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MONETARY POLICY RULES FOR SMALL AND OPEN DEVELOPING ECONOMIES: A COUNTERFACTUAL POLICY ANALYSIS

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This paper uses a model calibrated to suit a small open Asian economy to present a series of counterfactual policy experiments aimed at comparing conventional optimal inflation targeting (IT) under commitment and discretion and variations of simple fixed monetary policy rules (MPRs). Two significant points of departure between the model presented here and previous ones for industrial countries are the incorporation of the real exchange rate and consideration of possible contractionary depreciation/devaluation. This represents a realistic scenario for some Asian economies after the crisis. In assessing the impact of different policy types it is essential to find parameters for model calibration that suitably represent the small and open Asian economies that have recently implemented inflation targeting arrangements. We have used estimates from Thailand over a recent period (1993-2003) to assist in selecting these parameters.

Keywords: Asia, Developing Economy, Exchange Rate, Inflation Targeting (IT), Monetary Policy Rules (MPRs)
JEL classification: E52, E58, F31, F41

1. INTRODUCTION

Since the Asian financial debacle of 1997-98, four of the five crisis-hit countries - Korea, Indonesia, Thailand and the Philippines - have promoted the use of monetary policy rules (MPRs) fashioned around an inflation objective (so-called inflation targeting arrangements).[1] An essential part of an inflation targeting regime, the MPR typically specifies how the instrument of monetary policy is to be changed given the

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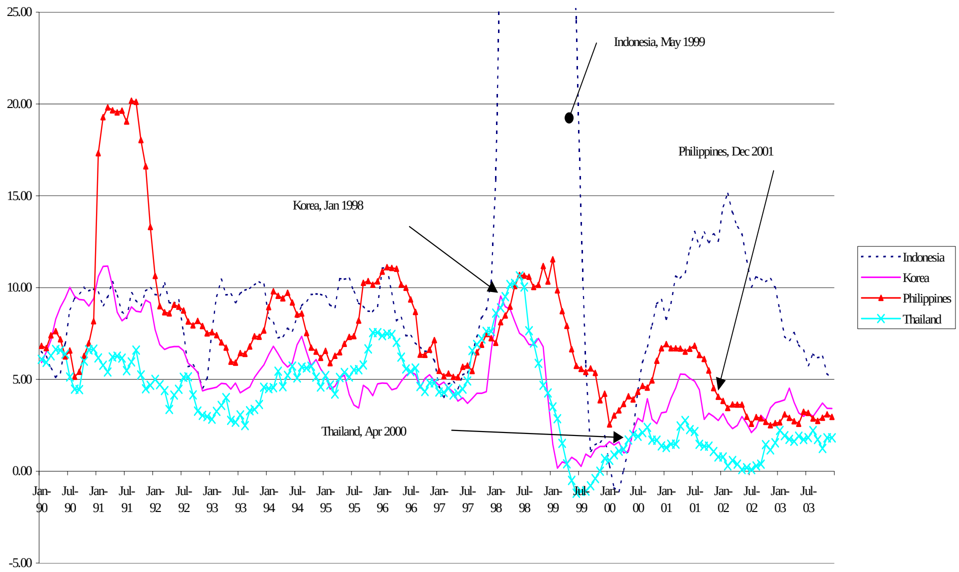
[1] Malaysia shifted to a rigid US dollar peg in September 1998 but then moved to an adjustable peg in July 2005. Table 1 summarizes the inflation targeting arrangements in the four countries and Figure 1 highlights recent inflationary outcomes.

characteristics of the macroeconomy and the policy objectives of the monetary authority. According to Taylor (2000):



Source: IFS. The dates corresponding to each country refer to when each country instituted inflation targeting regimes.

Figure 1. Inflation Rates

There is an interesting symbiotic relationship between inflation targeting and monetary policy rules. A monetary policy rule is nothing more than a contingency plan that describes as precisely as possible the circumstances in which a central bank changes the *instruments* of monetary policy (p. 2).

For much of the last decade, the literature on MPRs developed in a closed economy context (for instance, see Ball (1999) and Svensson (1997)). In this context, when calculating optimal policy, the primary objectives have been inflation and output. It is only recently, when inflation targeting (IT) has been suggested as a serious policy option for small and open emerging economies that research has begun to focus on rules in open economy models and consequently, on the role of the exchange rate.

The normative literature on IT in developing economies typically suggests that such an arrangement should be accompanied by freely floating exchange rates (in particular, see Masson *et al*. (1997)). As such, Indonesia, Korea, the Philippines and Thailand have all declared that their currencies have floated post-crisis (Carare and Stone (2003)). In contrast to the *de jure* exchange rate classifications, observations of the *de facto* regimes seem to suggest a reversion to US dollar pegs, albeit ones not as tightly managed as before the crisis (for instance, see Cavoli and Rajan (2005) and references cited within). What might we conclude from this? A plausible hypothesis is that central banks in the region have enacted IT policies and procedures but there is also some desire to manage exchange rate movements. In fact, Fischer (2001) notes that "in most countries, even those with floating exchange rate regimes, monetary policy is likely to respond to some extent to movements in the exchange rate" (p. 13).[2]

This paper numerically explores the implications of various MPRs using a macro model calibrated to suit a small and open developing economy. Particular attention is paid to the role of the real exchange rate in such MPRs. The paper is organized as follows: Section 2 presents a simple open macro model and a range of counterfactual policy responses that are consistent with a monetary authority pursuing an inflation target. To aid in the analysis, we use simple OLS and VAR estimates from Thailand over a recent period (1993-2003) to assist in selecting parameters to be used in the analyses. Section 3 examines the impact of these policies in the event of various shocks. Two significant points of departure between the model presented here and previous ones for industrial countries relate to the incorporation of the real exchange rate in the rule and consideration of possible contractionary depreciation/devaluation. This represents a realistic scenario for some Asian economies after the crisis. Section 4 offers some concluding remarks.

To preview the main conclusion, the results indicate that many of the characteristics that appear in simulated models of industrial economies also show up in this parameterization of the model. These characteristics include the tradeoffs between inflation and output and between inflation and the exchange rate in setting monetary policy. The tradeoff between inflation and the exchange rate is especially clear in our small open economy model and, as such, presents the interesting policy implication that monetary and exchange rate policies need not be a choice between two mutually exclusive corners, but a choice in a continuum between fixed and flexible exchange rates *a la* Frankel (1999) and Rajan (2002). Furthermore, as with models of industrial economies, the results show that the performance of any particular policy depends on the nature of the shocks to the economy.

2. SMALL OPEN ECONOMY MACRO MODEL

In order to investigate various MPRs and attempt to clarify the role of the exchange rate in IT arrangements, we consider a small open economy model of the type

[2] This issue has been examined analytically by Ball (1999), Svensson (2000), Taylor (2001) and from an East Asian perspective by Ho and McCauley (2003) and Ito and Hayashi (2004).

introduced by Ball (1999), but with the addition of some forward-looking behavior and foreign conditions.[3]

2.1. Outline of a Simple Model

Consider the following set of equations that characterize a stylized small and open economy:

$$y_t = \beta_1 y_{t-1} - \beta_2 (i_{t-1} - \pi_{t|t-1}) + \beta_3 q_{t-1} + \beta_4 q_{t-2} + \beta_5 y^*_{t-1} + \varepsilon^y_t, \quad (1)$$

$$\pi_t = [\alpha_1 \pi_{t-1} + (1-\alpha_1)\pi_{t+1|t}] + \alpha_2 y_{t-1} + \alpha_3 q_{t-1} + \alpha_4 q_{t-2} + \varepsilon^\pi_t, \quad (2)$$

$$e_{t+1|t} = e_t + i_t - i^*_t - \upsilon_t, \quad (3)$$

$$q_t = e_t + p^*_t - p_t, \quad (4)$$

$$\upsilon_t = \theta_\upsilon \upsilon_{t-1} + \eta^\upsilon_t, \quad (5)$$

$$y^*_t = \theta_y y^*_{t-1} + \eta^y_t, \quad (6)$$

$$\pi^*_t = \theta_\pi \pi^*_{t-1} + \eta^\pi_t, \quad (7)$$

$$i^*_t = g_\pi \pi^*_t + g_y y^*_t, \quad (8)$$

where $\pi_t = p_t - p_{t-1}$ and all other variables (except the nominal interest rate) are in logs and expressed as deviations from steady state values.

Equation (1) is the Aggregate Demand (AD) function. The output gap, y_t, depends on its own time lag and lagged measures of the real interest rate $(i_{t-1} - \pi_{t|t-1})$, lagged real exchange rate, q_{t-1} and q_{t-2}, and the foreign output gap, y^*_{t-1}. ε^y_t is a zero-mean demand shock. The nominal interest rate is given by i_t and is the instrument of monetary policy in our study. The AD function is essentially backward looking (see Ball (1999) and the first two models in Bharucha and Kent (1998)).

[3] This has become the workhorse model. See Bharucha and Kent (1998), Svensson (2000), Leitemo and Söderstrom (2001) and Morón and Winkelried (2003).

Equation (2) is a CPI-inflation (π_t) Phillips Curve. It is common in models of this type for the Phillips equation to be an expression for domestic or non-traded inflation and for there to be a separate equation for CPI inflation. Equation (2) allows the examination of the same issues as models with separate equations for non-traded and traded inflation in an open economy, viz. persistence, some forward looking price-setting behavior, exchange rate pass-through and the effect of output on inflation - in a model where these issues are embedded in the CPI equation.[4] Thus, when assessing IT, we are focusing on CPI IT only.[5] This is appropriate in that it corresponds to how IT is formally being pursued in many open economies in Asia (see Table 1). ε_t^{π} is a zero-mean inflation or supply shock.

Equations (3) and (4) are the conventional expressions for risk-adjusted uncovered interest parity (UIP) and the real exchange rate, respectively. The exchange rate is defined as the domestic price of foreign currency (US dollar). The risk premium is given by υ_t and, as in much of the literature, is assumed to follow an AR(1) process as described by Equation (5). η_t^{υ} is a risk premium shock. Equations (6) to (8) are expressions for foreign output, foreign inflation (π_t^*) and the foreign interest rate (i_t^*), where η_t^{υ} and η_t^{π} denote foreign demand and inflation shocks, respectively.

Substituting Equation (3) into (4) and using Equations (7) and (8) yields:

$$q_{t+1|t} = q_t + i_t - \pi_{t+1|t} + (\theta_\pi + g_\pi)\pi_t^* - g_y y_t^* - v_t. \qquad (9)$$

Expressing Equation (2) in terms of $\pi_{t+2|t}$ and using the following:

$$\pi_{t+1} = \pi_{t+1|t} + \varepsilon_{t+1}^{\pi}. \qquad (10)$$

we obtain:

$$\pi_{t+2|t} = (1/1-\alpha_1)[\pi_{t+1|t} - \alpha_1\pi_t - \alpha_2 y_t - \alpha_3 q_t - q_{t-1}]. \qquad (11)$$

These, along with Equations (1) and (5) to (9) constitute the state space system:

4 See Walsh (2003, p. 308) for how a CPI inflation expression can be derived from a non-traded inflation equation. The result is a forward-looking expression similar to Equation (2).

5 There is still some debate as to whether CPI IT is preferred to domestic IT in open economies (for instance, see Debelle and Wilkinson, 2002, Bharucha and Kent, 1998). However, for the most part, open economies pursue a policy of targeting headline CPI inflation or a measure of core CPI inflation that adjusts for volatile items. Debelle and Wilkinson (2002) examine optimal policy tradeoffs for CPI IT and domestic IT for Australia, and find few differences between them.

$$X_{t+1} = AX_t + Bi_t + \xi_{t+1}, \tag{12}$$

where: $X_t = [x_{1t}, x_{2t}]'$, $x_{1t} = [\pi_t, y_t, v_t, i_{t-1}, \pi_t^*, y_t^*, q_{t-1}]'$, $x_{2t} = [q_t, \pi_{t+1|t}]'$ $\xi_{t+1} = [\varepsilon_{t+1}^y, \varepsilon_{t+1}^\pi, \eta_{t+1}^u, 0, \eta_{t+1}^y, \eta_{\pi t+1}, 0,0,0]'$ $x_{1t} = (n_1 \times 1)$ vector of predetermined state variables, $x_{2t} = (n_2 \times 1)$ vector of forward-looking variables, and $n = n_1 + n_2$.

As detailed by Svensson (2000) and Taylor (2000, 2001), a key implication of the model is that monetary policy affects inflation directly via the price effects of currency movements, as well as indirectly via output (which in turn is impacted by both interest and exchange rate changes). The direct effect takes place after one period, while the lag structure of the model implies that indirect effect on inflation via the interest rate and output occurs after two periods. The more open the economy the stronger the pass-through effects of exchange rate changes on consumer prices, i.e., a larger coefficient on the q_{t-1} in Equation (2) and an increased effect of the exchange rate on goods demand in Equation (1).

2.2. Simple versus Optimal Monetary Policy Rules (MPRs)

a) Simple MPRs

The counterfactual MPR that we propose to investigate here is given by a variant of the Taylor Rule (*a la* Taylor (1993, 2000, 2001)):

$$i_t = f_\pi \pi_t + f_y y_t + f_{q1} q_t + f_{q2} q_{t-1}, \tag{13}$$

where all variables are expressed as deviations from equilibrium values as in the model above.

Generally speaking, the MPR can be derived in two ways. The first is to specify a simple MPR for the instrument that provides guidance for the monetary authority in setting monetary policy. The f coefficients are selected to reflect the central bank's preferences in relation to its monetary policy target. As such, the central bank's preferences are implied by the coefficients to the rule. More to the point, the original Taylor rule for a large and relatively closed economy like the US is one where $f_\pi f_1 > 0$ (specifically 1.5 and 0.5 respectively) and $f_{q1} = f_{q2} = 0$. For a small and open economy, the exchange rate should enter the MPR with a non-zero coefficient. In particular, f_{q1} must be greater than zero and f_{q2} must be less than or equal to zero.[6] This is the case

[6] There are similarities between rules of this type and monetary conditions indices (MCI) that have

because an appreciation (decrease) of the domestic currency necessitates a relaxation of monetary policy, i.e., currency appreciation tends to be deflationary. A positive f_{q2} represents a partial adjustment.

Table 2. Simulated Coefficient Estimates of Exchange Rate Variables

	f_{q1}	f_{q2}
Ball (1999)	-0.37	0.17
Svensson (2000)	-0.45	0.45
Taylor (1999)	-0.25	0.15

Source: Compiled by Authors.

The idea of partial adjustment relates mainly to the direct effect of the exchange rate on inflation. Consider some positive shock to inflation. The subsequent increase in the interest rate appreciates the currency, which may be met with an interest rate reduction. In the context of the original shock this could possibly be seen as premature easing. A partial adjustment decreases the magnitude of the interest rate reduction, therefore offsetting some of the premature easing. Recent work using model simulations find optimal values for f_{q1} range between -0.45 and -0.25, while those for f_{q2} range between 0.15 and 0.45 (Table 2).[7]

b) Optimal MPRs

The advantage of the foregoing simple rules is the fact that since the structure of the economy is not known with certainty, a rule that is robust across all models may be desirable. Nonetheless, they are justifiably open to the criticism of being ad hoc in nature. In contrast to the simple rules, the MPR could also be formally derived from explicit optimization of a central bank's loss function such as:

$$\min E_0 \sum_{t=0}^{\infty} \delta^t [\mu_\pi \pi_t^2 + \mu_y y_t^2 + \mu_i i_t^2 + \mu_{\Delta i}(i_t - i_{t-1})^2 + \mu_q q_1^2], \tag{14}$$

previously been employed in New Zealand and Canada. For analytical discussions, see Ball (1999) and Ball (2002) and for a discussion of its use in New Zealand see Dennis (1997).

[7] Note that an interest rate smoothing that exists with the partial adjustment is incidental because the objective of partial adjustment is to protect the inflation target.

where δ is a discount factor representing the central bank's rate of time preference, $\mu_\pi, \mu_y, \mu_i, \mu_n$ and μ_q are policy parameters that relate to inflation (π), output (y), interest rate (i) volatility and smoothing, and the real exchange rate (q), respectively.

The objectives of the monetary authority are principally inflation and output and also include an interest rate smoothing term. For our purposes we assume that μ_i, and μ_q both equal zero.[8] This gives it the specification of a loss function most often used in the literature on IT, where the primary objectives are inflation and output and this will be reflected in the positive values given to μ_π and μ_y. Once this function is minimized we can derive an optimal MPR akin to Equation (13).[9]

But what happens if the monetary authority is also concerned about exchange rate volatility as a policy objective in and of itself? If the desire for exchange rate stability stems from its potential deleterious effects on growth, arguably this implies that Equation (1) is mis-specified, an additional term for exchange rate variability needing to be added on to the right hand side of Equation (1). If this is done there ought not to be any reason to be concerned about exchange rate stability for its own sake. In other words, there is no reason that the exchange rate should enter the monetary authority's loss function independently over and above inflation and output. Thus, for the exchange rate to directly enter the monetary authority's loss function (i.e., $\mu_q > 0$), i.e., for the monetary authority to exhibit a genuine "fear of floating", it must either: (a) be valued for its own sake over and above its impact on inflation and output; or (b) if valued because of its effect on inflation and output, for some reason, its impact on the macroeconomy cannot be adequately captured in the specified macro model (Equations 1 and 2). In any event, even if the exchange rate is not in the loss function, the optimal rule will contain non-zero values of f_{q1} and f_{q2}. This essentially reflects the fact that it is optimal for the instrument of policy to respond to exchange rate changes in the pursuit of its inflation and output objectives.

In practice central banks are also keen on preventing sharp fluctuations in the interest rates (i.e., "optimal inertia") given its repercussions on macroeconomic stability and asset prices. It is for that reason that we set $\mu_{\Delta i} > 0$ (Lowe and Ellis (1997) and Sack and Weiland (1999)).[10]

[8] If μ_y is also set at zero, Mervyn King (1996) terms such an optimizing monetary authority an "inflation nutter".

[9] Note that under the solution methods employed in this paper, the optimal coefficient for the current real exchange rate, f_{q1}, cannot be derived as q is a jump variable. The optimal policy rules derived in Section 3.2 as for the control variable, i_t, as a function of the pre-determined variables in the system. See Svensson (2000).

[10] It bears noting that even those who strongly advocate that the IT monetary authority should react to asset prices in the course of policy making are clear that asset prices ought not to be included in the objective

3. SIMULATION RESULTS

The basis of our numerical investigations is to compare conventional optimal monetary policy under IT with various manifestations of a simple, exogenously determined MPR for two main reasons. One, to ascertain how effective optimal policy is in a model using parameters that might be representative of a post-crisis small Asian economy. Two, to compare the optimal policies with simple MPRs in order to investigate the importance of the exchange rate in the rule. The simple MPRs we will examine differ in how much the real exchange rate is represented in the rule. As such, we are concerned with what values the f parameters should take on. The next section contains some numerical policy experiments with a view to assessing the nature of exchange rate involvement in MPRs. We compare optimal policy under commitment and under discretion with different specifications of a simple rule for a calibration of the model presented above.

3.1. Model Parameterization

In assessing the impact of different policy types it is essential to find parameters for model calibration that suitably represent the small and open Asian economies that have recently implemented IT arrangements. We have used simple OLS and VAR estimates from Thailand over a recent period (1993-2003) to assist in selecting these parameters. While we appreciate that data from one country cannot hope to fully represent all others in the region, our objective here is to find parameters that adequately capture the basic structure of an economy for the purposes of generating some general conclusions through counterfactual policy analysis. Using data from Thailand is useful in that it is one of the first (along with Korea) to implement IT after the crisis and its exposure to the crisis enables us to explore the interesting policy implications of contractionary devaluation examined later in this section.

The selection of parameters conforms to current practices in this literature in that the structural parameters for the output gap and inflation equations and the exogenous processes are chosen.[11] The structural parameters are presented in Table 3. If one were to compare the parameters with those in Ball (1999) or Leitemo and Söderstrom (2001), it becomes apparent where the primary differences are and how these relate to emerging economies like Thailand. The real exchange rate (RER) coefficients in the output equation, $\beta_3 = -0.09$ and $\beta_4 = -0.05$ are of opposite sign to most of the previous

function (see Cecchetti, *et al*. (2000) and Cecchetti *et al*. (2002) for clear statements on this). Some of the general issues of clarity of objectives and transparency versus the benefits of discretion outlined in Section 4 are of particular relevance to this debate.

[11] See Ball (1999), Bharucha and Kent (1998), Leitemo and Söderström (2001), Morón and Winkelried (2003) and Svensson (2000).

work done in this literature. Hence devaluations/depreciations in Thailand appear to be contractionary (Bird and Rajan (2004) and Rajan and Shen (2003)).[12] Eichengreen (2001) discusses the issue of IT in the context of the "liability dollarization" problem in developing countries and we will take up this issue in more detail later.

Table 3. Model Parameters

Aggregate Demand	Phillips Curve	Foreign Conditions	Shocks
$\beta_1 = 0.60$	$\alpha_1 = 0.94$	$\theta_v = 0.85$	$\sigma_y = 1.39$
$\beta_2 = 0.36$	$\alpha_2 = 0.15$	$\theta_y = 0.80$	$\sigma_\pi = 0.14$
$\beta_3 = -0.09$	$\alpha_3 = 0.04$	$\theta_\pi = 0.80$	$\sigma_v = 1.70$
$\beta_4 = -0.05$	$\alpha_4 = 0.02$	$g_\pi = 1.50$	$\sigma_{y^*} = 0.71$
$\beta_5 = 0.01$	$\delta = 0.99$ (Discount Rate in Loss Function)	$g_y = 0.50$	$\sigma_{\pi^*} = 0.71$

Source: Authors. The model parameters are sourced in much the same way as the previous literature on this topic. The parameters for the Aggregate demand and Phillips curve equations are taken from simple OLS estimates for Thailand for the period 1993-2003 using quarterly data. The results appear robust to varying specification. The parameters for the foreign conditions are taken from the literature, especially Bharucha and Kent (1998) and Svensson (2000). A simple VAR model is used for the standard errors. Estimates are available from the authors upon request.

3.2. Stochastic and Dynamic Results

Using the solution techniques described in Söderlind (1999) and Söderström (2003) we evaluate the stochastic and dynamic behavior of the model where the MPR is: (i) initially derived as an optimal policy under commitment and under discretion; and (ii) exogenously determined as a simple rule. We draw on the baseline model calibrated for an industrial economy by Svensson (2000) and Leitemo and Söderström (2001) and for an emerging - financially vulnerable - economy *a la* Morón and Winkelried (2003).[13]

The policy configurations for optimal and simple MPRs are summarized in Table 4. The first four rows are the optimal policy settings for strict IT and flexible IT under *commitment* and *discretion*, respectively. Optimal policy under commitment occurs when a loss-minimizing central bank derives an optimal rule, sticks to it, and agents' expectations adapt to this rule. In the discretion case, the policymaker re-optimizes every

[12] Technically speaking, the model does not contain balance sheets. As such, we are not able to evaluate the source of the contractionary devaluation. However, this does not preclude the possibility of contractionary devaluation manifesting itself in our model via Equation 1. Also see Morón and Winkelried (2003).

[13] The solution uses standard dynamic programming methods based on the schur decomposition. See Söderlind (1999) and Klein (2000).

period (see Walsh (2003) for details). The loss function weight on inflation (μ_π) is set at 1 for all optimal rules. The output weight (μ_y) is set at 0 for strict IT and 0.5 for flexible IT. A weight of 0.01 is assigned to $\mu_{\Delta i}$ to capture a central bank's desire for instrument stability.

Table 4. Policy Configurations

Optimal Policy Rule under Commitment: *Strict Inflation Targeting*	$\mu_\pi = 1, \mu_y = 0.0, \mu_{\Delta I} = 0.01$
Optimal Policy Rule under Commitment: *Flexible Inflation Targeting*	$\mu_\pi = 1, \mu_y = 0.5, \mu_{\Delta I} = 0.01$
Optimal Policy Rule under Discretion: *Strict Inflation Targeting*	$\mu_\pi = 1, \mu_y = 0.0, \mu_{\Delta I} = 0.01$
Optimal Policy Rule under Discretion: *Flexible Inflation Targeting*	$\mu_\pi = 1, \mu_y = 0.5, \mu_{\Delta I} = 0.01$
Simple Monetary Policy Rule 1: *Strict Inflation Targeting*	$f_\pi = 1.5, f_y = 0, f_{q1} = 0, f_{q2} = 0$
Simple Monetary Policy Rule 2: *Flexible Inflation Targeting*	$f_\pi = 1.5, f_y = 0.5, f_{q1} = 0, f_{q2} = 0$
Simple Monetary Policy Rule 3: *Flexible open economy inflation targeting*	$f_\pi = 1.5, f_y = 0.5, f_{q1} = 0.4, f_{q2} = -0.2$
Simple Monetary Policy Rule 4: *Flexible open economy inflation targeting without partial adjustment*	$f_\pi = 1.5, f_y = 0.5, f_{q1} = 0.5, f_{q2} = 0$

Source: Authors. The μ parameters represent the policy preferences as given by the loss function (Equation 14). The f parameters are those representing the weight in the MPR of each respective variable.

Rows 5-8 in Table 4 are simple arbitrary MPRs (Rules 1 to 4). Rule 1 is a strict IT rule where the interest rate reacts only to inflation ("*strict IT*"). Rule 2 incorporates output ("*flexible IT*"). The parameters, $f_\pi = 1.5$ and $f_y = 0.5$, are those from the Taylor Rule. Rule 3 is the Taylor rule with some weight given to the current and lagged real exchange rates (f_{q1} and f_{q2}, respectively) to capture partial adjustment as described in Section 2 ("*open economy flexible IT*"). The values of f_{q1} and f_{q2} are respectively, 0.4 and -0.2. Rule 4 is a Taylor Rule with $f_{q1} = 0.5$ and $f_{q2} = 0$.[14] This rule is included to evaluate the effect of a stronger reaction to the exchange rate. It is, in a sense, a simple "fear of

[14] The choice of 0.5 for f_{q1} is based on the idea that central banks might view reacting to the real exchange rate as being of equal importance as reacting to output, but still not as important as inflation.

floating” rule (“*open economy flexible IT without partial adjustment*”).

Table 5. Coefficients to Optimal Rules

	π_t	y_t	v_t	i_{t-1}	π^*_t	y^*_t	q_{t-1}
Strict IT under Commitment	2.34	0.35	1.35	0.50	0.82	0.56	0.05
Flex IT under Commitment	2.21	1.90	-1.09	0.10	-0.59	-0.38	-0.08
Strict IT under Discretion	3.61	1.08	0.39	0.24	0.26	0.20	0.03
Flex IT under Discretion	2.28	1.99	-1.05	0.09	-0.07	-0.45	-0.08

Source: Authors. The coefficients are derived from minimizing the loss function (Equation14).

The coefficients of the simple rules in Table 4 can be contrasted to those for the optimal rules in Table 5. As expected, the coefficient value for inflation is higher for the strict IT policies than for the flexible IT policies. The most interesting result here is the magnitude of the reaction of inflation and output to the optimal rules compared to the simple MPRs. Additionally, if these coefficient values are compared to different parameterizations of the model, such as Svensson (2000) and Morón and Winkelried (2003), the coefficient values in the rule are also much higher under the set of parameter values employed in this model (implying a stronger reaction to inflation and output).

The remainder of this section is devoted to the investigation of the conventional optimal IT under commitment and discretion and the variations of the simple fixed MPRs. The objective is to compare the suitability of simple MPRs with those rules that have been optimally derived given the basic structure of the model as calibrated for Thailand.

a) Unconditional Standard Deviations

Table 6 presents the unconditional standard deviations of the model for each policy configuration. As expected, there is a tradeoff between inflation and output volatility for strict versus flexible IT. This is observed for both the optimal policies and the simple MPRs. The most appropriate way to assess the performance of the policy is to evaluate it against the importance a central bank might place on the various goal variables. For instance, if inflation variability was the only objective then the strict IT policy under commitment is preferable. If the volatility of the other variables is of concern, strict IT under discretion appears to be more appropriate, in that pursuing the inflation objective remains effective and does not induce excessive volatility in the other variables. This reflects the added flexibility in discretionary policy, in that when the central bank re-optimizes, it incorporates the evolution of those variables that impact on the inflation target into its information set.

Table 6. Unconditional Standard Deviations

Policy	Standard Deviation of Inflation	Standard Deviation of Output	Standard Deviation of Real Exchange Rate (RER)	Standard Deviation of Nominal Interest Rate
Strict IT under Commitment	0.36	13.76	34.08	7.38
Flexible IT under Commitment	2.47	2.26	12.88	5.54
Strict IT under Discretion	0.79	3.33	8.89	2.66
Flexible IT under Discretion	2.36	1.42	11.25	5.12
Rule 1: Strict IT	2.19	5.58	15.44	3.29
Rule 2: Flexible IT	3.10	4.16	16.61	3.29
Rule 3: Flexible open economy IT	5.79	6.42	13.56	6.46
Rule 4: Flexible open economy IT without partial adjustment	2.15	7.88	20.81	4.21

Source: Authors.

As expected, regardless of whether optimal policy is conducted under commitment or discretion, the choice between strict and flexible IT involves a tradeoff between output and inflation volatility. This tradeoff is also seen in Figure 2, which presents the output volatility/inflation volatility frontier for the optimal rules and the output volatility/inflation volatility points for the simple MPRs. The frontier is calculated by simulating the model under different values of μ_y in Equation (14). The values of μ_y vary from 0.0 to 1.0, where $\mu_y = 0.0$ is *strict IT*, $\mu_y = 0.1$ represents the output objective being a tenth as important as inflation (μ_π remains at 1.0) and so on. At a general level, it is fair to say that discretion dominates commitment under this model. There is a significant difference in the slope of each frontier. A central bank pursuing a policy under commitment, effectively locking in an IT rule, can expect far less variability around inflation than a discretionary central bank.

Consider next the simple rules. From Table 6, as with the optimal rules, there is a tradeoff between inflation and output volatility when selecting between strict IT (Rule 1) and flexible IT (Rule 2). There is also a tradeoff between Rule 1 and rule 3 (open economy flexible IT) in relation to inflation and real exchange rate volatility. This is not an altogether unexpected result, reflecting the difficulty in managing both domestic and external objectives. Rule 4 (open economy flexible IT without partial adjustment) provides more desirable inflation consequences but inferior real exchange rate results than Rule 3 because it prevents the central bank from pursuing overly easy policy (in the event of an inflation shock), but in doing so encourages relatively more exchange rate variability. If we observe the column containing the interest volatility in Table 6, we see that as we increase the reaction to the exchange rate in the rule, the interest volatility becomes larger. This is an expected but important result in that it suggests a tradeoff between added exchange rate intervention and possible instrument instability. This, coupled with the tradeoff between inflation and the exchange rate, is a possible reflection that monetary/exchange rate policies need not be a choice between two mutually exclusive corners but rather, a choice in a continuum between fixed and flexible exchange rates *a la* Frankel (1999) and Rajan (2002).

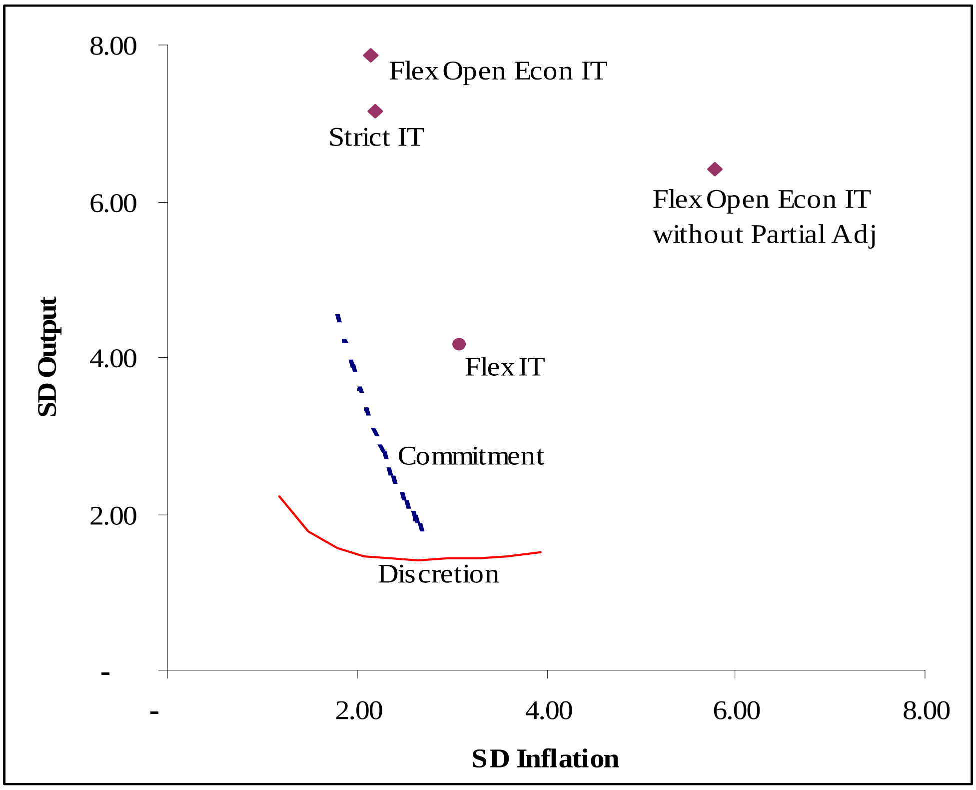


Figure 2. Output/Inflation Volatility Tradeoffs

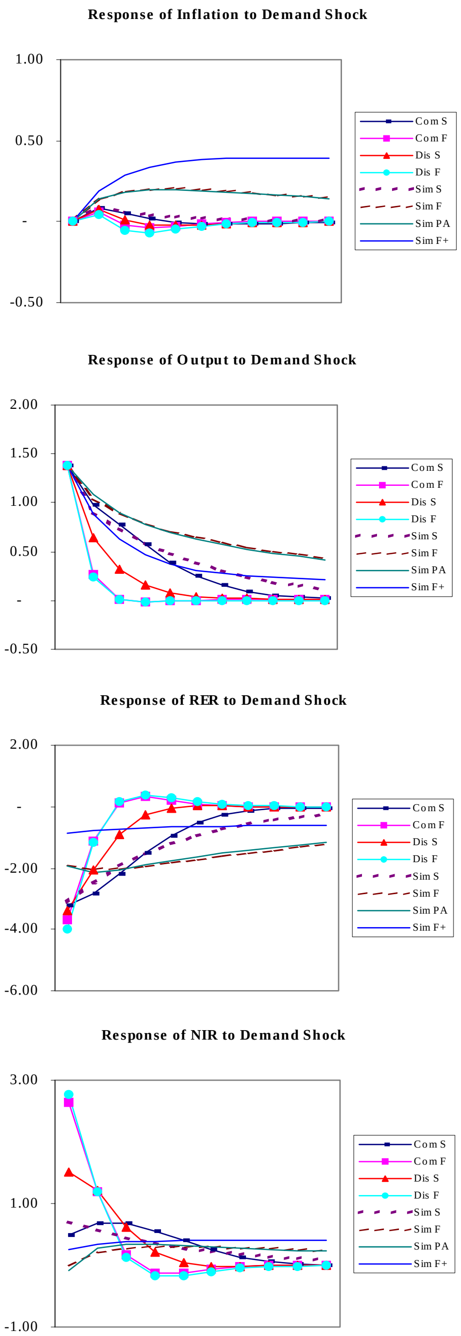
b) Impulse Response Functions (IRFs)

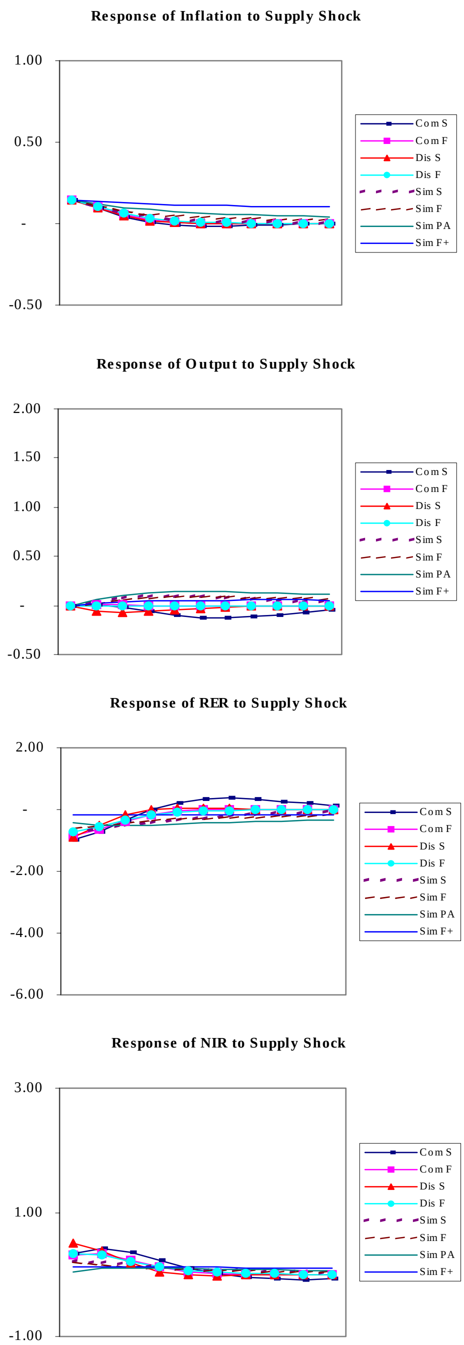
The results generated in this section are impulse (dynamic) responses to various (1 standard deviation) shocks to the goal variables in the model. Following Eichengreen (2001) we pay particular attention to three types of shocks, a positive domestic demand shock (a shock to ε_t^y), a foreign financial/risk premium shock (shock to η_t^y) and a negative terms of trade shock (η_t^y). We observe the responses of these shocks to inflation, output, the real exchange rate (RER) and the nominal interest rate (NIR) for 12 time periods. The impulse reaction functions (IRFs) are presented in Figures 3 to 6.

A positive demand shock is a shock to ε_t^y and the IRFs are in Figure 3. Such a shock affects y_t in Equation (1) directly, which in turn threatens to impact future inflation (from Equation 2). The policy response in terms of inflation in this case is to increase i_t to the extent given by the coefficient on f_π in the rule in Equation (13). This in turn leads to a real appreciation (decrease in q) of the currency (Equation 3). However, in the next period, if the coefficient on f_{q1} has a positive value, part of the interest rate increase will be reversed in response to the appreciation. Clearly, in the case of a domestic demand shock there is a trade-off between the goal of maintaining a stable exchange rate, on the one hand, and that of keeping inflation under tabs, on the other. The trade-off could be observed in the IRFs in that the optimal rules - which are primarily inflation driven - lead to convergence quite rapidly. Those simple rules with exchange rate terms take longer to converge, although if one observes the real exchange rate response to the demand shock, the initial effect of the shock is not as high. From the point of view of faster convergence, it would appear that those rules with a smaller reaction to the exchange rate (Rules 1 and 2) are preferable in this case. The lack of convergence of output can possibly be explained by the contractionary devaluation nature of the model.

Figure 4 captures the IRFs to an inflation shock. There does not appear to be too much difference in the policy types here owing to the lack of ambiguity of the inflation objective and the primacy of the inflation target in most policy types.

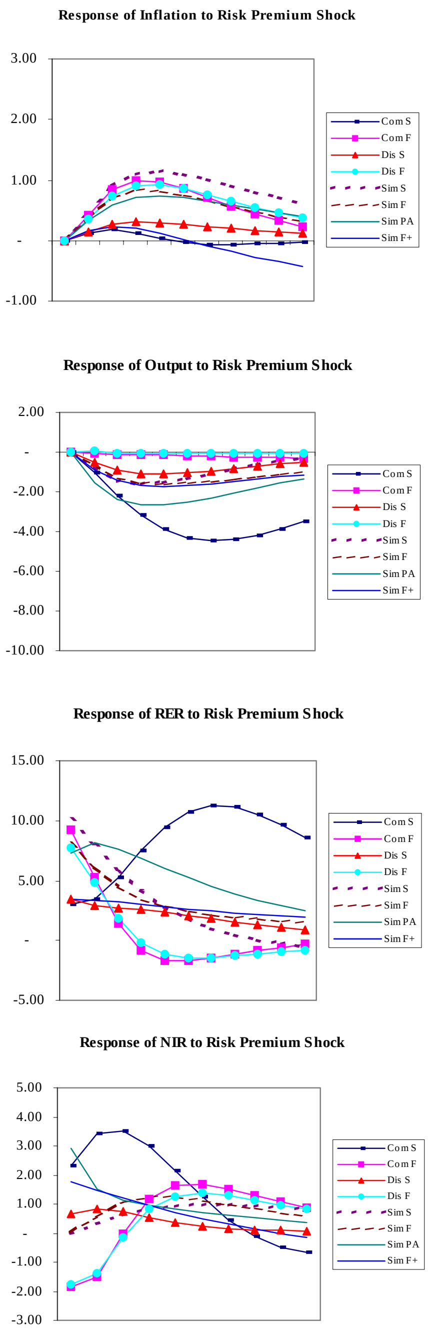
Next consider the case of a negative financial shock such as a rise in the risk premium (v_t) - a pure portfolio disturbance shock. In the model a risk premium shock is modelled as a shock to η_t^v and is presented in Figure 5. A risk premium shock causes a real exchange rate depreciation with consequent inflationary effects via pass through (Equation 2). In the case where devaluation has the conventional positive impact on output (i.e., "pro-competitiveness effects"), the currency depreciation ought to have positive output effects via the competitiveness channel, which in turn will have inflationary effects via the Phillips curve relation.

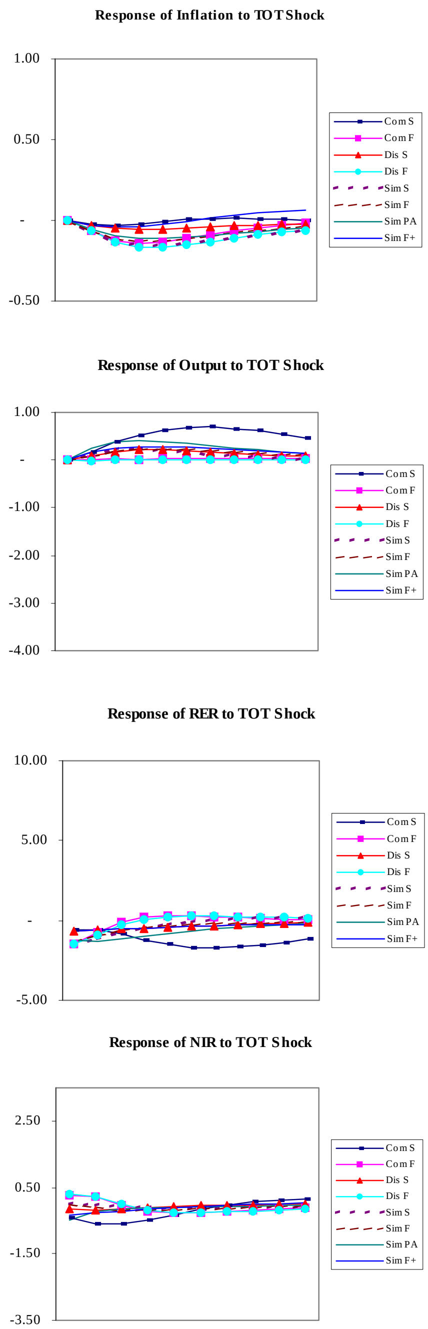




Impulse Responses

Figure 3. **Figure 4.**





Impulse Responses

Figure 5. **Figure 6.**

In this case, in view of the unambiguous inflationary effects of this shock, the IT monetary authority will raise interest rates. While this monetary policy response is optimal from an inflation perspective, it may be mistakenly interpreted as a "fear of floating" (i.e., exchange rate stability is viewed as an end in itself).

In the current parameterization of the model there exists a contractionary devaluation effect in the case of a financial shock. Here, the direct effect of an interest rate hike on output (0.36) is greater than the indirect effect through currency appreciation (0.09), resulting in a net output contraction from the interest rate hike. As with a demand shock, the effect of the output contraction is seen in response to output. The flexible IT rules clearly dominate the strict IT rules. The response of the strict IT policy under commitment reflects the inflation-only nature of the rule. Examining the responses to RER and the interest rate, we see that the flexible IT policies result in some over and undershooting due to the weight placed on output and the trade-off occurring between output and inflation. Initially, the interest rate decreases and the currency then depreciates in response to output, but thereafter the interest rate increases (and currency appreciates) to respond to inflation.

Foreign shocks are not only of the financial variety. As noted by Eichengreen (2001), a MPR is harder to use where the foreign shock involves a terms-of-trade or external demand shock - so-called "Prebisch shock". Consider the negative Prebisch shock (shock to η_t^{y}) and presented in Figure 6. In this case, an interest rate hike would merely exacerbate the decline in aggregate demand. Insofar as the inflationary effects via the aggregate demand channel outweighs the direct price or passthrough effect, the appropriate interest rates response would be to lower interest rates. While this would be at odds with the policy that may be advocated by a "fear of floating" monetary authority, it is consistent with received wisdom which suggests that the more variable the terms of trade, the more flexible ought to be the exchange rate regime. This seems to be reflected in the IRFs, where the policies with less exchange rate intervention appear to dominate.

But what happens if a country is financially vulnerable in the sense that a depreciation might be contractionary as suggested by our simple parameterization? In this event an interest rate reduction will exacerbate the deflationary effects, thus suggesting the need for an interest rate hike. It bears quoting Eichengreen (2001) at length on this issue:

(A) negative shock that reduces export demand and depresses output must be offset in the new long-run equilibrium by an appreciated exchange rate, not a depreciated one. In this peculiar world, overvaluation is good for output because its favorable financial effects dominate its adverse competitiveness effects. It can be reasonably objected that this is unrealistic…But relaxing this assumption means we are back in a world not just where the authorities allow the exchange rate to adjust to a new lower level following an adverse Prebisch shock but also where they do not jack up interest rates to significantly slow its movement. In other words, we are back in the world where they display "fear of fixing" rather than "fear of floating". A possible reconciliation is that when the exchange rate depreciates by a large amount, the adverse balance-sheet effects dominate, but when it depreciates by a small amount, the favorable competitiveness effects dominate. Large depreciations cause severe financial distress because they confront banks and firms with asset prices for which they are unprepared, while doing little to enhance competitiveness because of the speed with which they are passed through into inflation. For small depreciations, the balance of effects is the opposite; small depreciations are more likely therefore to satisfy the conditions for an expansionary devaluation (p. 27-9).[15]

Some support of this asymmetry between large and small exchange rate shocks is provided by Lahiri and Vegh (2001) and Moron and Winkelried (2003). They find that in for a "financially vulnerable country" a case can be made for a non-linear MPR. The non-linearity arises from the fact that the authority should defend the exchange rate in the "turbulent times" but allow the exchange rate to float in tranquil times.

4. CONCLUDING REMARKS

It is a standard conclusion in the closed economy literature on IT that, relative to strict IT, flexible IT controls inflation less effectively but addresses issues of excessive output volatility. This particular conclusion is shown to be true in open economy models presented in this paper.[16] We find that there are quite well defined tradeoffs between inflation and output as well as between inflation and the exchange rate. The contractionary devaluation scenario discussed above also seems to reinforce this view. The effect of the policy instrument (the interest rate operating alone and through the real exchange rate) on output is weakened by contractionary devaluation, whereas the effect through inflation is not. This potentially discourages flexible IT or those regimes involving management of the exchange rate.

Essentially, the question becomes one of whether the central bank wishes to pursue a single objective or a multiplicity of objectives. Our results indicate that there is a clear tradeoff between inflation and the real exchange rate and that flexibility encourages the adoption of different policies in response to different shocks. When one considers these, the results show that monetary policy under an IT arrangement may be flexible enough to allow the exchange rate to be addressed on the basis of responding to particular shocks. This is important when one considers the degree to which the inflation targeting central banks in Asia appear to manage movements in their exchange rates.

How does one reconcile the above analysis with some of the issues relating to

[15] See Krugman (1999) for an elaboration of these thresholds effects of devaluation in emerging economies. Also see Bird and Rajan (2004) and Rajan and Shen (2003).

[16] The shocks that were examined in this paper are highly stylized and assumed to be persistent. If they were transitory, the policy responses above would broadly remain intact, though the interest rate change would be less marked. The rationale is that both the price and output effects tend to have inertial components (see Equations 1 and 2) and therefore tend to be longer lasting.

implementing IT in practice? In practice, there is a growing recognition that as long as the country's inflation outlook remains consistent with the medium term inflation target range (i.e., the policy reference period), the monetary authority has space to use its judgment to judiciously react to other goals such as output, exchange rate or even asset price stability.[17] Nonetheless, there needs to be a clear lexicographic ordering in favor of the inflation goal, such that if the inflation target is threatened at anytime, there is a commitment by the monetary authority to relinquish all other goals in order to meet the inflation target. The more flexible the inflation target (i.e., larger the band and longer the policy horizon), the greater the degree of discretion that can be used by the monetary authority to meet other objectives and respond effectively to various shocks in the interim, though this would be at the expense of transparency and verifiability (Mishkin (2002)). In other words, multiplicity of objectives or flexibility in implementing the inflation target invariably complicates the communication strategy of the monetary authority's monetary policy.

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[17] This said, the shorter the target horizon, the quicker the feedback that the monetary authority receives about possible policy errors, thus allowing for more timely remedial actions. Conversely, the less certain one is about the transmission lag of policy and the less sure one is about the exact stricture of the economy, the greater the rationale for longer target horizon.

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