

**INFLATION TARGETING AND MONETARY POLICY RULES
FOR SMALL AND OPEN DEVELOPING ECONOMIES:
SIMPLE ANALYTICS WITH APPLICATION TO THAILAND**

by

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January 2005

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Comments by Pierre Siklos and other participants at the Western Economic Association meetings in Hong Kong (January 2005) are appreciated. The usual disclaimer applies.

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Abstract

This paper uses a simple stylized macro model to examine the case for and operational mechanics behind an open inflation targeting (IT) arrangement which has increasingly been advocated for small and open developing economies in Asia and elsewhere. The model is calibrated to Thailand, which was among the first Asian country to implement an IT arrangement. The numerical investigations are aimed at comparing conventional optimal monetary policy under commitment and discretion and the variations of the simple fixed MPRs (i.e. versions of “Taylor Rules”). The simple MPRs we will examine differ in how much the real exchange rate is represented in the rule. Will the general philosophy behind IT be suitable for small and open developing economies in Asia? Are some rules better than others? These are some of questions we attempt to explore in this paper.

Keywords: *Asia, developing economy, exchange rate, inflation targeting (IT), monetary policy rules (MPRs), Thailand*

JEL Class: *E52, E58, F31, F41*

1. Introduction

Buoyed by the apparent success of inflation targeting (IT) regimes in industrial countries in the early 1990s, it has been advocated by the IMF and other commentators as a viable policy option for emerging economies in Asia and elsewhere. Since the Asian financial debacle of 1997-98, four of the five crisis-hit countries -- Korea, Indonesia, Thailand and the Philippines -- have instituted monetary policy arrangements fashioned around an inflation objective¹. Each of these countries has passed legal and institutional legislations supporting their respective IT arrangements (Table 1)². These legislations so passed provide for many facets of the new monetary policy regime, including the appointment of key personnel and their tenure (five year terms in Korea and four years each in Indonesia and Thailand), the independence and autonomy of the monetary authority, the stated objectives of monetary policy, and the responsibilities and accountability with respect to the achievement of those objectives. For example, Article 3 of the Bank of Korea Act states that “monetary and credit policies of the Bank of Korea shall be formulated neutrally and implemented autonomously and [its] independence...shall be respected”, while Article 6 provides for the annual setting of the price stability target (www.bok.or.kr). The new Bank Indonesia law states that the single objective of monetary policy is to “pursue and maintain stability of the value of the rupiah” (www.bi.go.id)³.

How have these countries performed since implementing IT regimes?⁴ The inflation performances of these new regimes against their stated targets are provided in

¹ Malaysia shifted to a rigid US dollar peg in September 1998.

² The revised Bank of Korea Act was passed in December 1997 (and revised in April 1998), the new bank of Indonesia Act was passed in May 1999, and the Bank of Thailand Act was passed in May 2000 (Table 1).

³ Alamsyah *et al.* (2001) note of the new Bank Indonesia pronouncement:

The value of the rupiah” could refer to its value in terms of another currency unit – presumably the US dollar, but perhaps some other currency..The alternative interpretation is that it refers to the value of the goods and services the rupiah can buy. This interpretation implies that the objective is the maintenance of domestic price stability, and it is this interpretation that has emerged as the operational one (p.314).

Table 2⁵. At a superficial level, the performances have thus far been commendable, with Thailand, Korea and the Philippines for the most part being within target. Indonesia has struggled to keep its inflation within its target range, while Korea also surpassed its 2001 and 2002 targets. Figure 1 shows the inflation rates relative to the crisis and pre-crisis periods and against when IT regimes were introduced in each country. It shows, at least circumstantially, that the introduction of IT may have had some effect of reducing inflation for Korea, Thailand and the Philippines (although factors such as the contractionary effects of the crisis were also important). The situation for Indonesia is not altogether clear, but this may be a reflection of the ambiguity of its monetary policy objective with respect to inflation.

The normative literature on IT in developing economies typically suggests that such a regime should be accompanied by freely floating exchange rates (in particular, see Masson *et al.* 1997). 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 - the exchange rate arrangements that countries are actually implementing - seem to suggest a reversion to US dollar pegs, albeit ones not as tightly as before the crisis (see Cavoli and Rajan, 2005 and references cited within). What might we conclude from this? Central banks in the region have enacted IT policies and procedures and there has been some increase in the volatility of exchange rate post-crisis, but there is also some evidence of exchange rate management. Is this a consequence of “flexible” inflation target which involves maintaining a fairly broad inflation target band that needs to be hit gradually over time (such as 2-3 years), rather than as soon as possible (this allows for short-term over or under shooting of the target). This way, the monetary authority’s

⁴ For a recent review on IT in East Asia, see Ito and Hayashi (2004)

⁵ Each of these monetary authorities defines inflation a little differently. Indonesia excludes the effect of government prices and incomes policy. Korea uses CPI excluding petrol and some farm products. Thailand excludes raw food and energy prices (see McCauley, 2001 and Table 1).

performance is judged by the average inflation rate over the business cycle rather than at each year⁶.

The remainder of this paper explores the case for and operational mechanics behind various open IT regimes using a simple macro model calibrated to suit a small and open developing economy (Thailand). This is an important aspect of the paper in that it is the combination of parameter values underlying the model that determines the effectiveness or otherwise of an IT regime and various Monetary Policy Rules (MPRs).

Section 2 presents a simple open macro model and presents a range of counterfactual policy responses that are consistent with a monetary authority pursuing an open inflation target. Section 3 examines the impact of these policies in the event of various shocks. The post-crisis monetary policy arrangements in many Asian countries provide a suitable context for analyzing the overall success of an open IT regime and what part the exchange rate might play in the construction of such a regime. The results presented in Section 3.2 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. 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. A significant point of departure between the model presented here and previous ones for industrial countries is the incorporation of possible contractionary depreciation/devaluation. Section 4 concludes with a discussion of the complexities and tradeoffs in the actual implementation of a flexible IT regime.

⁶ One might call this the “Australian view” of IT (see Debelle, 2003).

2. Open Economy Inflation Targeting (IT)

What exactly is IT? While definitions vary in the literature, Eichengreen (2001) provides a definition consistent with the general consensus:

(A) monetary policy operating strategy with four elements: an institutionalized commitment to price stability as the primary goal of monetary policy; mechanisms rendering the central bank accountable for attaining its monetary policy goals; the public announcement of targets for inflation; and a policy of communicating to the public and the markets the rationale for the decisions taken by the central bank (p.4).

As suggested by the preceding quote, IT is conducted in conjunction with a monetary policy rule (MPR). In general terms, the MPR is one element of a strategy employed by the monetary authority as part of its overall monetary policy. The MPR specifies how the instrument of monetary policy is to be changed given the characteristics of the macro economy and the policy objectives of the monetary authority. The MPR implicitly assumes that the instrument of monetary policy will always react strongly to inflation (or some forecast of future inflation). The MPR provides a guide to the policymaker as to how to manipulate the instrument of monetary policy; the inflation target simply makes a statement of what the instrument is being ultimately used for. According to Taylor (2000):

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, 1999a and Svensson, 1997). In this context, when calculating optimal policy, the primary objectives have been inflation and output (deviations). As a result, this has become the conventional stance of monetary policy under an IT system. It is only recently, when 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, the role of the exchange rate. For instance, 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)⁷.

2.1 Small Open Economy Macro Model

In order to investigate and attempt to clarify the role of the exchange rate in the setting of the MPR, let us consider a small open economy model of the type introduced by Ball (1999b) but with the addition of some forward-looking behavior and foreign conditions⁸. The principal motivation for keeping the model simple is to facilitate its calibration to Thailand (see Section 3).

Consider the following set of equations:

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

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

$$e_{t+1|t} = e_t + i_t - i_t^* - u_t \quad (3)$$

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

$$u_t = \theta_u u_{t-1} + \eta_t^u \quad (5)$$

$$y_t^* = \theta_y y_{t-1}^* + \eta_t^y \quad (6)$$

$$\pi_t^* = \theta_\pi \pi_{t-1}^* + \eta_t^\pi \quad (7)$$

$$i_t^* = g_\pi \pi_t^* + g_y y_t^* \quad (8)$$

All variables (except the nominal interest rates) are in logs and expressed as deviations from steady state values.

Equation (1) is the Aggregate Demand (AD) function. Here, the output gap, y_t , depends on its own lag, a measure of the real interest rate ($i_t - \pi_{t+1|t}$), the real exchange rate, q_t , and the foreign output gap, y_t^* . ε_t^y is a zero-mean demand shock. The nominal

⁷ This issue has been examined by Ball (1999b), Svensson (2000) and Taylor (2001).

⁸ This has become the workhorse model (see Bharucha and Kent, 1998, Svensson, 2000, Leitomo and Söderstrom, 2001 and Morón and Winkelried, 2003).

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, 1999b and the first two models in Bharucha and Kent, 1998).

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 equation⁹. Thus, when assessing IT, we are focusing on CPI IT only¹⁰. This is appropriate in that it corresponds to how IT is formally being pursued in many open economies in Asia. ε_t^π is a zero-mean inflation or supply shock.

Equations (3) and (4) are the conventional expressions for uncovered interest parity (UIP) and the purchasing power parity (PPP), respectively. The exchange rate is given by the domestic price of foreign currency (US dollar). The risk premium is given by u_t and, as in much of the literature, is assumed to follow an AR(1) process as described by Equation (5). η_t^u 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^y and η_t^π denote foreign demand and inflation shocks, respectively.

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

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

⁹ See Walsh (2003, p.308) for how a CPI inflation expression can be derived from a non-traded inflation equation and using $\pi_{ct} = p_{ct} - p_{ct-1}$. The result is a forward-looking version of an expression similar to Equation (2).

¹⁰ There is still some debate as to whether CPI IT is preferred to domestic IT in open economies (see Debelle and Wilkinson, 2002, Bharucha and Kent, 1998 for instance). 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.

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

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

we obtain:

$$\pi_{t+2|t} = (1/1-\alpha_1)[\pi_{t+1|t} - \alpha_1\pi_t - \alpha_2y_t - \alpha_3q_t - q_{t-1}] \quad (11)$$

These, along with equations (1) and (5) to (7) constitute the state space system:

$$X_{t+1} = AX_t + B_i + \xi_{t+1} \quad (12)$$

where:

$$X_t = [x_{1t}, x_{2t}]', \quad x_{1t} = [\pi_t, y_t, v_t, i_{t-1}, \pi_t^*, y_t^*, q_{t-1}]', \quad x_{2t} = [q_t, \pi_{t+1|t}]'$$

$$\xi_{t+1} = [\varepsilon_{t+1}^y, \varepsilon_{t+1}^{\pi}, \eta_{t+1}^u, 0, \eta_{t+1}^y, \eta_{t+1}^{\pi}, 0, 0, 0]'$$

$x_{1t} = (n_1 \times 1)$ 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 contemporaneously, while the lag structure of the model implies that indirect effects on inflation via 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):

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

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. This is the basic philosophy behind the Taylor rule. 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. While these simple rules may be ad hoc, their virtue is the fact that since the exact structure of the economy is not known with certainty, a model that is robust across all model structures might be desirable.

b) Optimal MPRs

The MPR could also be formally derived from explicit optimization of a central bank's loss function such as:

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

where δ is a discount factor representing the central bank's rate of time preference, μ_π , μ_y , μ_i , μ_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 zero¹¹. 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)¹². Even if μ_q is zero, the optimal rule will contain non-zero values of f_{q1} and f_{q2} (see equation 13) 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.

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, with 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, it will enter the MPR with a positive

¹¹ If μ_y is also set at zero, Mervyn King (1996) terms such an optimizing monetary authority an "inflation nutter".

¹² 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)

coefficient in view of its information content about current and future inflation (and output)¹³.

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)¹⁴.

c) *Comparisons*

The foregoing caveats notwithstanding, 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 with parameters that might be representative of a post-crisis small Asian economy, viz. Thailand. 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 original Taylor rule for a large and relatively closed economy like the US is one where $f_{\pi}, f_y > 0$ (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 zero¹⁵. This is so as 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}

¹³ Strictly speaking though, Equation (1) requires the inclusion of an export-weighted real exchange rate, Equation (2) requires the use of import weighted nominal exchange rates.

¹⁴ 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 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.

represents a partial adjustment. 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, in an open economy, 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 3)¹⁶.

The next section contains some numerical 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. Simulation Results

3.1 Model Parameterization

In assessing the impact of different policy types, the model is calibrated to represent a small and open Asian economy, viz. Thailand. For this, we have used simple OLS estimates from Thailand which was the first country impacted by the Asian financial crisis and among the first to adopt an IT regime. 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 chosen¹⁷. We use OLS and VAR estimates for Thailand for the last 10 years to assist in selecting these parameters. The structural parameters are presented in Table 4. If one compares the parameters with

¹⁵ There are similarities between rules of this type and monetary conditions indices (MCI) that have previously been employed in New Zealand and Canada. For analytical discussions, see Ball (1999b) and Ball (2001) and for a discussion of its use in New Zealand see Dennis (1997).

¹⁶ Note that an interest rates smoothing that exists with the partial adjustment is incidental because the objective of partial adjustment is to protect the inflation target.

¹⁷ See Ball (1999b), Bharucha and Kent (1998), Leitimo and Söderström (2001), Morón and Winkelried (2003) and Svensson (2000).

those chosen in Ball (1999b) or Leitimo and Söderström (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 work done in this literature (see Table 3). Hence devaluations/depreciations in Thailand appear to be contractionary (Bird and Rajan, 2004 and Rajan and Shen, 2003)¹⁸. 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.

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 Leitimo and Söderström (2001) and for an emerging -- financially vulnerable -- economy *a la* Morón and Winkelried (2003)¹⁹.

The policy configurations for optimal and simple MPRs are summarized in Table 5. 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 reoptimizes every 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

¹⁸ 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).

¹⁹ The MATLAB code for the model solutions is adapted from those obtained from Paul Söderlind's webpage: <http://home.tiscalinet.ch/paulsoderlind/>. We appreciate him making the codes publicly available.

weight of 0.01 is assigned to $\mu_{\Delta i}$ to capture a central bank's desire for instrument stability.

Rows 5-8 in Table 5 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 2.2c and Table 3 ("*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 $f_{q2} = 0$ ²⁰. 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 floating" rule ("*Open Economy Flexible IT without Partial Adjustment*").

The coefficients of the simple rules in Table 5 can be contrasted to those for the optimal rules in Table 6. 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. Will the general philosophy behind IT be suitable for small and open developing economies in Asia? Are some rules better than others? These are some of the questions we attempt to explore below.

²⁰ 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.

a) *Unconditional Standard Deviations*

The first set of results is unconditional standard deviations of the model for each policy configuration. These are presented in Table 7. As expected, there is a tradeoff between inflation and output volatility for strict versus flexible IT. This is observed for the both 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. If, for instance, 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, it seems that strict IT under discretion may be more efficient. This reflects the added flexibility in discretionary policy, in that when the central bank reoptimizes, it incorporates the evolution of those variables that impact on the inflation target in its information set.

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 7, 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 the Open Economy Flexible IT (Rule 3) 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 better inflation but worse 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 currency variation. If we observe the column containing the interest volatility in Table 7, 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 a choice in a continuum between fixed and flexible exchange rates *a la* Frankel (1999) and Rajan (2002).

b) Impulse Response Functions (IRFs)

The next set of results that are generated 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^v) 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 tradeoff between the goal of maintaining a stable exchange rate, on the one hand, and that of keeping inflation under tabs, on the other. The tradeoff 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. 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 tradeoff 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 parametrization for Thailand? In this event an interest rate reduction will exacerbate the deflationary effects, thus suggesting the need for an interest rate hike. Eichengreen (2001) notes of this case:

(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 (pp.27-9)²¹.

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: Implementing IT in Practice

The shocks that were examined in this paper for Thailand 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. While the preceding discussion is somewhat simplified, it shows that monetary policy under an IT regime may be flexible enough to allow the exchange rate to be addressed on the basis of responding to particular shocks.

There is, however, 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 stability²².

²¹ 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).

²² 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.

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. In other words, multiplicity of objectives/flexibility in implementing the inflation target invariably complicates the communication strategy of the monetary authority's monetary policy. As Mishkin (2002) notes:

The KISS principle ("Keep It Simple Stupid") suggests that monetary policy should be articulated in as simple way as possible. The beauty of inflation target regimes is that by focusing on one objective – inflation – communication is fairly straightforward. (p.14).

Apart from lack of clarity regarding the goal of monetary policy, there are a number of concerns with incorporating multiple variables in the loss function (i.e. multiple targeting).

One, it is difficult to measure output gaps given the problems with estimating equilibrium output and equilibrium exchange rate (Mishkin, 2002). Of course, one way to overcome this concern would be to target output and exchange rate variability as opposed to variation from equilibrium (Ades, *et al.*, 2002). In the case of the exchange rate objective, this effectively implies the monetary authority focuses on the resource allocation costs of large exchange rate fluctuations as opposed to those due to currency misalignment²³.

Two, when the monetary authority explain its monetary policy actions by referring to the need to ensure output or exchange rate stability, "the political debate about monetary policy is likely to focus on short-run issues" (Mishkin, 2002, p.11), be it job

²³ Williamson (1999, 2001) has suggested that the monetary authority target a Band-Basket-Crawl with fairly wide bands, thus allowing for a degree of discretionary monetary policy to be

creation, exchange rate stability of even asset price stability. This in turn may “obscure the transparency of monetary policy and make it less likely that the public will support a monetary policy that focuses on long-run considerations” (Mishkin, 2002, p.14) and may worsen the output-inflation tradeoff.

Three, in relation to the above, responding too heavily and frequently to currency movements in the short-term could risk transforming the flexible inflation target to a *de facto* soft currency peg which in turn tends to be crisis-prone. This observation may be especially pertinent to some Asian economies like Thailand where there are concerns of a reversion to exchange rate based monetary policy regime. For instance, an IMF report on exchange rate regimes has rightly cautioned that:

There is an important danger...in slipping back into *de facto* pegging of exchange rates against the US dollar. While this may be sustainable for some considerable period, this may well eventually contribute to recreating the problems that led up to the Asian crisis.” (Mussa *et al.*, 2000, p.59).

The foregoing notwithstanding, the optimal MPRs themselves can and do depend heavily on the foundation and structure of economic and financial systems of an individual country. Consequently, there is significant margin of error in the policy rules that are frequently written down in the form of a mechanical operational instruction (algebraic formula)²⁴, thus suggesting need for a degree of discretion in its implementation. Additionally, some amount of flexibility is desirable given the uncertainty about the link between policy instruments (exchange rate and interest rate) and policy outcomes (inflation), as well as other types of uncertainty, including those inherent in forecasting inflation.

implemented within the band. Willett (2002) makes the valid point that one could approach the design of exchange rate bands in an analogous manner to that of IT.

²⁴ For instance, what are the factors that enter the monetary authority's loss function?; is the loss function quadratic?; what is the true structural economic model? All of these will impact the final policy rule that is derived.

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Table 1
Highlights of Inflation Targeting Regimes in Selected Asian Economies

Country	Date	Target price index	Target Width	Target horizon	Escape Clauses	Accountability	Target set by	Publication and accountability
Indonesia	May 1999	Headline CPI	Table 2	1-2 years	none	None, but parliament can request reports at any time	Central Bank	Quarterly Inflation report, Annual report to public
Philippines	Dec 2001	Headline CPI (Core CPI measure introduced Feb 2004)	Table 2	2 years	Yes, in the event of oil price shocks, food supply shocks	Public explanation of the nature of the breach and steps to address it	Central Bank	Quarterly inflation report, publication of monetary policy meetings
Thailand	Apr 2000	Core CPI (excluding food and energy)*	Table 2	Indefinite	None	Public explanation of breach and steps taken to address it	Central Bank in consultation with Government	Inflation Report, inflation forecasts and publication of models used
Korea	Jan 1998	Core CPI (excluding non-cereal agricultural products and petroleum products)	Table 2	indefinite	Changes caused by major force	None	Central Bank in consultation with Government	Inflation report and submission to parliament, publication of monetary policy meetings

Source: Compiled by authors from Bank of Korea, Bank Indonesia, Bank of Thailand, Bangko Sentral ng Pilipinas websites
For more information see, Sun (2004)

Table 2
Actual Headline (Core) versus Targeted Inflation Rates (in percent):
Korea, Indonesia, Thailand, the Philippines

	1999		2000		2001		2002		2003	
	Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual
Korea	3.0	0.8	2.5	1.8	2.5	3.6 (3.2)	2.5	3.7 (3.1)	2.5	3.4 (2.7)
Indonesia			3-5	9.4	3-5	12.5	3-5	10.0	9.0	5.1
Thailand			<3.5	1.4 (0.8)	<3.5	0.8 (1.2)	<3.5	1.6 (0.3)	<3.5	1.8 (0.2)
Philippines					6-7	6.1	5.0*	3.1	5.0*	3.1 (3.4)

Notes: * plus/minus half percentage point

Sources: Bank of Korea, Bank Indonesia, Bank of Thailand, Bangko Sentral ng Pilipinas websites

Table 3
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

Table 4
Model Parameters

Aggregate Demand	Phillips Curve	Foreign Cond	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.

Table 5
Policy Configurations

Optimal Policy Rule under Commitment: <i>Strict Inflation Targeting</i>	$\mu_\pi = 1, \mu_y = 0.0, \mu_{\Delta l} = 0.01$
Optimal Policy Rule under Commitment: <i>Flexible Inflation Targeting</i>	$\mu_\pi = 1, \mu_y = 0.5, \mu_{\Delta l} = 0.01$
Optimal Policy Rule under Discretion: <i>Strict Inflation Targeting</i>	$\mu_\pi = 1, \mu_y = 0.0, \mu_{\Delta l} = 0.01$
Optimal Policy Rule under Discretion: <i>Flexible Inflation Targeting</i>	$\mu_\pi = 1, \mu_y = 0.5, \mu_{\Delta l} = 0.01$
Simple Monetary Policy Rule 1: <i>Strict Inflation Targeting</i>	$f_\pi = 1.5, f_y = 0, f_{q1} = 0, f_{q2} = 0$
Simple Monetary Policy Rule 2: <i>Flexible Inflation Targeting</i>	$f_\pi = 1.5, f_y = 0.5, f_{q1} = 0, f_{q2} = 0$
Simple Monetary Policy Rule 3: <i>Flexible Open Economy Inflation Targeting</i>	$f_\pi = 1.5, f_y = 0.5, f_{q1} = 0.4, f_{q2} = -0.2$
Simple Monetary Policy Rule 4: <i>Flexible Open Economy Inflation Targeting without partial adjustment</i>	$f_\pi = 1.5, f_y = 0.5, f_{q1} = 0.5, f_{q2} = 0$

Source: Authors; see text for details

Table 6
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

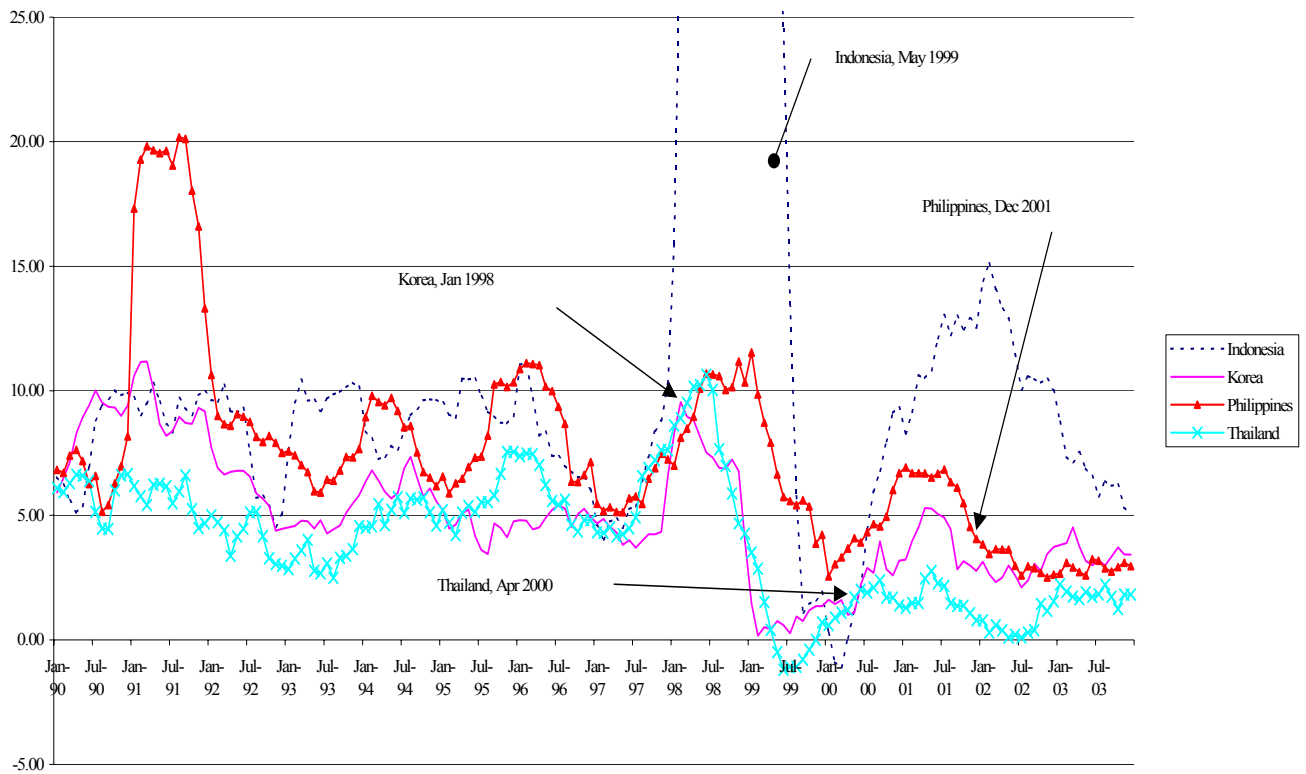
Source: Authors; see text for details

Table 7
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

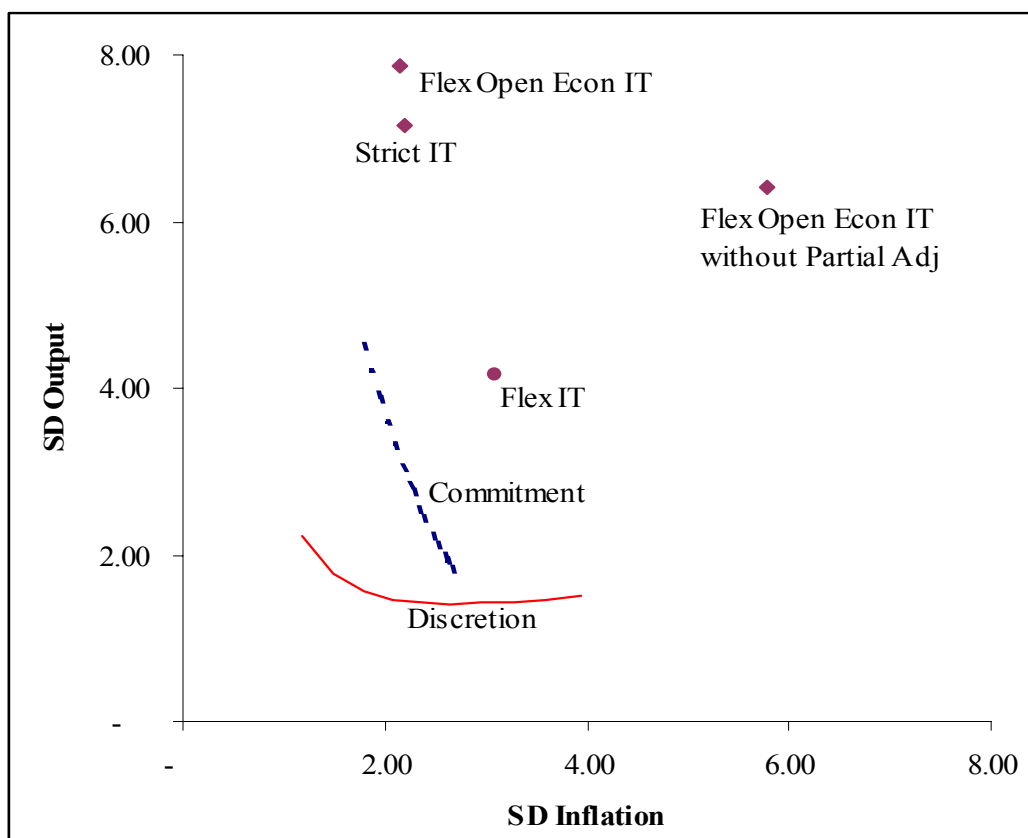
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Figure 1
Inflation Rates



Source: IFS

Figure 2
Output/Inflation volatility tradeoffs



Impulse Responses

Figure 3

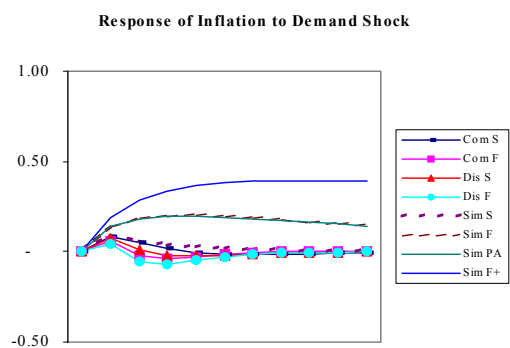
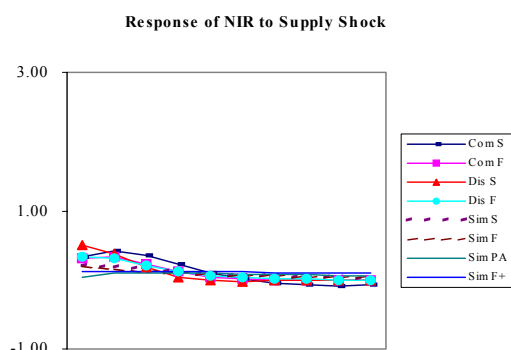
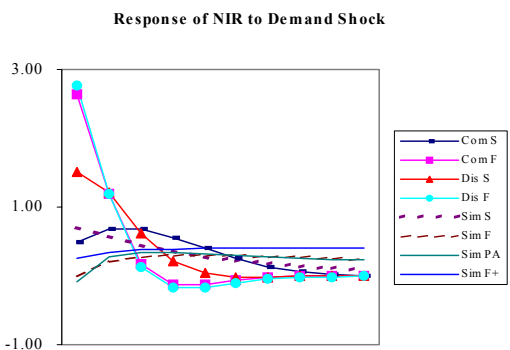
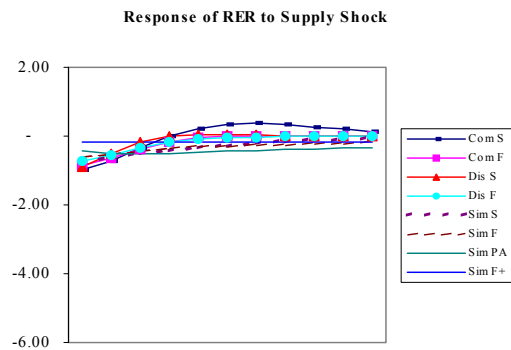
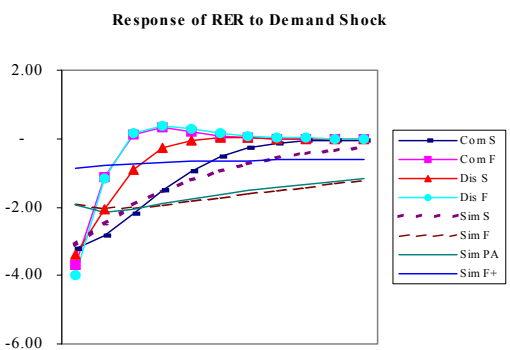
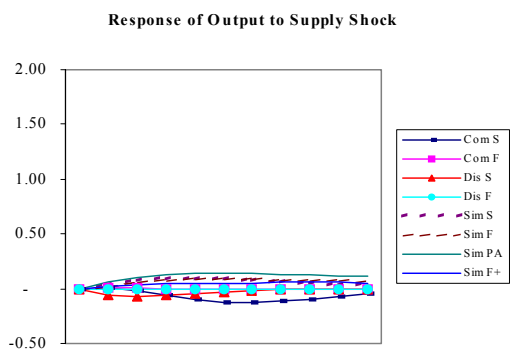
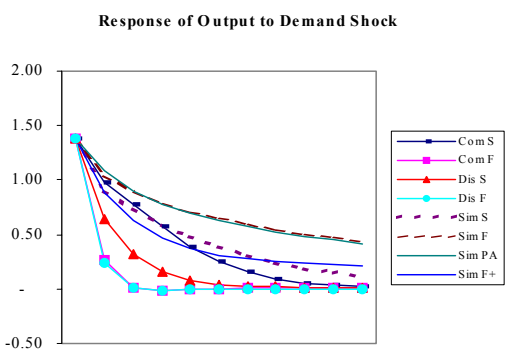
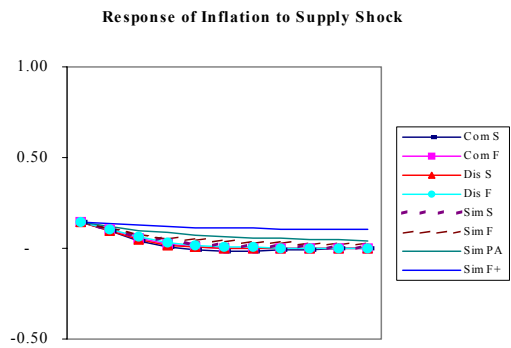


Figure 4



Impulse Responses

Figure 5

