. In response to a domestic productivity shock which generates a persistent hump shaped increase in inflation, there arises a persistent hump shaped contraction of output (Figure 1). Facing a monetary policy tradeoff, the central bank generally raises the nominal policy interest rate to control inflation, and the currency appreciates in real effective terms. The current account balance generally improves reflecting the improvement in the terms of trade.

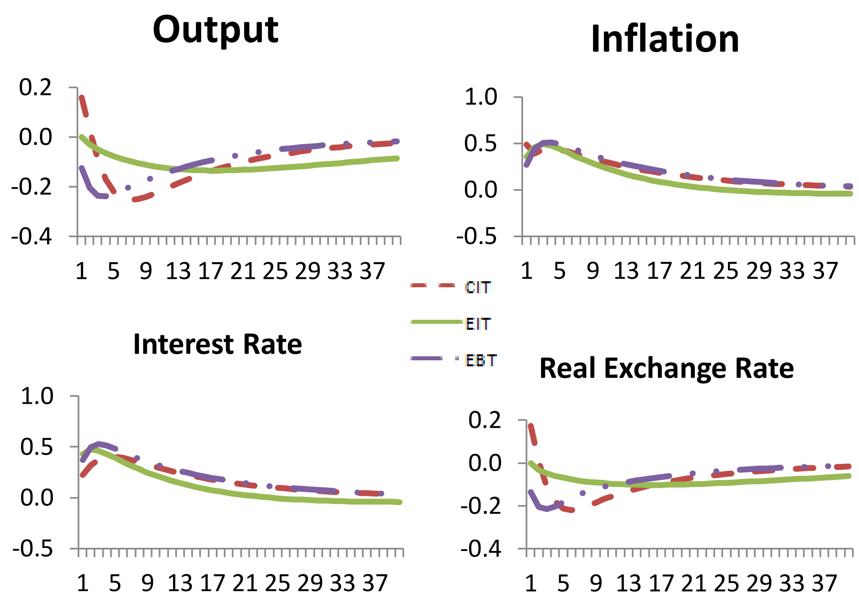

Figure 1: IRFs of domestic productivity shock

Below, figure 2 does not confirm the superiority of EIT at all possible given weights to output and inflation in the loss function. It can be seen that the Taylor curve of all three policies overlap each other when the weight is fully given to output volatility, in other word the central bank do not care about inflation movement. Then as the weight is given to inflation variability more, the curve starts to spread a little bit but not as much. Hence, it can be inferred from the result that EIT has a small advantage in controlling inflation under the domestic productivity shock.

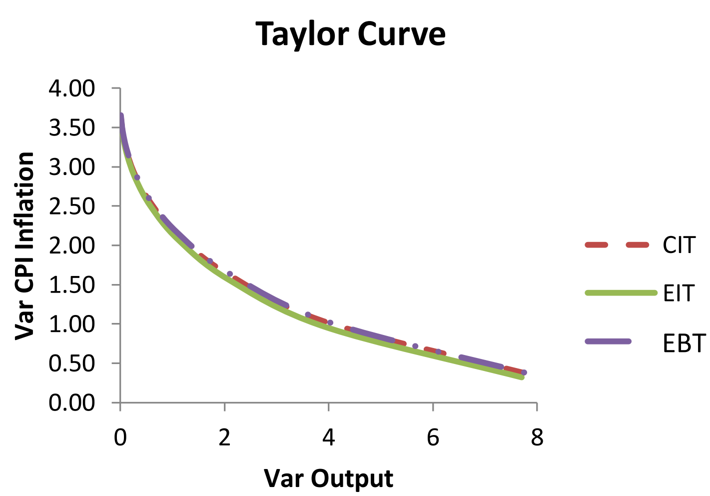

Figure 2: Taylor curve with alternative policy regimes
under domestic productivity shock

Labor Supply Preference Shock

	CIT	EIT	EBT
Output	0.07	0.07	0.06
Domestic Inflation	0.19	0.20	0.23
CPI Inflation	0.19	0.19	0.23
Nominal Interest Rate	0.17	0.17	0.23
Exchange Rate (1st diff)	0.19	0.19	0.23
Real Exchange Rate	0.05	0.04	0.04

Table 2: cyclical properties from labor supply preference shock

Table 2 shows that the domestic inflation variability increases when central bank added exchange rate to its reaction function as the output variability stay constant. Assuming direct control over exchange rate as the main instrument dampen output movement but raise domestic inflation further. In response to a labor supply shock, wages are lowered in the labor market from excess labor. The expansion of output follows from higher employment (Figure 3). This expansion, however, generates a decrease in inflation in a systemic economy. The central back then have to response with a lower interest rate to pick the inflation up, which typically leads to depreciation in real exchange rate. The current account improves because the firms use this to their advantage in the exporting market.

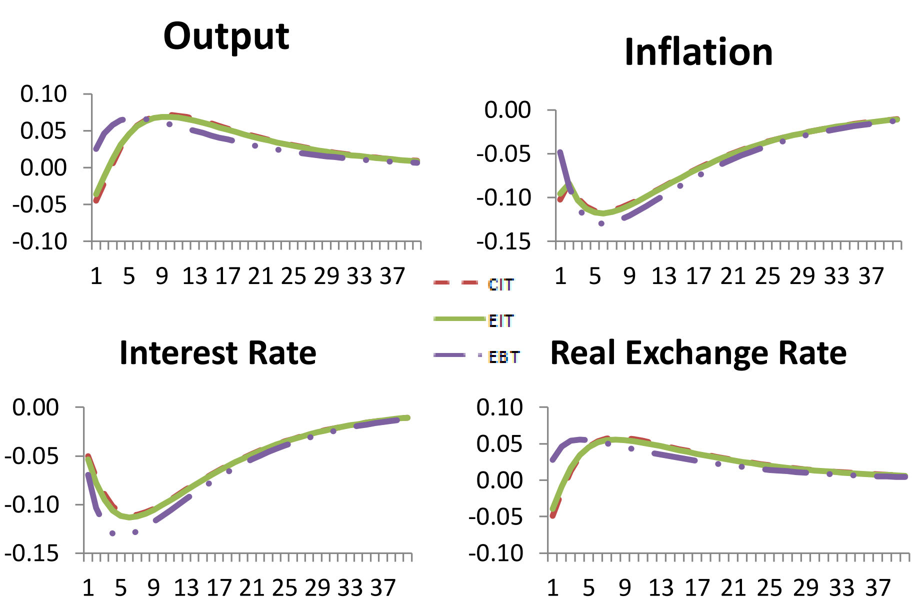

Figure 3: IRFs of labor supply preference shock

Consider figure 4, the result from table 2 was confirmed by the Taylor curves. CIT is clearly better than other two policies regardless of the weight given to the volatilities of inflation and output. This particular shock is exclusively internal, so intervention with the exchange rate should not be necessary, which support here from the lower overall welfare. The worst policy under this shock is EBT which produces the most volatility to exchange rate, so it is strengthen the point of avoiding intervention in exchange rate under this shock furthermore.

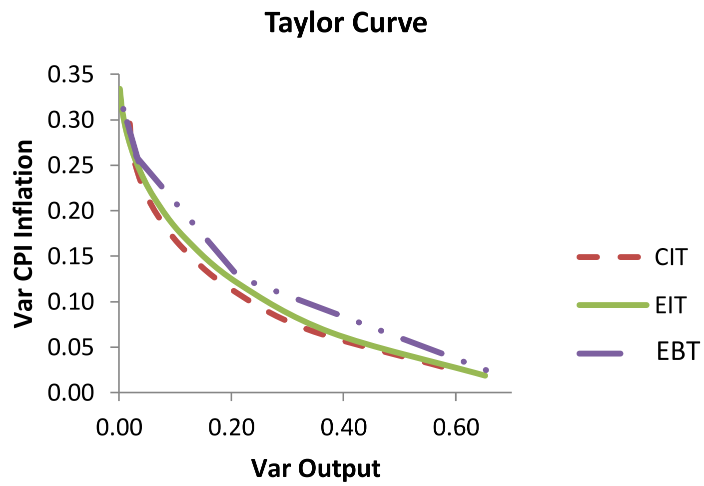

Figure 4: Taylor curve with alternative regimes under labor supply preference shock

Foreign Demand Shock

	CIT	EIT	EBT
Output	0.319	0.261	0.306
Domestic Inflation	0.432	0.419	0.437
CPI Inflation	0.886	0.923	0.899
Nominal Interest Rate	0.240	0.098	0.247
Exchange Rate (1st diff)	3.100	3.432	3.148
Real Exchange Rate	6.637	6.893	6.690

Table 3: cyclical properties from foreign demand shock

According to table 3, targeting both inflation and exchange rate at the same time leads to significantly lower output movement with small decrease in domestic inflation variablity. The interest rate does not reponses as much as the case without exchnage rate in the reaction function while the exchange rate vary more. In the case of using exchnage rate as the policy tool, both infaltion and output variablity increases. A positive foreign demand shock raises domestic production of home goods and induces an even larger positive income effect in total output on impact. The large income effect results in higher total consumption, with this being tilted more towards foreign consumption goods, rather than domestic goods. As a result, imports rise faster than exports and the current account deteriorates. With productivity held constant, this expansion leads firms to demand more labor and given relatively low indexation of wages, real wages rise.

With higher marginal costs of production, domestic prices, core and headline inflation, as well as real home goods prices rise inducing the central bank to tighten the monetary stance by raising the nominal interest rate inducing real exchange rate appreciation (Figure 5).

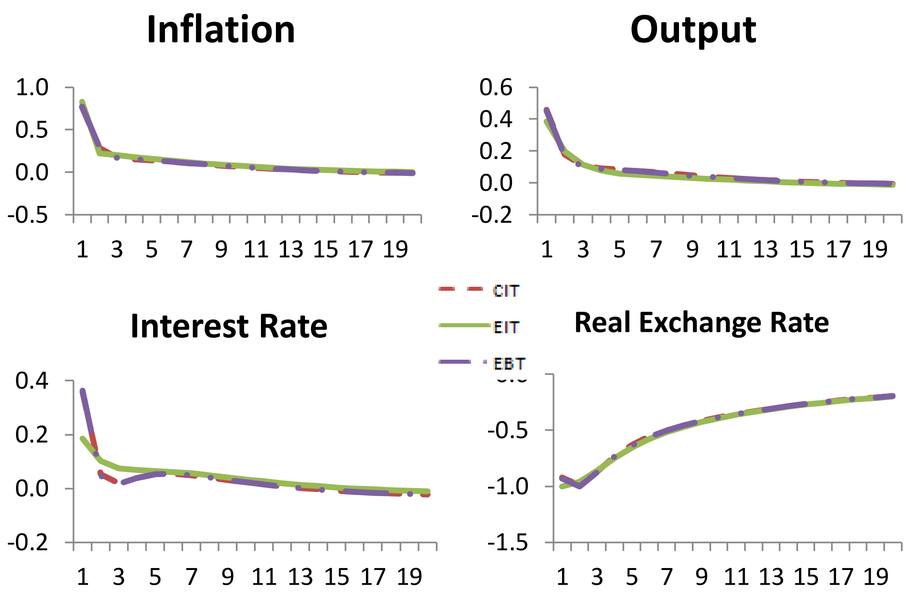

Figure 5: IRFs of foreign demand shock

From figure 6, Taylor curves of both CIT and EIT are almost identical to each other, and both of them appear to be more efficient under foreign demand shock. For EBT curve, it jumps when the weight is given more toward inflation volatility, which cause from the higher volatility that potentially stimulate the shock of foreign demand even more.

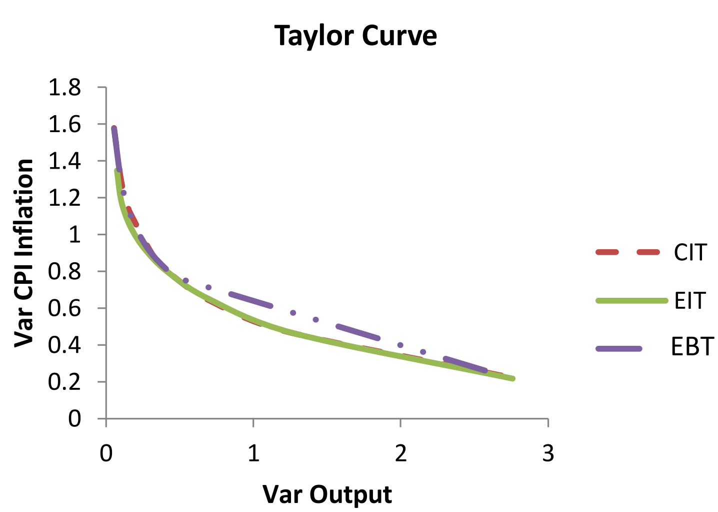

Figure 6: Taylor curve with alternative regimes
under foreign demand shock

Foreign Inflation Shock

	CIT	EIT	EBT
Output	0.053	0.048	0.059
Domestic Inflation	0.011	0.009	0.018
CPI Inflation	0.020	0.018	0.024
Nominal Interest Rate	0.062	0.089	0.118
Exchange Rate (1st diff)	0.242	0.250	0.205
Real Exchange Rate	1.307	1.362	1.301

Table 4: cyclical properties from foreign inflation shock

From table 4, both output and inflation variability decreases as then central bank move to two targets regime (EIT). However, the more sensitive response on interest rate leads to higher exchange rate movement also. When central bank utilize exchange rate as a policy instrument, the economy is worse off because it boosts output and inflation volatilities. The inflationary pressure from the rest of the world increases domestic inflation through imported inflation (Figure 7). The central bank counters the inflation with the contraction policy, raising nominal interest rate. The exchange rate appreciates as a result, which help improve the current account position. Appreciation of exchange rate and lower foreign good consumption lead to expansion in home good consumption which in turn expand the output.

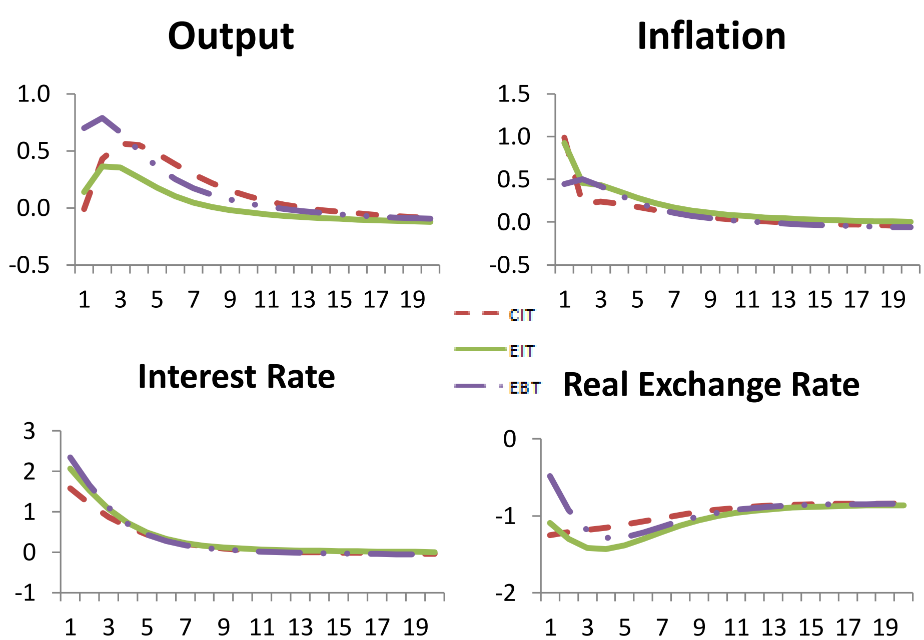

Figure 7: IRFs of foreign inflation shock

According to figure 8, the best choice is EIT. It is outperform its entire peers in all cases under the foreign inflation shock. CIT has the worse tradeoff as expected because this shock is very external and relate heavily to exchange rate. All supporters for EIT always support their argument for the policy with this example. As the external inflation shock will pass through exchange rate, utilizing exchange rate a counter measure make the most sense for the small open economy (Ghosh et al., 2016).

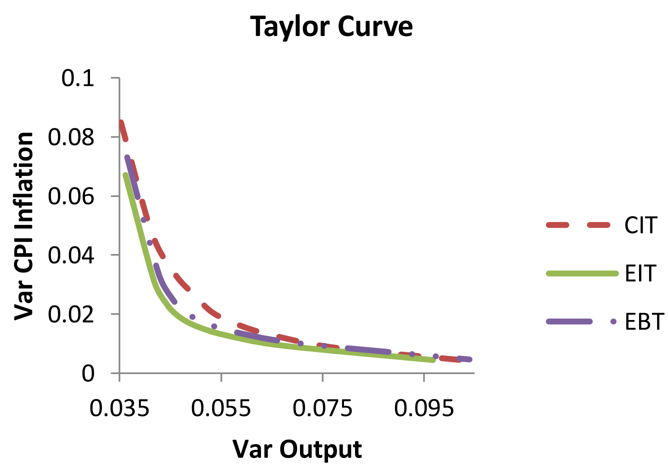

Figure 8: Taylor curve with alternative regimes under foreign inflation shock

Foreign Interest Rate Shock

	CIT	EIT	EBT
Output	0.043	0.038	0.045
Domestic Inflation	0.032	0.033	0.040
CPI Inflation	0.053	0.054	0.058
Nominal Interest Rate	0.075	0.088	0.117
Exchange Rate (1st diff)	0.120	0.120	0.107
Real Exchange Rate	1.422	1.491	1.421

Table 5: cyclical properties from foreign interest rate shock

According to table 5, the adoption of exchange rate in policy rule decrease output volatility but slightly increases domestic inflation volatility. As for the adoption of exchange rate as the main instrument, the economy is worse off than other two cases. Both output and inflation variability increases as a result. An increase in foreign interest rates sharply contracts consumption and output on impact (Figure 9). The contraction in aggregate demand in turn induces firms to hire less and employment falls, exerting downward pressure on real wages and core and headline inflation. With lower aggregate demand, imported goods fall. Lower marginal costs and sluggish domestic demand induce the central bank to gradually lower its policy rate. The firms benefit from lower interest rates and marginal costs, shifting their production to exportation. This results in real exchange rate depreciation.

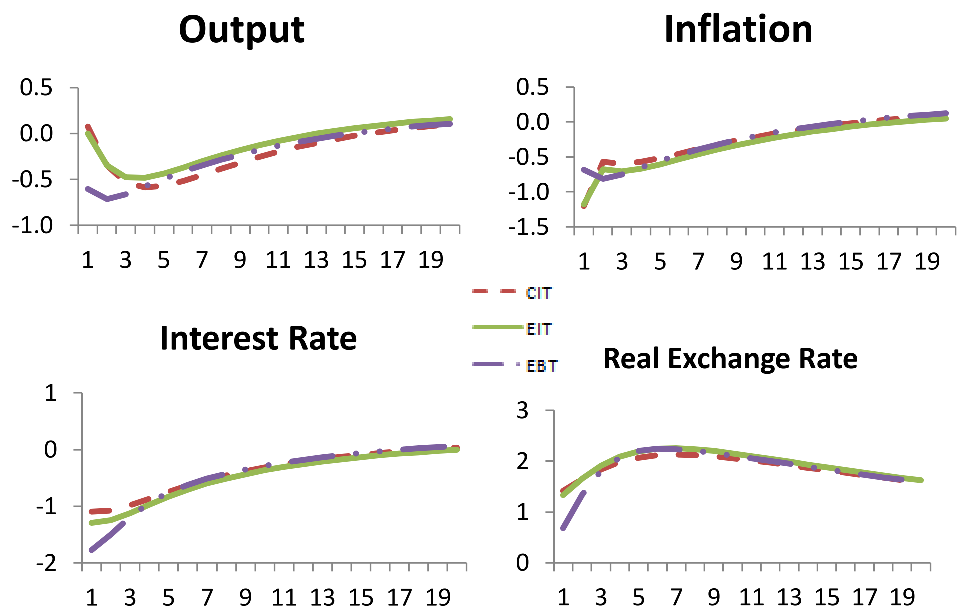

Figure 9: IRFs of foreign interest rate shock

Consider figure 10, CIT is the best choice when the weight is given more toward inflation variability, and EIT produces the least loss to the economy when central bank shift the concern toward output volatility. Hence, both of them can attain the optimal point depends on the weight given under foreign interest rate shock. The main issue of this shock is the capital flow which can be managed using both interest rate and exchange rate.

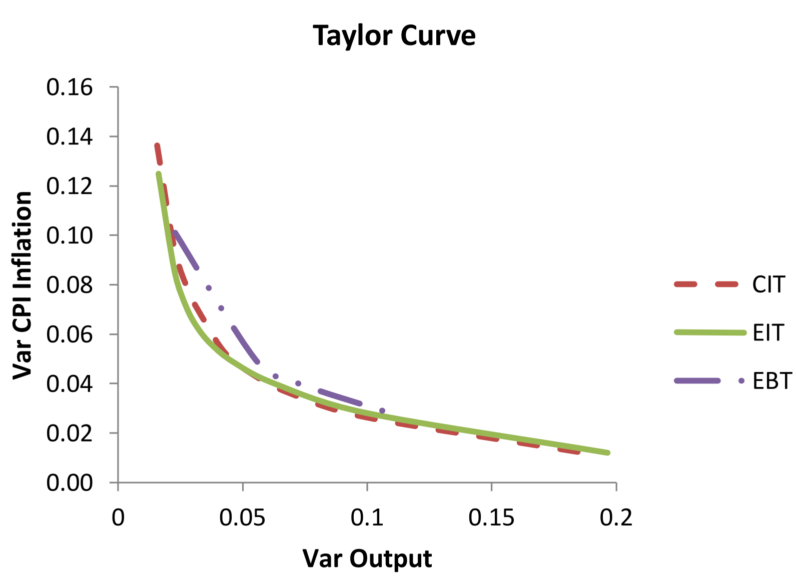

Figure 10: Taylor curve with alternative regimes under foreign interest rate shock

Foreign Demand of the Domestic Commodity Shock

	CIT	EIT	EBT
Output	0.29	0.25	0.24
Domestic Inflation	0.61	0.60	0.62
CPI Inflation	1.00	1.03	1.04
Nominal Interest Rate	0.28	0.18	0.28
Exchange Rate (1st diff)	3.03	3.26	3.19
Real Exchange Rate	5.68	5.79	5.87

Table 6: cyclical properties from foreign demand of domestic commodity shock

Table 6 shows that the central bank can lower the output and inflation volatility by adding exchange rate to the reaction function. This also lowers the reaction of interest rate from allocated optimal weight. For utilizing exchange rate as the main policy tool, the output movement is induced while the inflation volatility rises by the small amount. A positive shock to the exportable commodity increases production of the commodity good and directly implies an increase in output and consumption (Figure 11). The expansion is inflationary, with higher real domestic prices and wages, prompting the central bank to tighten monetary policy. As with any expansion biased towards tradable goods, a boom in this sector would induce real appreciation of the exchange rate. While exports of the commodity good rise, net exports growth does not raise since the appreciation harms non-commodity exports.

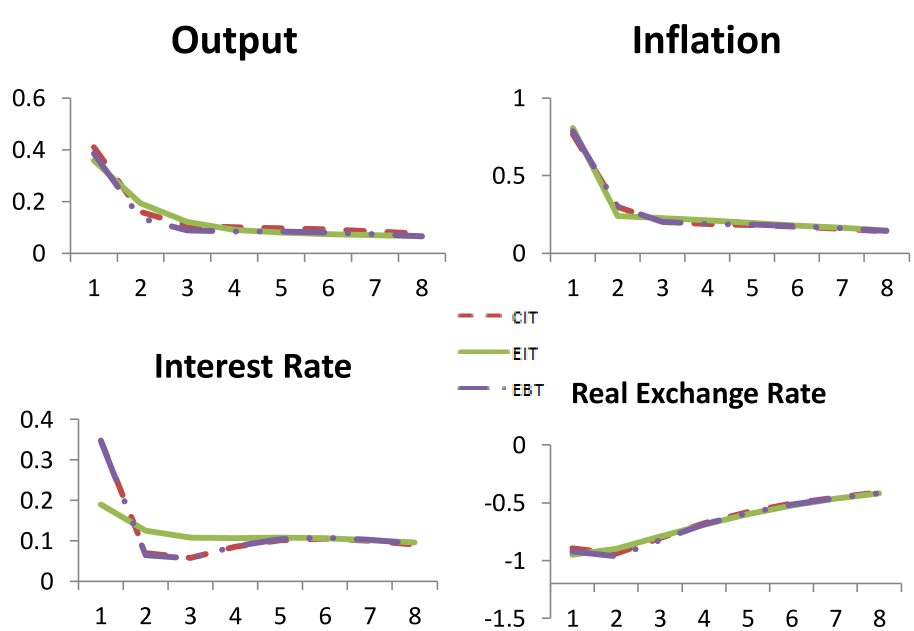

Figure 11: IRFs of foreign demand of domestic commodity shock

Under the foreign demand of the domestic commodity shock, figure 12 confirms the result in table 6 that EIT and EBT reduce the inflation and output volatility from CIT. As the assumption of the model is all commodity is exported, this shock then become exclusively external. Exchange rate then become a very important factor in the decision making of the foreign demand to the commodity product, so controlling exchange rate then smooth out the shock which in turn reduce the welfare loss for the economy. CIT, on the other hand, leaves exchange rate to be flexible which can lead to exchange rate volatility amplifying the shock.

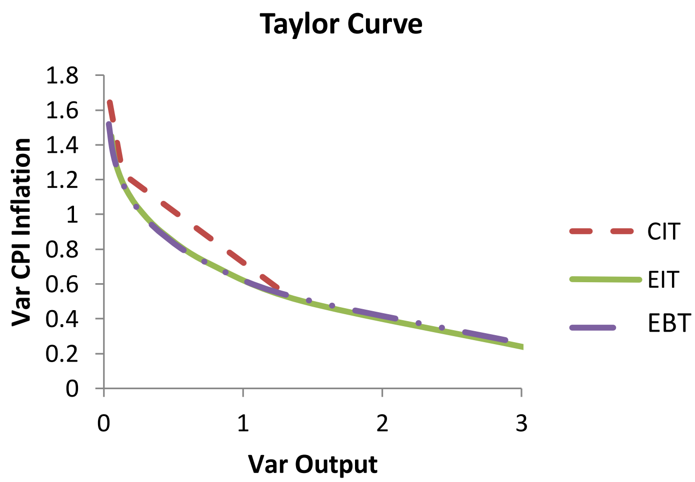

Figure 12: Taylor curve with alternative regimes under foreign demand of domestic commodity shock

International Commodity Prices Shock

	CIT	EIT	EBT
Output	0.95	0.92	0.94
Domestic Inflation	0.08	0.06	0.08
CPI Inflation	0.11	0.10	0.12
Nominal Interest Rate	0.10	0.11	0.21
Exchange Rate (1st diff)	0.23	0.25	0.23
Real Exchange Rate	25.47	25.95	26.12

Table 7: cyclical properties from international commodity price shock

According to table 7, the variability of output and inflation decrease as the central bank adopts the two targets regime while the nominal interest rate volatility rises slightly. Using the exchange rate as the main instrument produces almost the same volatilities on output and inflation while interest rate varies a lot as a result. In response to a commodity price markup shock which generates an increase in the price of commodities, inflation increases and the central bank raises the nominal policy interest rate (Figure 13). For net exporters of commodities, the currency generally appreciates in real effective terms, inducing a terms of trade driven expansion of domestic demand mitigated by monetary policy tightening, which translates into an expansion of output in spite of terms of trade driven expenditure switching. The current account balance tends to improve.

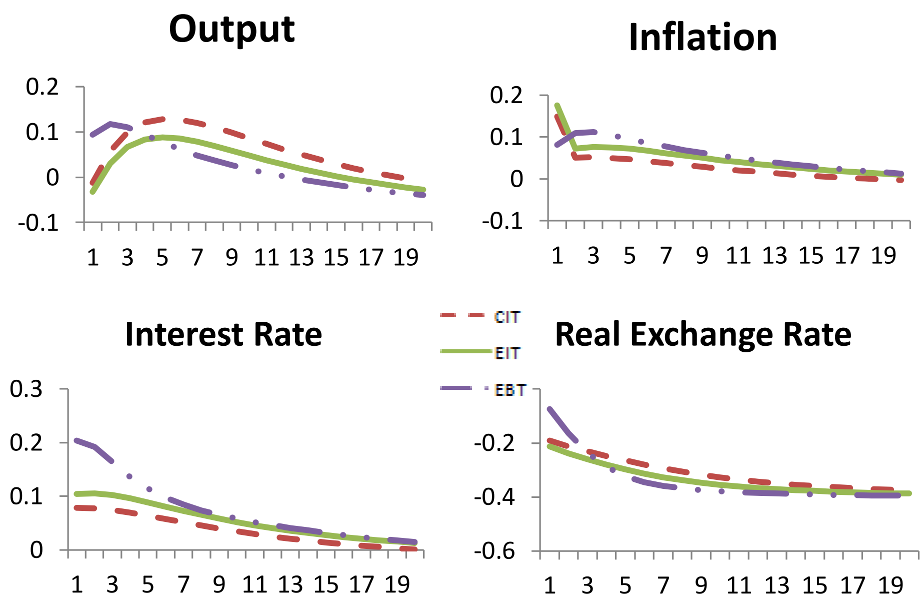

Figure 13: IRFs of international commodity price shock

From figure 14, CIT and EIT curves are very close together where EBT is quit far away from them. This shows that either of them can work as efficient as the other under this shock. EBT is not as good here because it produces very high interest rate and exchange rate volatility at the same time which amplifies the effect of the shock and makes the economy worse off.

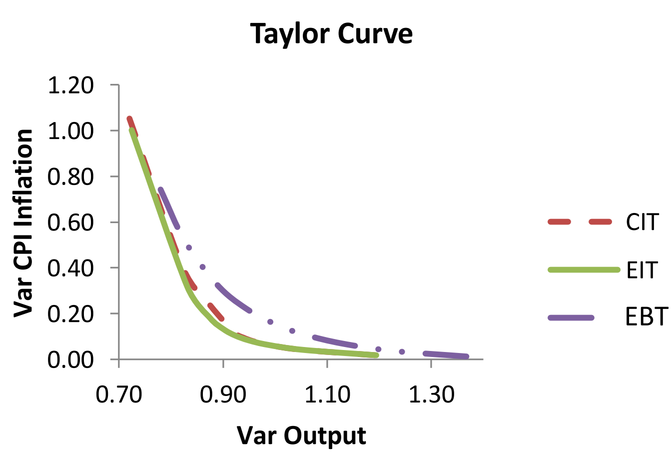

Figure 14: Taylor curve with alternative regimes under international commodity price shock

Monetary Policy Shock

A monetary-policy shock in traditional Keynesian models with no frictions results in intertemporal consumption smoothing, which households shift consumption from today to tomorrow. However, New Keynesian models with frictions suggest that a high interest rate induces households to choose a consumption profile characterized by an increasing growth rate of consumption (Christiano et al., 2005). In this case, with a one off increase to the interest rate, the currency appreciates in real effective terms. Reflecting the interest rate and exchange rate channels of monetary transmission, a persistent contraction of output arises, accompanied by a persistent decrease in inflation (Figure 15).

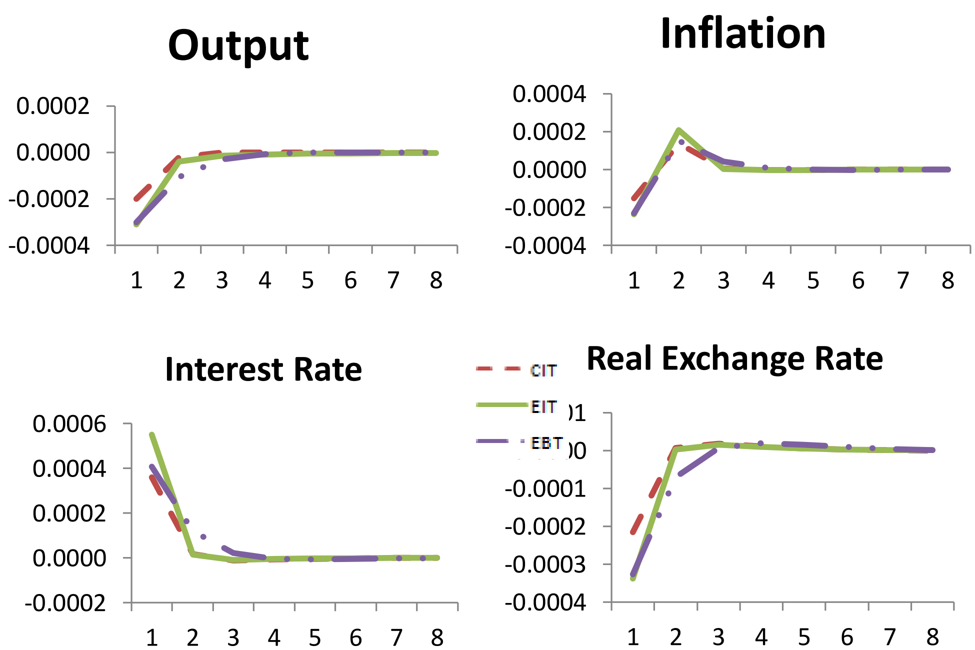

Figure 15: IRFs of monetary policy shock

Figure 16 shows an upward sloping Taylor curve shows. This implies that there is no scope for the long-run tradeoff between output inflation volatility. As output variability increases, inflation variability will also increase. The lowest coordinate indicates the most forceful policy response which produces the greatest sum of the optimal parameter in the reaction function. With lower degree of policy forcefulness, lower sum of the optimal parameter in the reaction function, the point on the Taylor curve increases in an upward sloping manner.

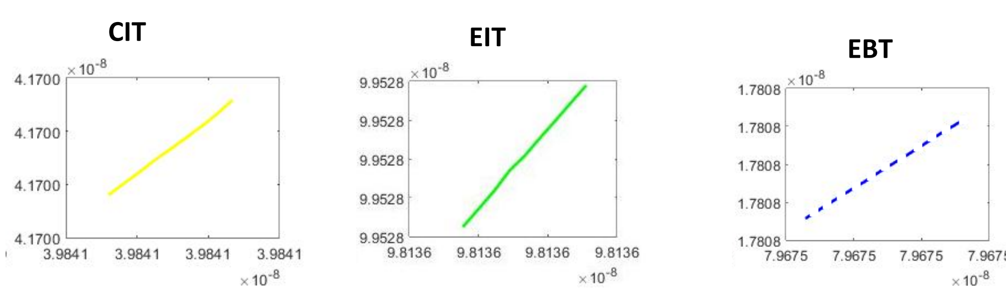

Figure 16: Taylor curve with alternative regimes under monetary policy shock

B. The Comparison Summary

	CIT	EIT	EBT
Domestic Productivity	★	★	★
Labor Preference	★		
Foreign Demand	★	★	
Foreign Inflation		★	
Foreign Interest Rate	★	★	
Foreign Commodity Demand		★	★
International Commodity Prices	★	★	
TOTAL	5	6	2

Table 8: The Policies Comparison Summary

The comparison summary table summarizes the optimal policy under alternative disturbances. For each shock, a star will be given to the policy that its Taylor curve places closest to the origin. According to table 9, all three regimes can perform at equal efficiency under domestic productivity shock. Furthermore, CIT emerges as the best policy to cope with labor preference shock. By design, this shock is exclusively internal, so managing exchange rate or assuming direct control as a policy tools can essentially amplify the shock. As for EIT, it is the most efficient of them all under foreign inflation and foreign commodity demand shock. This conclusion aligns with the literatures that EIT can manage external shock better than CIT especially the external inflation shock. Because of the nature of this particular shock that mostly pass through exchange rate channel, managing exchange rate volatility then lower the effect of the shock to the economy. However, there are cases where CIT and EIT can perform under similar tradeoff, namely foreign demand, foreign interest rate, and international commodity prices shocks. Lastly, EBT in Thailand case does not perform well at all. The possible explanation for this might be the nature and the openness of the Thai economy that is different from the successful case in Singapore.

V. Conclusion

The global financial crisis has prompted a fundamental re-thinking about the role of exchange rate in inflation targeting policy, especially for emerging market economies. In this paper, the performance of different inflation targeting monetary policy regimes is tested under alternative kinds of disturbances. The paper utilizes Beidas-Strom and Poghosyan (2011)'s framework and focus on the case of a small open economy where varying policy regimes has effects on the sensitivity of inflation to output gap and output gap to interest rate change. The monetary policy frameworks tested in this paper include: Conventional Inflation Targeting

(CIT), Exchange rate and Inflation rate Targeting (EIT), and Exchange rate-Based Inflation Targeting (EBT). Some conclusions can be drawn.

On one hand, due to the characteristic of the small open economy which takes world price as given, it is expected to be fully affected by external shock, especially the world cost push shock. Moreover, external shock is expected to transferred more into the economy, making inflation becomes more volatile which leads to difficulty for the central bank in conducting monetary policy. Because of this well-known structural features of emerging market economies, benign neglect of large exchange rate movements are likely to make the economy worse-off. If two policy instruments are available (the policy interest rate and foreign exchange market intervention), then they should be used in tandem to achieve both price-stability and exchange rate objectives. Hence, EIT is the right policy in managing external shocks.

On the other hand, the superiority of CIT under the internal shocks, such as domestic productivity and labor preference shock, should not be over looked. It does not make sense to intervene with exchange rate when the shock only occurs in the domestic level because the exchange rate sterilization can amplify the shock and worsen the economy. Therefore, there is no clear-cut evidence which monetary approach performs best overall for small open economy. The answer depends on the types of shock the economy encountered. Whether monetary policy should target exchange rate or dampen exchange rate volatility, the answer relies on whether the characteristic of economic disturbances has an effect on destabilizing exchange rate movement. The frequency and magnitude of the shock are important factors that should also be taken into account when considering the optimal policy.

Certain caveats do exist and worth consider here. In this model, the parameters are mostly obtained from Beidas-Strom and Poghosyan (2011). Some are obtained from the parameters in Thailand Small model of Chai-Anant et al. (2008). Hence, a precise parameterization to fit with Thailand economic structure and analysis of frequency and magnitude of alternative disturbances are beneficial and improves the accuracy of the analysis.

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Appendixes

Log-linearized Model

Real Wage

$$\left(1 + v_L\phi_L + \sigma_L\epsilon_L(\phi_L + v_L)\right)\widehat{wr}_t = (1 - v_L)(1 - \phi_L)\left(\left(\sigma_L\hat{l}_t + \frac{1}{1-h}\right)\hat{c}_t - \frac{h}{1-h}\hat{c}_{t-1} + \zeta\right) + \phi_L(1 + \sigma_L\epsilon_L)\widehat{wr}_{t-1} + v_L(1 + \sigma_L\epsilon_L)\widehat{wr}_{t+1} - (\phi_L + v_L\xi_L)(1 + \sigma_L\epsilon_L)\hat{\pi}_{C,t} + \phi_L\xi_L(1 + \sigma_L\epsilon_L)\hat{\pi}_{C,t-1} + v_L(1 + \sigma_L\epsilon_L)\hat{\pi}_{C,t+1}$$

Consumption $\hat{c}_t = \frac{1}{1+h}\hat{c}_{t+1} + \frac{h}{1+h}\hat{c}_{t-1} - \sigma_C\frac{1-h}{1+h}\hat{\imath}_t + \sigma_C\frac{1-h}{1+h}\hat{\pi}_{C,t+1}$

UIP $\hat{\imath}_t = \hat{\imath}_t^* + \varrho\left(\widehat{rer}_t + \hat{b}_t^* - \widehat{prx}_t - \hat{x}_t\right) + \Delta e_{t+1}$

Domestic Consumption of Home Goods $\hat{c}_{H,t} = \hat{c}_t - \eta\widehat{pr}_{H,t}$

Foreign Consumption $\hat{c}_t^* = \hat{c}_t - \eta\widehat{pr}_t^*$

Price Relationship $(1-\alpha)\widehat{pr}_{H,t} + \alpha\widehat{pr}_t^* = 0$

Inflation of Home Goods

$$\phi\hat{\pi}_{H,t} = \frac{\phi\beta}{1+\beta\xi_H}\hat{\pi}_{H,t+1} + \frac{\phi\xi_H}{1+\beta\xi_H}\hat{\pi}_{H,t-1} + \frac{(1-v_H)(1-\phi)}{1+\beta\xi_H}\left(\widehat{wr}_t - \hat{a}_t - \widehat{pr}_{H,t}\right)$$

Evolution of Real Price $\hat{\pi}_{H,t} = \widehat{pr}_{H,t} - \widehat{pr}_{H,t-1} + \hat{\pi}_{C,t}$

Evolution of Real Exchange Rate $\Delta\hat{e}_t = \widehat{rer}_t - \widehat{rer}_{t-1} + \hat{\pi}_{C,t} - \hat{\pi}_t^*$

Equilibrium $\hat{a}_t + \hat{l}_t = \frac{C_H}{Y_H}\hat{c}_{H,t} + \left(1 - \frac{C_H}{Y_H}\right)\hat{c}_{F,t}$

Domestic Consumption of Foreign Goods $\hat{c}_{F,t} = \hat{y}_t^* - \eta^*\left(\widehat{pr}_{H,t} - \widehat{rer}_t\right)$

IS Curve $\hat{y}_t = \frac{C}{Y}\hat{c}_t + \frac{C_F}{Y}\hat{c}_{F,t} + \left(\frac{X}{Y} - \frac{C_F}{Y}\right)\hat{y}_S - \alpha\frac{C}{Y}\hat{c}_t^*$

Net Foreign Asset Position

$$\frac{(1-\varrho)}{\theta(1+\hat{\imath}_t^*)}\hat{b}_t^* = \left(\frac{1}{(1+\hat{\pi}_t^*)(1+g_y)} - \frac{1-\varrho}{\theta(1+\hat{\imath}_t^*)} - \frac{M}{eB^*}\right)\widehat{rer} + \frac{1}{\theta(1+\hat{\imath}_t^*)}\hat{\imath}_t^*$$
$$+ \frac{1}{(1+\hat{\pi}_t^*)(1+g_y)}\hat{b}_{t-1}^* - \frac{1}{(1+\hat{\pi}_t^*)(1+g_y)}\hat{\pi}_t^*$$
$$+ \left(\frac{X}{eB^*} - \frac{\varrho}{\theta(1+\hat{\imath}_t^*)}\right)\left(\widehat{pr}_{X,t} + \hat{x}_t\right) - \frac{M}{eB^*}\hat{c}_t^*$$

Monetary Policy rule $\hat{\imath}_t = \psi_i \hat{\imath}_{t-1} + (1-\psi_i)\left(\psi_\pi \hat{\pi}_{C,t} + \psi_y \hat{y}_t + \psi_{\Delta e}\Delta\hat{e}_t\right) + v_M$

Foreign Inflation

$$\phi^*\hat{\pi}_t^* = \frac{\phi^*\beta}{1+\beta\xi^*}\hat{\pi}_{t+1}^* + \frac{\phi^*\xi^*}{1+\beta\xi^*}\hat{\pi}_{t-1}^* + \frac{(1-\phi^*)(1-\beta\xi^*)}{1+\beta\xi^*}\left(\widehat{rer}_t - \widehat{pr}_t^*\right)$$

Evolution of Foreign Real Price $\hat{\pi}_t^* = \widehat{pr}_t^* - \widehat{pr}_{t-1}^* + \hat{\pi}_{C,t}$

Export Commodity Real Price $\widehat{pr}_{X,t} + \hat{x}_t = \frac{C_F}{X}\left(\widehat{pr}_{H,t} + \hat{c}_{F,t}\right) + \left(1 - \frac{C_F}{X}\right)\left(\widehat{rer}_t + \widehat{pr}_S^* + \hat{y}_S\right)$

Export $\hat{x}_t = \frac{C_F}{X}\hat{c}_{F,t} + \left(1 - \frac{C_F}{X}\right)\hat{y}_S$

Table A1: Baseline Parameterization

Parameters	Value	Description
Households and labor		
Yh/Y	0.8	Share of home goods production in total GDP
σ_L	1	Inverse elasticity of labor supply
h	0.7	Habit formation parameter
Private consumption basket		
α	0.4	Share of foreign goods in consumption
η	1	Elasticity of substitution in consumption between home and foreign goods
σ_c	1	Inverse elasticity of consumption
Nominal rigidities		
ϕ_L	0.875	Probability of adjusting wages
ξ_L	0.9	Weight of wage indexation to past inflation
ϕ	0.75	Probability of adjusting domestic prices
ξ_H	0.5	Weight of price indexation to past inflation in home sector
Foreign Sector		
NX/Y	0.02	Net exports to GDP ratio
η^*	1	Elasticity of substitution in consumption between foreign and home goods
ϱ	0.001	Elasticity of FX borrowing
ξ^*	0.5	Weight of price indexation to past inflation in foreign sector

Monetary Policy		
ϖ_i	0.7	Smoothing coefficient of Taylor rule
ϖ_π	1.5	Reaction to inflation
ϖ_y	0.5	Reaction to output gap
$\varpi_{\Delta e}$	0.5	Reaction to real exchange rate
Stochastic processes		
ρ_a	0.95	Persistence of productivity shock
ρ_{ys}	0.9	Persistence of commodity shock
ρ_{y^*}	0.9	Persistence of foreign demand shock
ρ_{i^*}	0.95	Persistence of foreign interest rate shock
ρ_{π^*}	0.7	Persistence of foreign inflation shock
ρ_ζ	0.8	Persistence of labor preference shock
$\rho_{pr_s^*}$	0.95	Persistence of law of one price shock
ρ_v	0	Persistence of monetary policy shock