Working Paper
in Economics and
Development Studies

Department of Economics
Padjadjaran University

No. 200707

Approximating Monetary Policy: Case Study for the ASEAN-5

Arief Ramayandi
Padjadjaran University/
Australian National University

August, 2007

Center for Economics and Development Studies,
Department of Economics, Padjadjaran University
Jalan Cimandiri no. 6, Bandung, Indonesia.
Phone/Fax: +62-22-4204510
http://www.lp3e-unpad.org

For more titles on this series, visit:
http://econpapers.repec.org/paper/unpwpaper/

Approximating Monetary Policy: Case Study for the ASEAN-5

Arief Ramayandi*†

AJRC - CSEG
Australian National University

2007

Abstract

Empirical studies on the process of monetary policy making in a number of advanced economies have shown that a simple policy reaction function (PRF) performs well in explaining the setting of monetary policy. This paper examines an application of a simple PRF in an attempt to broaden the understanding of monetary policy making processes in five developing ASEAN countries. As found to be the case in the more advanced economies, a simple PRF is also found to perform well in explaining the setting of monetary policy in these countries. Moreover, the findings uncover the main drivers behind the conduct of monetary policy and provide a relatively consistent explanation about the monetary policy episodes in the sample economies.

JEL classifications: E50, E52, E43
Keywords: Monetary policy, policy reaction function, ASEAN

---

*Address: AJRC, Crawford School of Economics and Government, The Australian National University. e-mail: arief.ramayandi@anu.edu.au

†The author thanks M. Hasni Shaari and Pornpen Sodsrichai for insightful discussions on the conduct of monetary policy in Malaysia and Thailand; and Gordon de Brouwer, Tom Kompas, Peter Drysdale and David Vines for helpful comments on the earlier draft of the paper.

Contents

1 Introduction

Monetary policy plays a key role in managing economic fluctuations. For that reason, understanding the conduct of monetary policy is of considerable interest. Essentially, monetary policy making is an intricate process where a monetary authority gathers an extensive set of relevant economic information before delivering its policy action. This fact makes efforts for tracking the true representation of monetary policy very complicated. Therefore, a question about whether or not a simple representation can approximate the true conduct of monetary policy becomes relevant. A simple representation of monetary policy, although it may not be very precise, can help in understanding the conduct of monetary policy and provide pictures about possible directions of any future monetary policy stance.

To help in understanding such issues, the literature has sought a simple characterisation of policy reaction functions in order to summarise the monetary authority's behaviour in setting policy. A common successful simplification is generally known as the Taylor (1993) type of rule. In this type of rule, the monetary policy stance is typically seen to be driven by fluctuations of inflation around its long-run steady state target and fluctuations in measures of the economic cyclical variable (normally represented by the output-gap). Existing literature in this area has shown that variants of the Taylor type rule have done reasonably well in explaining changes in the direction of monetary policy in developed economy cases.[1]

While the above approach has been relatively successful for approximating monetary policy in the more advanced economies, little is known on the outcome of a similar exercise in developing economies. The purpose of this paper is to examine the simple monetary policy reaction function in the case of five ASEAN economies (Indonesia, Malaysia, the Philippines, Singapore and Thailand) in order to understand the setting of monetary policy in the region and to identify the key drivers behind it. To serve this objective, we estimate a general form of the simple policy reaction function for each of the economies using a sample of quarterly data spanning 1989 to 2004.

One of the challenges faced for conducting the above exercise is the fact that monetary authorities in ASEAN make use of different tools and approaches to implement monetary policy. To reconcile the issue, this paper will justify the inclusion of the key interest rate as a common proxy for the policy variable of those economies. Another important issue is that most of the sample countries report shifts in their adopted monetary regime during the chosen sample period. Since the dates for those potential shifts are predetermined, the paper also presents the estimates of policy reaction functions using sub-samples that start or end around those known dates for each case and investigate if the shifts are clearly reflected in the data.

This paper is structured as follows. Section 2 provides a brief description of the nature of monetary policy in each of the economies in the sample. Section 3 offers a justification for the choice of proxy for the policy instrument and presents the methodology adopted to

[1] For example, Clarida et al. (1998) for the case of six major economies, Taylor (1999) and Clarida et al. (2000) for the US case, Nelson (2000) for the UK case, and de Brouwer and Gilbert (2005) for the case of Australia.

conduct the estimation. Section 4 outlines the data set and discusses the issues surrounding it. Section 5 reports and evaluates the findings. Section 6 concludes.

2 Monetary Policy in ASEAN-5 Countries: A Brief Description

The conduct of monetary policy in most of the five ASEAN countries under consideration has varied during the last two decades. This variation is mainly in response to the 1997 Asian financial crisis, and can clearly be seen in those economies that were hit the hardest by the crisis (like Indonesia and Thailand). For the economies where the impact of the crisis was not as severe (like Singapore and the Philippines), the changes are less obvious. This section provides a brief general description of the development of monetary policy in those countries within the relevant time period.

2.1 Indonesia

The ultimate goal of Bank Indonesia (BI – the central bank of Indonesia) has always been to achieve and maintain stability in the value of its currency (Rupiah). During the pre-crisis period, BI adopted a crawling peg exchange rate regime to achieve this goal.[2] Severe depreciation pressure in the crisis period forced BI to abandon the exchange rate regime and adopt a freer regime within a tighter base money targeting framework. This was done to restore confidence in the currency and to tame inflation. In achieving the base money target, BI relies upon open market operations through the sale of BI certificates (SBI).

Institutionally, there was also a major change in the conduct of monetary policy in Indonesia in the post-crisis period. In 1999 a new central banking law was enacted establishing the independence of BI.[3] The act obliges BI to set an inflation target every year and direct monetary policy to achieve it. In other words, the act has directed BI to adopt an inflation targeting type of framework. Lately, the operating target in conducting monetary policy has also shifted from base money targeting to targeting an interest rate (the 30-day SBI rate).

2.2 Malaysia

Price stability that provides a supportive environment for promoting a sustainable level of economic activity is the ultimate objective of Bank Negara Malaysia (BNM – the central bank of Malaysia). To accomplish this objective, the BNM monetary policy strategy prior to the mid-1990s had been based on targeting monetary aggregates. The strategy was internal in the sense that it was not formally announced to the public, where BNM influenced the day-to-day volume of liquidity in the money market to be consistent with its monetary growth target. Large capital inflows and their reversal in the early 1990s,

[2] Based on the classification of the International Monetary Fund (IMF), Indonesia is categorised as having adopted a managed floating exchange rate regime at that time. However, the Rupiah exchange rate was practically fixed to the US dollar with a fixed depreciation rate normally announced once a year.

[3] See Bank Indonesia (2000) for further explanation.

however, is considered to be creating instability in the monetary aggregates, which was then used as a target by the bank (Cheong, 2005). Consequently, towards the mid-1990s, BNM shifted its focus from monetary targeting to interest rate targeting. For the operational policy target, BNM uses the 3-month interbank rate. As for the exchange rate regime, BNM is then categorised by the IMF as a managed floater. The Malaysian ringgit exchange rate is set to be free within some unannounced band and the BNM intervenes whenever needed.

In response to the Asian financial crisis, the ringgit exchange rate was fixed in the late 1998 coupled with an imposition of a selective capital control in order to provide BNM with greater monetary autonomy in influencing domestic interest rates to support the economic recovery.[4] In July 2005, however, BNM has shifted back to adopting a managed float exchange rate regime for the Malaysian ringgit.

2.3 The Philippines

The primary objective of Bangko Sentral ng Pilipinas (BSP – the central bank of the Philippines) monetary policy is to maintain price stability that is conducive for balanced and sustainable growth of the economy. BSP has gained its monetary policy independence since around 1986. Starting from January 2002, BSP has also officially adopted an inflation targeting framework for its monetary policy regime. As for the exchange rate regime, BSP has been categorised as an independent floater.

To achieve the primary objective of its monetary policy, BSP adopted a strict monetary targeting framework until mid-1995. This was done on the basis of the perceived stable and predictable relationship between the monetary target and the ultimate target of monetary policy. The operating objective was to target M3 by manipulating base money as the policy instrument. As this perceived stable relationship started to become questionable, BSP gradually shifted its monetary policy framework in 1995. The new monetary policy framework at that time was to complement monetary aggregate targeting with some form of inflation targeting. Later on, more weight was put on the latter. Following the changes, the policy instrument was also gradually adjusted from quantity targeting to targeting the interest rate.[5]

2.4 Singapore

The primary objective for the Monetary Authority of Singapore (MAS) is to promote price stability to ensure low inflation as a sound basis for sustainable economic growth. In accomplishing its objective, MAS has adopted a unique monetary policy framework by centering on exchange rate management rather than managing the money supply or the interest rate. Since 1981, MAS has managed the Singapore dollar exchange rate against an undisclosed trade-weighted basket of currencies of Singapore's major trading partners and competitors.[6] The composition of this basket is being periodically reviewed and revised

[4] As argued by Kim and Lee (2004), imposition of capital control and a fixed exchange rate regime may still provide independence for a central bank from an international influence.

[5] See Lamberte (2002) for the more detailed discussion.

[6] See, among others, discussions in Parrado (2004) and McCallum (2006).

to take into account changes in Singapore's trade patterns. However, details concerning the index and the boundaries of the target band are not disclosed. The extent of any appreciation or depreciation depends mainly on the expected inflationary pressures and the MAS intervenes in the foreign exchange market to prevent excessive fluctuations in the exchange rate.

The justification of this unique behaviour lies primarily in the characteristics of Singapore's economy being small and open. In such a case, the exchange rate is deemed to be an ideal intermediate target for monetary policy to maintain price stability. The high degree of financial openness and sensitivity of capital flows to interest rate differentials makes it difficult to target either money supply or interest rates in Singapore. Net flows of funds from abroad account for the bulk of changes in domestic money supply and domestic interest rates are largely determined by foreign rates and market expectations on the future strength of the Singapore dollar.

2.5 Thailand

Unlike the other central banks in the region, the Bank of Thailand (BoT – the central bank of Thailand) does not carry an explicit statement of its primary objective in its Bank of Thailand act. In practice, however, maintaining monetary and financial stability for achieving sustainable economic growth has always been the primary goal of the BoT. On top of that, the BoT has also announced the adoption of explicit inflation targeting in May 2000.

To achieve its goal the BoT's monetary policy framework can be divided into three different episodes. Before the 1997 financial crisis, the BoT adopted the pegged exchange rate regime as the anchor of its monetary policy.[7] Unlike the Indonesian case, however, the value of the Baht against the US dollar was announced and defended on a daily basis rather than being determined annually.

The 1997 crisis forced the BoT to float the exchange rate and adopt monetary targeting for conducting its monetary policy. As in the case for the pegged exchange rate adopted previously, liquidity management was also conducted on the daily basis to ensure against excessive volatility in interest rates and liquidity in the financial system. In May 2000, the BoT made an extensive reappraisal of both the domestic and the external environment, and concluded to move on to adopting the inflation targeting framework in conducting monetary policy.[8] The main cause for this change was an assessment that the relationship between money supply and output growth has become less stable, especially in the period after the major crisis where the uncertainty in credit extensions as well as the rapidly changing financial sector took place in Thailand. Under this framework, the BoT implements its monetary policy by influencing short-term money market rates via its key policy rate, the 14-day repurchase rate.

[7] See, for example, discussion in Phuvanatnaranubala (2005).

[8] See, among others, discussions in Devakula (2001) and in Phuvanatnaranubala (2005).

3 The Monetary Policy Reaction Function

3.1 Approximating monetary policy

Identifying monetary policy is not an easy task. Not only do different monetary authorities adopt different operating targets in conducting their policy, but the adopted operating target itself often varies over time. This situation points to the identifying monetary policy problem, where it is hard to find a consensus on how to measure the size and direction of changes in monetary policy (Bernanke and Mihov, 1998). In dealing with the issue, various measures for representing monetary policy have been utilised in the empirical literature. They cover the range of operating targets commonly used by monetary authorities; i.e. monetary aggregates (quantity targeting), short-term interest rates (price targeting) and, in some cases, exchange rates.

Under the condition where an economic system operates with certainty, there is no conflict between using the quantity targeting or price targeting as an instrument for conducting monetary policy. On the other hand, when uncertainty is introduced into the picture, the choice of policy instrument matters in determining the best outcome for monetary policy (Poole, 1970). This may be one of the reasons why, in practice, monetary authorities tend to alter their operating instruments to cope with the relevant economic challenges that they are facing. On practical grounds, however, Goodfriend (1991) and Goodhart (1995) argue that regardless of what monetary regime a monetary authority claims it follows, the actual implementation of monetary policy can be approximated by looking at how a monetary authority sets the short-term interest rate. It is argued that a policy that actually targets the short-term interest rate can better deal with the short-run variability of the velocity of money and provide an achoring function to prices in the assets market.[9] For this reason, the short-run interest rate has been most widely used to proxy the monetary policy stance in recent theoretical and empirical literature.[10]

As discussed in the previous section, the operating target for conducting monetary policy in the ASEAN-5 countries has also varied in the last decades. In many cases, the exact form of the monetary policy instrument is also rarely transparent. These situations create difficulties for obtaining a precise measure of monetary policy for all of the observation period. To deal with this problem, following the approach commonly found in the current literature, the relevant short-term interest rate for the selected ASEAN countries is used to approximate the monetary policy stance in this paper.

The preference to model a monetary policy reaction function using the interest type rule is basically due to the ability of this model to track real data well, according to the empirical literature.[11] Furthermore, the relationship between the three candidate proxies of the operating target for monetary policy (monetary aggregates, interest rate and the exchange rate) have been relatively well defined by the theory. The monetary authority cannot fix both money and interest rates at the same time. Once the monetary authority

[9] Further arguments from central bankers point of view can also be found in, for example, Poole (1991).

[10] See for example Bernanke and Blinder (1992), Clarida et al. (1998; 2000), de Brouwer and Gilbert (2005), Nelson (2000),etc. for the empirical literature and Woodford (2003), etc. for the theoretical foundation.

[11] See the empirical literature in the footnote above as an example.

has chosen one as an instrument, the other becomes a variable. A similar argument applies to the choice between interest rate and exchange rate. If exchange rate is fixed by the authority, then interest rate will have to adjust whenever needed to keep the exchange rate intact. Another reason for focusing on interest rate rather than changes in monetary aggregates is the potential inadequacy of the latter to represent the true policy stance due to its dependence on a variety of non-monetary policy influences. As a monetary authority typically prefers to smooth fluctuations of the interest rate, decisions to change the stock of monetary aggregates may be taken to accommodate innovations in money demand. Therefore, changes in monetary aggregates may not be followed by corresponding changes in interest rates. In other words, changes in monetary aggregates may reflect changes in both its supply and demand components without necessarily reflecting changes in a policy stance.

Following the above arguments, this paper attempts to approximate monetary policy for the selected economies by estimating the interest rate type rule. Given this decision, the case of Singapore needs some further attention. As discussed earlier, the Singaporean monetary authority has been consistently running its monetary policy by managing the Singapore dollar exchange rate against an undisclosed trade-weighted basket of currencies of Singapore's major trading partners and competitors since 1981. Consequently, exchange rate targeting would be the most appropriate representation of monetary policy in Singapore. McCallum (2006) stresses that the exchange rate targeting employed by the MAS is fundamentally different from a traditional fixed exchange rate arrangement. The MAS, he argues, manages the exchange rate as its monetary policy instrument rather than short-term interest rate.

To study the conduct of monetary policy in Singapore, Parrado (2004) estimates a variant of the Taylor type rule with changes in the trade weighted index (TWI) of exchange rate as the operating target variable. The estimated equation takes the following form:

$$\Delta e_t = \rho \Delta e_{t-1} + (1-\rho)\left(\alpha + \beta \pi_{t+n} + \gamma x_t\right) + \varepsilon_t \tag{1}$$

where Δe_t is the change in TWI at time t; π_{t+n} is the inflation rate at time $t+n$; x_t is the measure of the output gap at time t; α, β, γ and ρ are the relevant parameters that will be discussed further in the next subsection; and ε_t is the residual term with $E(\varepsilon_t) = 0$.

To maintain comparability with the other economies in the sample, this study will instead approximate the monetary policy in Singapore by taking interest rate as the instrument for monetary policy. This strategy is justified by exploiting the uncovered interest parity (UIP) relation as follows:

$$i_t = i^* + E_t \Delta e_{t+1} + \xi_t \tag{2}$$

where i_t is the domestic nominal interest rate at time t; i^* is the exogenous foreign interest rate; and E_t is the expectation operator taken at time t. ξ_t is a term introduced to capture the possibility of any short-term distortion that could potentially distort the parity. For simplicity it is assumed that $\xi_t \sim \left(0, \sigma_\xi^2\right)$ and is intertemporally independent, so that the parity holds in expectation.

Combining equation (1) and the UIP relation above we end up with the following relationship:

$$i_t = \rho i_{t-1} + (1-\rho)(\alpha + \beta\pi_{t+n+1} + \gamma x_{t+1}) + (i^* - \rho i^*) + u_t \quad (3)$$

where $u_t = \xi_t - \rho\xi_{t-1}$. The relationship in (3) is similar to a variant of interest rule type of equation which will be discussed in more detail in the following subsection. The differences, however, lie in the additional term $(i^* - \rho i^*)$ and the potentially non-zero $cov(u_t, u_{t-1})$.

3.2 The reaction function: Specification and estimation strategy

There are several different strategies that can be pursued in order to obtain a policy reaction function. To obtain a prescriptive form of a reaction function for example, Fuhrer (1997) estimated a small SVAR model for the United States economy and derives the optimal rule from the model. de Brouwer and O'Regan (1997) derives an optimal policy rule from a small structural model of the Australian economy. Another example would be Filosa (2001) who derives a modified Taylor rule for a number of the developing countries. However, since this strategy tends to produce a prescriptive policy rule for the policy makers rather than tracing back the historical conduct of monetary policy, the methodology is not really suitable in serving the purpose of this study.

Another approach for getting a policy rule is by estimating the general (baseline) specification of a policy reaction function using a historical data set of the economy under consideration. In particular, it focuses on the possibility of monetary authorities in small open developing economies adhering to the Taylor type interest rule[12] in delivering their past policy conduct. This type of policy rule typically assumes that policy makers respond to the development in the deviation between inflation from its target level and the output gap. To progress with the estimation, there are at least two different strategies that can be pursued. The first would be to estimate the Taylor type policy reaction function (also known as the backward-looking rule). The second would be by estimating a similar specification but using the forward-looking assumption.

The backward-looking specification, however, is often criticised for neglecting one important aspect of monetary policy making in the real world; that is its forward-looking perspective. It is argued that instead of looking at the current or lagged values of inflation and output, policy makers in practice tend to base their policy decisions on expectations of future values of those variables. Clarida et al. (1998) propose an estimable methodology to deal with this forward-looking policy reaction function and have demonstrated that their methodology works well in evaluating the monetary policy behaviour in G7 countries. Batini and Haldane (1999b; 1999a) and de Brouwer and Gilbert (2005) find that this forward-looking specification performs better in evaluating the monetary policy behaviour relative to the backward-looking one. For that reason, the policy reaction functions in this study are estimated based on the forward-looking assumption and the methodology adopted closely follows that proposed by Clarida et al. (1998; 2000).

[12]Known also as the Bryant et al. (1993) rule. This rule is classified as more general in terms of specification, where the Taylor rule is considered as one of the variants. See discussion in de Brouwer and Gilbert (2005).

The specification for the baseline policy rule takes a simple form. Within each of its operating periods, a monetary authority is assumed to set the nominal interest target rate $\left(\widetilde{i}\right)$ based on developments in the expected inflation around its target and the output gap.

$$\widetilde{i}_t = \bar{\imath} + \kappa_1 \left[E_t \left(\pi_{t+n} \mid \Omega_t\right) - \pi^*\right] + \kappa_2 E_t \left(x_{t+q} \mid \Omega_t\right) \tag{4}$$

where $\bar{\imath}$ can be interpreted as the long-run equilibrium level of the nominal rate; π^* is the long-run inflation target; x is the output gap that serves as a measure of cyclical variable; and Ω_t is the set of information available to the monetary authority at the time they set interest rates. Clarida et al. (1998) also entertain an extension of the baseline model by allowing for a possibility for other variables (such as exchange rate, money growth, international interest rate, etc.) to affect the target rate explicitly. That is:

$$\widetilde{i}_t = \bar{\imath} + \kappa_1 \left[E_t \left(\pi_{t+n} \mid \Omega_t\right) - \pi^*\right] + \kappa_2 E_t \left(x_{t+q} \mid \Omega_t\right) + \kappa_3 E_t \left(z_{t+k} \mid \Omega_t\right) \tag{5}$$

where z denotes the other variable affecting the target policy rate.

The policy reaction function outlined in (4) or (5) is acknowledged to be too restrictive for describing the actual movement in the policy rate.[13] It is restrictive in the sense that (i) the functional form in both (4) or (5) assumes that the target rate will adjust immediately to developments of the affecting variables (regardless of the magnitude); (ii) they represent the systematic response of a monetary authority to the development in the economy without acknowledging a possibility of randomness in the policy action; and (iii) they assume that a monetary authority has perfect control over the interest rate.

Abrupt and frequent changes in the policy rate could disrupt the capital market and consume the credibility of a monetary authority. Since credibility is very important for a monetary authority, it then typically prefers to smooth the movements in interest rate. To avoid a loss of credibility from impulsive large changes in the policy instrument, it is further assumed that a monetary authority smooths the interest rate by adjusting it partially to the target:

$$i_t = (1 - \rho_i)\, \widetilde{i}_t + \rho_i i_{t-1} + v_t \tag{6}$$

where i_t is the actual interest rate at time t; ρ_i is the partial adjustment coefficient that captures the degree of interest rate smoothing; and v_t is the error term introduced to capture randomness in policy action and the fact that a monetary authority does not have perfect control over interest rate. The intuition behind such an adjustment scheme is that the authority does not adjust the interest rate fully according to its desired current target level, but taking some linear combination between its desired target level and the past value of the interest rate to smooth its movement.

Substituting (4) into (6) to obtain an estimable equation for the policy reaction function gives us the following:

$$i_t = (1 - \rho_i)\, \alpha_i + (1 - \rho_i)\, \kappa_1 \pi_{t+n} + (1 - \rho_i)\, \kappa_2 x_{t+q} + \rho_i i_{t-1} + \varsigma_t \tag{7}$$

[13] See Clarida et al. (2000).

where,

$$\alpha_i = \bar{\imath} - \kappa_1 \pi^*$$

and,

$$\varsigma_t = -(1-\rho_i)\left\{\left[\kappa_1 \pi_{t+n} - E_t\left(\pi_{t+n} \mid \Omega_t\right)\right] + \kappa_2\left[x_{t+q} - E_t\left(x_{t+q} \mid \Omega_t\right)\right]\right\} + v_t$$

with $E_t(\varsigma_t) = 0$. The later term (ς_t) is a linear combination of the forecast errors of inflation, the output gap and the exogenous disturbance v_t.

Once the estimable functional form is established, the next step would be to determine a vector of instrumental variables ($\mathbf{u}_t$; $\mathbf{u}_t \in \Omega_t$ and orthogonal to ς_t) that includes the monetary authority's information set at the time they choose the interest rate. That is the elements of $\mathbf{u}_t$ need also to be uncorrelated with v_t and hence $E_t(\varsigma_t \mid \mathbf{u}_t) = 0$. The last condition provides a basis for estimating the vector of unknown parameters $\begin{bmatrix} \kappa_1 & \kappa_2 & \alpha_i & \rho_i \end{bmatrix}'$ by using the generalised method of moments (GMM) with an optimal weighting matrix that accounts for possible serial correlation in ς_t.[14]

In order to estimate the relation set out in (7), the sample period from which the data are obtained needs to contain sufficient variations in the variables involved and, also, be sufficiently long to fairly identify the slope coefficients in the policy reaction function. Clarida et al. (2000) also maintain a stationary assumption for both nominal interest rate and inflation in order to be able to work out the long-run inflation target for their estimates by imposing an additional restriction. The next section will discuss the above requirements for the case of the ASEAN-5 countries.

Additional notes are needed for Singapore's case concerning the situation explained in the earlier subsection. To estimate Singapore's policy reaction function using interest rate by exploiting the UIP condition leaves us with an extra term. If we are sure about the currency reference used in its exchange rate management policy, then i^* is identified in principle. In that case one can estimate the PRF using the differential between domestic and foreign interest rate ($i_t - i_t^*$) as the dependent variable. However, in the case where the currency reference is unclear, identification for i^* becomes difficult. In that case, one can proceed in estimating (7) by at least imposing two alternative assumptions. If one is willing to assume i^* to be constant, then the term can be lumped in to the constant term of the equation. If i^* is not constant over time, but ($i^* - \rho i^*$) series is stationary, then its constant component could be captured in the constant term of the policy reaction function and its remainder would be part of the error term in the function. Since the term is stationary, then the stochastic component of it will also be stationary. Therefore, the residuals from the estimated policy reaction function will still appear to be stationary.

[14] See Favero (2001, pp. 222-225) for a more detailed explanation.

4 Data

To estimate the approximate monetary policy reaction function, the analysis is conducted using quarterly data starting from 1989 to 2004.[15] This particular period is chosen since most of the countries analysed underwent significant structural changes in their economy during the 1980s. These structural changes were also accompanied by significant policy variation. Indonesia for example, underwent two significant banking and financial sector deregulations in the 1980s. Similar changes also occurred in Malaysia where BNM deregulated the interest rate structure of the banking system throughout the early 1980s. To avoid too many potential breaks in the policy regime, the analysis is conducted with the beginning of the 1990s as a starting point.

Following from the explanation in the earlier section, variables considered for the analysis are the short-term nominal interest rate, consumer price indices (CPIs), real output and the relevant exchange rate. Most of the data are taken from the CEIC Asia database except for the TWI of exchange rate data for Singapore, Malaysia and the Philippines, which are taken from the IMF estimates in the International Financial Statistics (IFS) database.[16] Real output data for Malaysia and Indonesia before 1991 and 1993, respectively, are obtained from their central banks. Details about data are provided in Appendix A.

4.1 Interest rates

In this paper, interest rates are treated as the proxy for the policy variable. Following the current policy rate, the 30-day SBI rate is used for Indonesia, the 90-day Manila reference rate for the Philippines and the 14-day repo rate for Thailand. Although the current policy target rate for Malaysia is the 3-month interbank rate, this study uses the 3-month treasury bills (TB) discount rate instead. This proxy is chosen because of the data availability from the CEIC database. The interbank rate is only available starting from 1996 in the version where the data are obtained, while the TB discount rate data are available for the whole period under consideration. Nevertheless, the correlation between the two series during the period where both series are available is very high (about 97 per cent). Lastly, the 3-month interbank rate is used as a proxy for Singapore substituting the actual policy target TWI. Appendix A.1 provides the graphs of each country's interest rates and reports the statistical results for their stationarity tests.

Interest rates for the five ASEAN countries under consideration share similar patterns over the sample period. They tend to start off higher in the beginning of the sample and tend to be relatively lower towards the end. In other words, there seems to be a decreasing trend in the nominal interest rates in the region. This tendency, however, does not appear to be pronounced in the case of Indonesia, which, together with the Philippines, has a relatively higher average rate than its neighbours. Another shared feature is the interest rate jump around the period of the East Asian financial crisis. Indonesia, the economy that was

[15] An exception applies for Thailand's case where the quarterly output data is only available starting from 1993.

[16] The real effective exchange rate estimates for Indonesia and Thailand are unavailable. For the two countries we use the domestic currency exchange rate to the US dollar instead.

hit hardest by the crisis, experienced the highest jump (reaching about 6 times higher than its average rate), while other countries were experiencing about a 2 to 3 times higher jump relative to their average rates. An exception for this observation is the Philippines. Although it experienced an interest rate increase during the period, the level fluctuated closely around its sample period average. This observation accentuates the argument that unlike its neighbouring countries in the region, the Philippines' economy was not disturbed much by the crisis.

To test for stationarity of the series along the sample period, two tests are conducted; i.e. the Augmented Dickey-Fuller (ADF) test for unit root in a series (Dickey and Fuller, 1979) and the KPSS test for stationarity of a series (Kwiatkowski et al., 1992). The KPSS test is conducted to complement the ADF test for unit root, which is deemed to have low power against its relevant alternative of non-unit root in the series. The results for both tests to the interest rate series are reported in Appendix A.1. All of the interest rate series are found to be stationary during the sample period according to the KPSS test, but Singapore and Thailand data are only found to reject the unit root hypothesis marginally, based on the ADF test. The tests also confirm the observation about the decreasing trend in the series. The SBI rate series for Indonesia is found to be stationary during the sample period, while all of the other series are found to be trend stationary.

4.2 Inflation rates

To proxy the inflation rate, this study uses year on year changes in the consumer price index (CPI) series. Inflation is calculated as the difference between the log value of today's CPI and the log value of its fourth quarter lag. The inflation rate series shares similar general observations with the nominal interest rate series. As also observed in the nominal interest rate series, the region's inflation series displays a decreasing trend over the sample period. This tendency, again, appears to be less pronounced for the case of Indonesia. The series also experiences jumps during the financial crisis period. Together with the general observation in the nominal interest rate series, this observation suggests that the movement in the nominal interest rate in the region tends to be correlated with the movement in inflation rate.

The stationarity tests conducted (as reported in Appendix A.2) also support the general observation made on the decreasing tendency in inflation rate over the sample period. Both tests conclude that Indonesia's inflation rate is stationary, while the rest are trend stationary. Note however, that in the case of Malaysia this conclusion is only accepted relatively marginally.

4.3 Exchange rates

The exchange rate variable is measured as its annual percentage changes by taking the difference between its current log values and its fourth quarter lag. This paper uses the TWI of exchange rate from the IFS to measure the relative exchange rate changes for the cases where data are available, namely Singapore, Malaysia and the Philippines. For Thailand and Indonesia, since the series are not available, the exchange rate with respect to the US dollar is used instead. The utilisation of TWI is considered to be preferable since, particularly for the case of Singapore and Malaysia, the variable is the working exchange rate variable considered by the monetary authority. As a caveat, however, the TWI does not necessarily represent the true working variable that those authorities are using since in practice the actual weights are not publicly announced.

As reported in Appendix A.3, all the annual changes in the exchange rate measure appear to be stationary and only the series for Singapore appear to be stationary around a (decreasing) trend. The latter may appear due to the role of the TWI in Singapore that serves the means for an actual operating instrument of its monetary policy.

4.4 Measuring the output gap

Due to the unobservable nature of the potential output, measuring the output gap has almost always been a difficult task. The task is even more problematic in the case of developing economies. For the case of Asian economies, only few empirical research efforts have been conducted in providing an appropriate measure for the output gap, e.g. Coe and McDermott (1996) and Gerlach and Yiu (2004). As noted by the earlier studies, the time series behaviour for the real output in the Asian economies may differ from the other advanced economies and they also have been exposed to large disturbances, particularly during the crisis period in the late 1990s.

Taking the above situation into account, Gerlach and Yiu (2004) compare estimates of the output gap for selected Asian countries (Hong Kong, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore and Taiwan) produced by different purely statistical methodologies; namely, the Hodrick-Prescott (HP) filter, the band-pass (BP) filter, the Beveridge-Nelson (BN) filter and the unobservable components (UC) time series approach. They arrived at a conclusion that estimating the output gap in Asian countries does not appear to be more difficult than in other advanced economies. This conclusion is due to general similarities in the results – that match well with the common perceptions of economic fluctuations for their sample economies – obtained from those different methods. Additionally, the HP and BP filters, and the UC method generate relatively similar estimates of the output gaps. Therefore, it suggests that the three approaches produce estimates that contain relatively the same information for variables that policy makers are interested in.

4.4.1 Estimating potential output

Following the conclusions from Gerlach and Yiu (2004), this study employs the HP filter method to estimate the unobserved potential output for the five ASEAN countries. The HP filter is applied directly to the seasonally adjusted series for the case of Malaysia, Singapore and the Philippines.[17] This treatment is applied by considering the fact that those three economies do not seem to be experiencing a capacity fall during the crisis period.

[17] A seasonally adjusted series is used to avoid the unnecessary regularities from disturbing the behavioural pattern in the series. For the case of Singapore, the seasonally adjusted series for real output data is used. For the case of four other economies in the sample, the seasonally adjusted data is not available, therefore, the real output series is seasonally adjusted using the census X12 seasonal filter.

For the cases of Indonesia and Thailand, however, the real output series drops severely right after the crisis. For the case of Indonesia particularly, the estimated growth of capital stock is around 0 in 1998 and negative in 1999 as shown in Figure 2 in Appendix A. This observation motivates the possibility of a break in the potential output in Indonesia around a year after the financial crisis hit the country. As Thailand was also severely hit by the crisis, it is assumed to have experienced a similar break in its potential output around a year after. To approximate the magnitude of the break, the real output is fitted to a linear trend and a dummy variable indicating the starting period of the potential break (around a year after the date when the crisis hit the country). This dummy appears to be negative and significant for both the cases of Indonesia and Thailand. The HP filter is then applied to estimate the potential output for both countries after adjusting for the break.

4.4.2 the output gaps

Using the potential output estimates outlined above, the output gap measures are calculated as the difference between the log of seasonally adjusted output and its HP filtered series. The estimates are shown in Figure 6. A thing to note about estimates for Indonesia and Thailand is that the closing of the gap in 1999 is mainly due to the drop in the trend of potential output as explained earlier. This may look like a speedy recovery for both economies, but in fact it is the drop in productive capacity that actually closes up the gap. As reported in Appendix A.4, all the output gap measures appear to be stationary.

5 Empirical Results

This section reports estimates of the policy reaction function for the ASEAN-5 economies. It will first discuss the results obtained from the baseline estimation for all the sample economies and go into a further discussion of each individual country issues. The baseline estimates here refer to the estimation results of equation (7) for the entire sample period considered in this study. Later, in the analysis for the individual economies, the possibility for a break in the behaviour of the monetary authorities according to their historical description as discussed in Section 2 is considered.

5.1 Baseline estimates

Estimation of the baseline policy reaction function for each of the sample countries is conducted using the GMM technique by exploiting the most parsimonious set of instruments for each case.[18] In general, the instrument list includes lag values of i, π, x and annual change in the exchange rate (Δe) as the underlying information at the time the interest rates are set. This choice of instruments is motivated by the variables that commonly appear in a simple structural model of a small open economy. In the estimation, we alter

[18]Parsimonious selection of the instrument variables is strongly suggested in order for the instruments to be optimal based on the Monte Carlo simulations by Tauchen (1986) and Kocherlakota (1990). See Hamilton (1994, pp. 426-27). Instrument variables in this study are picked according to the strength of correlation between the instrument and the variable it instrumented.

the target horizon for inflation ($n = 0, ..., 4$) and fix the one for the output gap to be equal to 0. Details for the result of the baseline estimation for the whole sample period are presented in Appendix B.

For the case of Indonesia, the list of instrument variables used is found to be valid according to the Hansen J-test for all n. The best[19] estimate is obtained at $n = 1$ and the fit worsens as n gets larger. The effect of different target horizons for inflation is found to be consistently positive and significantly different from zero except for $n = 4$. The further the target horizon for inflation in the PRF, the lower is its ability to track the actual movement in interest rate (the fit is actually dropped significantly at $n > 2$). It suggests that longer forecast profiles of inflation do not appear to be significant in explaining movements in the policy rate. While this situation appears to be dramatic for the case of Indonesia, the estimate for the other countries does not appear to be as obvious. Unlike inflation, the measure of the output gap does not appear to be significant in affecting the movement in the policy rate in Indonesia. Not only does the parameter appear to be insignificantly different from zero, but its magnitude also insensibly appears to be negative.

As for the case of Indonesia, the list of instruments used to estimate PRF in Malaysia is also found to be valid for all n considered. The best estimate in this case is obtained at $n = 1$. The effect of different target horizons for inflation are also found to be consistently positive and significantly different from zero. However, unlike what is found in the case of Indonesia, the magnitude of this parameter is found to be relatively stable in this case. The magnitude of this parameter lies around the value of 1.7. The coefficient on the measure of the output gap in the case of Malaysia is also found to be positive and significant up to $n = 1$. The weight however, is small relative to the weight put on the forecast of inflation.

The findings for the case of the Philippines are slightly different. In this case, the best PRF estimate is obtained at $n = 1$, but based on the Hansen $J-$statistics the list of instruments are only valid for $n = 0$ and 1. Both the forecast of inflation and the measure of the output gap are found to have a positive and significant effect on the interest rate. However, unlike the other cases, the weight for the output gap dominates in driving the movement of the interest rate. While the point estimate of the output gap parameter in the PRF is found to be above 1, the point estimate of the forecast of inflation parameter is found to be well below 1.

In the case of Singapore, the utilised instrument list is also found to be valid for all n. The best estimate in this case is obtained at $n = 0$. For all of the inflation target horizons that appear to be significantly different from zero (the case where $n = 0, 1$ and 4), the point estimates of the parameters are scattered around the value of one. The point estimates for parameters of the measure of the output gap also fall near the value of one, except for the case where $n = 1$ where the estimated parameter is only marginally significantly different from zero. This finding indicates that the parameter estimate is relatively stable given different target horizons of inflation.

As discussed earlier, the case of Thailand is estimated using shorter intervals due to data availability problems. However, the list of instrument variables utilised in this case still

[19] "Best" here is defined according to the highest fit obtained from the estimation.

appears to be valid and the best fit is achieved at $n = 3$. The forecast of inflation appears to enter the PRF with a positive effect that is significantly different form zero regardless of the target horizon considered. The magnitude of the parameter for this variable is found to be larger than the other cases considered in this study (the point estimate is generally more than 2 except for the case where $n = 0$). Similarly to the case of estimated policy reaction functions for Indonesia, the measure of the output gap does not appear to enter the function significantly.

In terms of the degree of the interest rate smoothing, the findings vary among countries. The movement of interest rates in Singapore is found to be highly persistent, with ρ_i value around 0.87 to 0.88. The interest rate movements in Thailand and Malaysia are also found to be relatively persistent, with the weight on the lag interest rate varying around 0.7 to 0.85 in the case of Thailand and 0.7 for Malaysia. In the case of the Philipines and Indonesia, the weight for the lag interest rate falls slightly more than one half. Particularly for the case of Indonesia, however, the interest rate movements become more and more driven by inertia as we move the forecast horizon for inflation further ahead. This observation confirms that, in the case of Indonesia, further target horizons for inflation ($n \geq 2$) have less explanatory power over the movement in interest rate.

Another general observation out of this exercise is that in most cases α_i ($= \bar{\imath} - \beta\pi^*$) tends to come out as insignificant. This observation could arguably come up as a result of the relatively short sample period for the estimation. Although the sample period contains sufficient variation in the variables considered, we can not ignore the fact that during that period (except for Indonesia), the interest rate and the inflation series are stationary around a (decreasing) trend.[20]

Depending on available external information to assume the value of one of the components of α_i, most previous empirical studies on monetary policy reaction functions attempt to infer either the long-run inflation target or the long-run equilibrium level of nominal interest rate from the information provided by the estimate of α_i.[21] While uncovering the value of either $\bar{\imath}$ or π^* is a valuable exercise for drawing policy implications, the behaviour of some variables in the sample period used by this study (particularly nominal interest rate and inflation) constrain us from conducting similar exercise. The data suggests that some kind of adjustment towards a lower long-run inflation targets and nominal interest rates may take place during the sample period considered. For that reason, this paper avoids identifying the values for either long-run equilibrium interest rate or long-run inflation target for our sample countries since α_i from the estimation is not very likely to carry relevant information concerning the exact value of any of the two variables.

A summary of the best results is presented in Table 1. It reports the summary of the GMM estimates for each country based on the best fit of the results reported in Appendix B. As indicated earlier, the best fit for Indonesia, Malaysia and the Philippines is obtained at the target horizon for inflation (n) equal to 1; for Singapore it is obtained at $n = 0$ and for Thailand at $n = 3$.

[20] See appendix A.1 and A.2.

[21] For example, Clarida et al. (2000) fix the US real interest rate target to its observed sample average to infer the value of π^*; and de Brouwer and Gilbert (2005) instead fix π^* to a given inflation target value applicable for the case of Australia to back out its neutral nominal interest rate.

Table 1: Parameters for the baseline estimates of the policy reaction function

Country	α_i	κ_1	κ_2	ρ_i	Adj. R^2	$J-test$
Indonesia	4.18	1.15	-0.24	0.536	0.893	2.63
$(n = 1)$	(1.62)	(0.11)	(0.45)	(0.05)		[0.75]
Malaysia	0.56	1.66	0.19	0.69	0.873	4.31
$(n = 1)$	(0.39)	(0.12)	(0.05)	(0.076)		[0.51]
Philippines	0.07	0.72	1.22	0.55	0.791	3.02
$(n = 1)$	(0.01)	(0.18)	(0.60)	(0.12)		[0.22]
Singapore	0.82	1.27	0.94	0.85	0.879	6.80
$(n = 0)$	(0.87)	(0.49)	(0.46)	(0.05)		[0.34]
Thailand	-3.61	2.65	0.09	0.70	0.917	4.13
$(n = 3)$	(0.82)	(0.30)	(0.24)	(0.04)		[0.66]

Note: 1. Numbers in brackets are the relevant standard errors.
2. Numbers in square brackets are the p-values for the J-test.

A number of interesting observations come out in Table 1. First of all, the basic model is not rejected at the conventional significance level for any of the cases considered. Further, the best fit GMM estimates of the policy reaction function are able to track the movement in the interest rate very well as shown by the relatively high adjusted R^2 values. The estimated values of κ_1 have the expected positive sign and are significant for all cases. The point estimate of κ_1 is generally $\geqslant 1$, except for the case of the Philippines.[22] Where it is significantly different from zero, the estimated values of κ_2 also tend to have the expected positive sign. For Singapore and the Philippines, the weight on the output gap in the policy reaction function is fairly high. In the case of the Philippines, the point estimate even outweighs the weight for the forecast of inflation. For Malaysia, although it is significantly different from zero, the weight on the output gap is relatively small, and for the case of Indonesia and Thailand, the parameter for this variable does not even come out to be significantly different from zero.

The estimated figures seem to support the general price stabilising objective of monetary policy in the considered economies.[23] The estimated PRF above shows an indication that in general the sampled countries share a relatively similar preference by adhering to the Taylor principle in conducting their monetary policy ($\kappa_1 > 1$). Following the common wisdom in the theory, this implies that the monetary policy of these countries has been stabilising for the economy. That is, monetary policy reacts to expected inflation and so tends to stabilise fluctuations in both output and inflation. With some caveats in mind,[24] the Philippines seems to be the only exception to these results. Instead of putting more weight on inflation in driving monetary policy, the results suggest that the authority in the Philippines put a more than one-to-one weight on the output gap. Nevertheless, the results reported in Table 1 indicate that a simple Taylor type rule, combined with an interest smoothing behaviour of the monetary authority, is able to summarise the

[22] Note, however, that the t-statistics test marginally fails to reject the hypothesis that $\kappa_1 = 1$ in the Philippine's case.

[23] See, among others, Taylor (1999), Clarida et al. (1999; 2001), and Woodford (2001) for discussions on the Taylor principle.

[24] See previous footnote

behaviour of interest rate setting in the 5 ASEAN economies reasonably well.

Another interesting point to note is that exchange rate does not appear to be explicitly important in driving the setting of interest rate. It is, however, part of the important background information utilised by the central bank in determining their monetary policy stance. An exercise of putting exchange rate measure as an additional explanatory variable, as in equation (5), does not present any indication that it enters the equation with a parameter that is significantly different from zero.[25] However, the results of the J-statistics test justify the inclusion of the lag exchange rate as a valid instrument for the GMM estimation. This finding is in line with the argument of Taylor (2001), in which he argues that including exchange rate directly into the interest rate rule does not yield much improvement in the performance of the optimal rule. He further argues that even in the version of the simple interest rate rule that excludes the exchange rate variable, as in equation (4), the impact of exchange rate movement is already reflected in the outcome of inflation and the output gap that is considered in making interest rate decisions. Hence, adding the exchange rate as an additional variable to the interest rate rule will only give a marginal improvement (if any) to the basic simple version of the interest rate rule.

Finally, although varying in terms of its magnitude, the estimate of the smoothing parameter (ρ_i) is fairly high in all cases (ranging from 0.53 to 0.85). This finding indicates that monetary policy appears to be relatively persistent and subject to some inertia. That is, typically only less than half of the changes in the target interest rate are reflected in the changes in the actual interest rate. This finding confirms that the monetary authorities in the ASEAN-5 countries (although with varying degree) prefer to smooth the adjustments in their interest rate.

5.2 A closer look at individual cases

Results presented in Table 1 are obtained using the entire sample period for this study. As discussed in Section 2, most of the countries under consideration experience shifts in their monetary policy regime during the sample period. To have a better picture about this issue, we look further at individual country cases and see if the shift is reflected in the data.

To study the individual country cases, we begin by looking at the potential changes in monetary policy regime around the dates discussed in Section 2. Indonesia and Malaysia shift their monetary policy regime right after the Asian financial crisis hit the economy. The Philippines changes its policy regime in 1995. Thailand moves on to adopting the inflation targeting framework in 2000. Unlike its neighbours, Singapore's monetary policy regime has been constant throughout the sample period. In order to assess the possibility of changes in behaviour, the PRFs are re-estimated by using the sub sample that ends or begins around those dates. The results of this exercise are presented in Table 2.

Table 2 indicates that, except for the case of Indonesia, there is no significant difference between the PRF estimate from the whole sample period and the one obtained from the sub sample considered. In the case of the Philippines, all parameter estimates from the

[25] The results for this exercise are shown in Table 12 in Appendix B.

Table 2: Estimated parameters for the subsample period

Country	Sub sample	α_i	κ_1	κ_2	κ_3	ρ_i	Adj. R^2	$J-test$
Indonesia:	(1989-1997)	-0.16	-	-	3.40	0.66	0.69	3.24
		(2.90)	-	-	(0.60)	(0.11)		[0.78]
	(1998-2004)	-2.73	1.78	1.04	-	0.52	0.85	2.99
		(1.55)	(0.11)	(0.48)	-	(0.03)		[0.70]
Malaysia:	(1989-1997)	1.01	1.54	0.17	-	0.63	0.72	1.73
		(2.18)	(0.58)	(0.13)	-	(0.08)		[0.88]
Philippines	(1995-2004)	0.06	0.66	1.31	-	0.53	0.42	4.16
		(0.01)	(0.23)	(0.72)	-	(0.11)		[0.13]
Thailand	(1994-1999)	-3.58	2.60	0.13	-	0.69	0.86	2.86
		(1.02)	(0.29)	(0.34)	-	(0.03)		[0.83]

Note: 1. Numbers in brackets are the relevant standard errors.
2. Numbers in square brackets are the p-values for J-test.

sub sample under consideration are not significantly different from their point estimate counterparts obtained from the whole sample period. For the case of Malaysia, the constant term (α_i) remains insignificantly different from zero and the rest of the parameters are not significantly different from their respective point estimates reported in Table 1. A similar case is also observed for Thailand, where the output gap remains to enter the PRF insignificantly. Another interesting observation out of the exercise based on the sub sample period is that exchange rate remains directly insignificant in explaining changes in the interest rate for all of the three cases above. Inclusion of exchange rate explicitly in the extended PRF, as in equation (5), does not produce significant parameter estimates for that particular variable.[26] Based on those findings, we conclude that during the sample period under consideration the available data does not suggest the existence of a significant break in the behaviour of monetary policy for those countries. In other words, although changes in monetary policy regime have been conceptually introduced within the sample period, the behaviour in conducting monetary policy in Thailand, Malaysia and the Philippines does not appear to change significantly.

The case of Indonesia is slightly different from three of its neighbouring economies discussed above. In this case, the estimation using different sub samples (pre and post-crisis samples) produces significantly different point estimates of the PRF parameters. When the post-crisis period is considered, inflation enters the function with a larger parameter magnitude and the output gap also enters the function significantly with a coefficient magnitude around one. When the pre-crisis period is considered, neither inflation nor the output gap enters the function significantly. For this period, estimation of the extended PRF as in equation (5), by including changes in the exchange rate, also shows that the parameters for both inflation and output are not significantly different from zero. However, changes in the exchange rate significantly affect the movement in interest rate. This last finding confirms the crawling peg regime adopted by the Indonesian monetary authority in the pre-crisis period. The interest smoothing parameter for both sub samples remains to be insignificantly different from the point estimate obtained from the whole sample es-

[26] The results are presented in Table 13 in Appendix B.

timation. Note, however, the point estimate for ρ_i in the pre-crisis sub sample is relatively higher than the one obtained under the whole sample estimation.

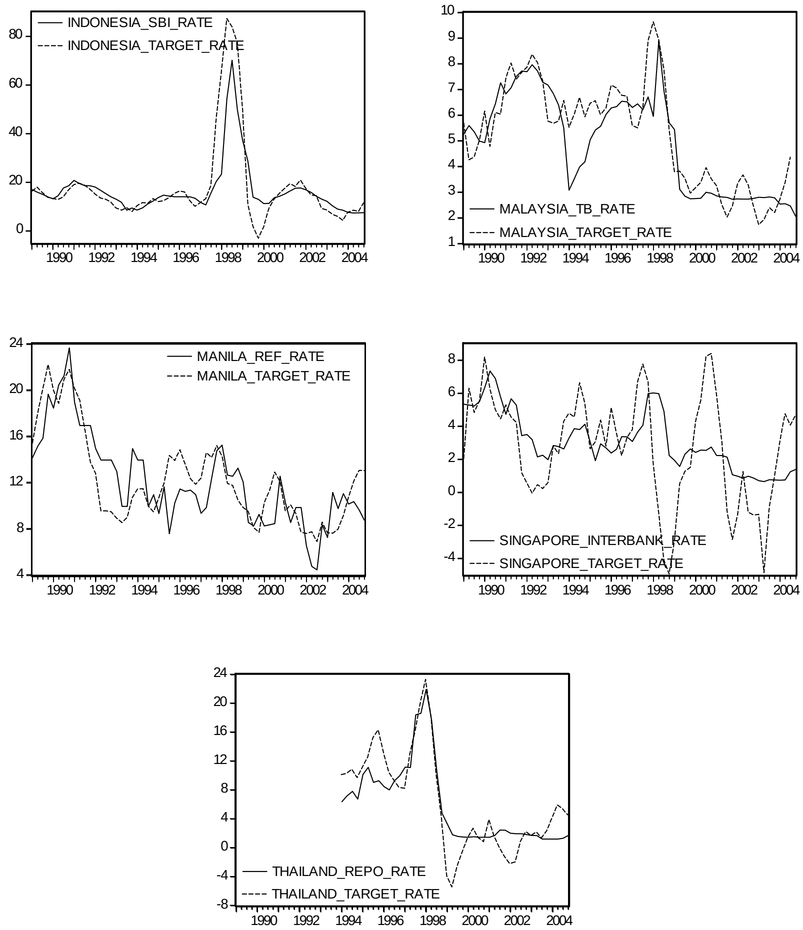
The above findings suggest that in the case of Indonesia, there is an indication of a significant shift in the way monetary policy is conducted in that country. The data suggests that changes in the SBI rate during the pre-crisis period are mainly driven by changes in the exchange rate. On the other hand, after the crisis, the SBI rate in Indonesia is mainly driven by both inflation and the output gap. This signifies the policy shifts from a (crawling) peg exchange rate regime to a Taylor type rule in conducting monetary policy. We need to note that Thailand also adopted a pegged exchange rate regime in the pre-crisis period. However, unlike the case of Indonesia, the Baht value against the US dollar was announced and defended on a daily basis rather than being determined annually. The board of the BoT evaluated the domestic economic situation before deciding the preferred value of the currency and kept it fixed within a day. Therefore, the exchange rate management adopted by the BoT at that time looks more like the one adopted by Singapore rather than Indonesia. This may be a reason why we do not observe significant changes in monetary policy behaviour in the Thai data as is observed in the Indonesian data.

Singapore is the only country that is likely to have a constant monetary policy regime throughout the sample period. As reported in Table 1, the best fit for our GMM estimation is obtained at inflation forecast horizon (n) equal to zero. Parrado (2004) estimates a variant of a Taylor type rule with changes in the TWI of exchange rate as the operating target variable and prefers $n = 3$ (nine month forecast horizon in inflation) for representing the policy reaction function in Singapore. If the Parrado result is taken as valid, then based on the argument represented by equation (3), the corresponding counterpart for the interest rule would be the one with $n = 4$. To reconcile this issue, we compare the point estimates of the parameters for the two functions as reported in Table 10 of Appendix B. Magnitude of all the estimated parameters for both the PRF with $n = 0$ and $n = 4$ are insignificantly different from each other. Therefore, both inflation and the output gap enter the policy reaction function similarly, regardless of the choice of the forecasting time horizon for inflation.

Figure 1 compares the actual movement in the interest rate with the implied target rate obtained from our estimation. The implied target rate series are calculated from the estimated parameters after disallowing for partial adjustment. Therefore, it is calculated based on the functional form described in equation (4), characterised by the estimated parameters. That is, the estimates for the implied target rate are calculated using the equation for a simple rule, characterised by the estimated parameters of $\alpha_i, \kappa_1, \kappa_2$ and κ_3 for each country.

There is an advantage from conducting this exercise relative to plotting the fitted model against the actual interest rate. While the fitted models are able to track the actual interest rate more closely (as is obvious from their high adjusted R^2 values), they allow for inertia to take place in determining the values of the fitted series. As a consequence, they conceal the information about the importance of the determinants of the monetary policy stance. By disallowing this effect, the exercise carried out in Figure 1 provides a way to reveal information about how well the determinants of monetary policy track movements in the actual interest rate.

Figure 1: Actual versus target interest rate



In most cases the implied target rates are, interestingly, able to capture the actual rate movements quite well. The correlation coefficient between the two series is relatively high and positive in most of the cases; i.e. 0.9 for the case of Indonesia, 0.85 for the case of Malaysia, 0.79 for the case of the Philippines, 0.89 for the case of Thailand and 0.44 for the case of Singapore. These positive and typically high correlation coefficients signal that both the actual interest rate and the implied target rate are relatively closely associated. That is, movements in one series are typically followed by movements in the other series with the same direction and a relatively similar proportion. In other words, the simple rule characterised by our PRF estimation tends to be reasonably good in explaining the monetary policy stance of the countries under consideration.

As seen in the figure for Indonesia's SBI rate, the implied target rate for this case tracks the actual movement in SBI rate very well along the sample period. The implied target rate in this case is calculated as a combination of the two different simple reaction functions reported in Table 2; that is, based on a pure exchange rate targeting regime up to the second quarter of 1997 (right before the crisis hit the country) and based on the simple Taylor type rule for the rest of the sample period. In the absence of the inertial adjustment process, both the pre and post-crisis implied target rate are able to capture the general swings of the SBI rate very well. At the onset of the 1997 crisis, the target rate shoots up well above the actual SBI rate and drops ahead of the actual SBI rate right after the peak of the crisis. This suggests that during that particular period, the interest rate smoothing behaviour is playing a fairly significant role in toning down the fluctuation of the SBI rate. In general, however, monetary policy in Indonesia is mainly driven by the change in the exchange rate during the pre-crisis period and by both inflation and output during the post-crisis period. In the post-crisis period, the role of inflation dominates the output gap in setting the monetary policy. However, a great deal of consideration of the position of the output gap is also in place ($\kappa_2 \approx 1$). This finding is understandable considering that the country is still struggling with the recovery process from the impact of its 1997-98 crisis.

The implied target rate series for the case of Malaysia is generated using the simple rule as described in equation (4), characterised by the relevant parameter estimates reported in Table 1. Figure 1 shows that in the absence of the partial adjustment process the target rate for Malaysia captures the general fluctuations in the TB discount rate quite well. However, a noticeable gap between the two series arose during 1994. The sharp decline in Malaysia's actual rate in 1994 is not accompanied by a similar movement in the target rate. The main reason for this sharp decline is the large inflow of short-term foreign capital into the country.[27] The Malaysian Ringgit at that time was considered undervalued, but BNM did not allow it to appreciate by intervening in the foreign market. BNM did a sterilised intervention to keep the Ringgit value intact. In spite of this, the amount of liquidity inflows at that time was so large that some of them managed to find their way to the domestic money market, inducing an excess liquidity in the economy, hence, forcing the actual interest rate to fall. To mop up this excess liquidity, BNM later responded by borrowing heavily in the money market, introducing Bank Negara Bills and raising the statutory reserve requirement. This response eventually managed to restore the interest rate to be in line with the implied target rate. These incidents were not captured by the simple rule since they did not alter inflation expectation and the output gap by much at that time. Therefore, while the actual rate plummeted to around three per cent per annum, the target rate stayed fluctuating around six per cent per annum.

Another relatively noticeable gap is shown in the period during which the BNM was exercising selective capital controls and a fixed exchange rate regime after the crisis. Although it does not appear to be as dramatic as observed in 1994, the implied target rate fluctuates quite significantly around the relatively steady actual rate in that period. Those two noticeable deviations, however, are somewhat eliminated once we allow for the partial adjustment in the policy reaction function. The fitted model shows a sharp decline in 1994 and its fluctuation around the actual rate in the post crisis sample appears to be significantly more moderate. Although the interest rate smoothing behaviour occasionally dominates the direction of monetary policy, expected inflation and the output gap are, by and large, found to be acting as the main driver for monetary policy in Malaysia during the sample period considered. The setting of monetary policy is dominated by changes in

[27] See Bank Negara Malaysia (1999).

inflation expectation with a relatively small weight put on changes in the output gap.

Unlike most of its neighbouring ASEAN nations, the Philippines was not severely affected by the 1997 financial crisis. This feature distinguishes the country from most of its neighbours in terms of the heavily tightened monetary policy at the onset of the crisis. When the whole period estimates of parameters are used to characterise the construction of the implied target rate series, Figure 1 shows its relative ability to capture the general swings in the actual rate. The only apparent disagreement between the two series arises in the beginning of 1995, when the new monetary policy framework is introduced. The target rate rises while the actual Manila reference rate falls at that time. This situation may take place due to the adjustment process to the adoption of the new framework. Generally, the estimated PRF does a good job in tracking the actual movement of the interest rate. It further indicates that the monetary policy setting in the Philippines is driven by changes in both the output gap and expected inflation. The point estimate of the parameters suggests that the output gap in this case dominates inflation expectation in terms of the weight considered when setting monetary policy. Although different from its neighbouring economies, this finding may be justified considering that the Philippines economy is more unstable relative to its neighbours.

The MAS (Monetary Authority of Singapore) adopted a unique monetary policy framework by centering on exchange rate management rather than managing the money supply or interest rate. In general, our PRF approximation using the interest rate as the policy variable agrees with the one using changes in TWI of exchange rate reported by Parrado (2004). Both the PRF versions agree that the monetary policy in Singapore is essentially affected by inflation and the output gap. A slight disagreement, however, comes in the relative weight between inflation and the output gap in the PRF. While relative weight between them in the interest rule version is close to unity, the magnitude is about four in the TWI rule version. This distinction may arise due to differences in how interest rate and TWI of exchange rate react upon changes in inflation expectation and the output gap.

A more remarkable finding, however, is that both versions of PRF come up with virtually the same very high partial adjustment parameter. This agreement suggests a relatively robust finding that the conduct of monetary policy in Singapore in strongly driven by inertia. This feature clearly emerges when we compare the series of actual interest rate and the series of implied target rate. The correlation coefficient between the two series is relatively low (0.44) compared to the other economies in the sample. The Singapore case in Figure 1 also shows that although the implied target rate is relatively good in capturing the general direction of the swings in the actual rate, the target series deviate quite profoundly from the actual series, particularly during the post-crisis episode. All of those wide swings, however, die out once one lets the partial adjustment mechanism affect the determination of the interest rate. These observations suggest that although the monetary policy setting in Singapore is significantly affected by inflation and the output gap, it is in principle dominated by the partial adjustment mechanism. That is, while inflation and the output gap are playing a role in determining the direction of monetary policy, the process itself is mainly dominated by inertia.

As reported earlier in Tables 1 and 2, the estimate of κ_2 (the parameter measuring the sensitivity to the output gap) for the case of Thailand is relatively small and insignificantly different from zero. It, therefore, suggests that the Bank of Thailand has effectively been managing its policy by relying solely on developments in the forecast of inflation. Depending on the definition used, this situation may or may not be interpreted as BoT effectively pursuing a pure inflation targeting.[28] Nevertheless, the implied target rate for the case of Thailand is calculated by setting $\kappa_2 = 0$. The high correlation coefficient between the implied target rate and the actual repo rate (0.89) indicates that the former is capturing the direction of changes in the latter very well. The most striking feature in the Thailand panel of Figure 1 is that the target rate correctly captures the magnitude of changes in the actual rate during the course of the crisis. Off the crisis period, although the direction for changes in actual repo rate is still driven by inflation expectation, its movement is largely affected by inertia. In the period leading to the crisis for example, had the monetary policy was solely driven by inflation expectation, the actual rate should have been set at a notably higher rate. Overall, the findings suggest that the monetary policy setting in Thailand is effectively driven only by inflation expectation, with obvious preference over an adoption of interest smoothing adjustment mechanism.

In summary, the exercise conducted in this subsection has pointed out that the policy feedback rule represented by a simple interest rate reaction function can generally be used to represent the conduct of monetary policy in our sample countries. Although changes in monetary policy management are reported, the behaviour in setting up the monetary policy is typically unchanged, with Indonesia as a particular exception in this case. Expected inflation and the output gap are typically acting as the main driver of monetary policy in the five ASEAN economies considered. The way those important economic variables dictated the setting of monetary policy, however, is typically moderated by the existence of interest rate smoothing mechanism adopted by the monetary authority. Singapore is the case where this effect is found to be strongest.

6 Concluding Remarks

The objective of this paper is to approximate the basis of how monetary policy is set in the sample of five ASEAN economies. This is done by examining simple monetary policy reaction functions over a past of one and a half decade. Although the primary objective of monetary policy in the sample countries is mainly focused on price stabilisation, the conduct of monetary policy in most of the sample economies during the period under examination has been reported as undergoing variation in terms of the way their monetary policy is being managed. This paper takes account of the issue by dividing the sample period into sub-samples marked by the dates when variations are reported to be taking place.

The findings suggest that the conduct of monetary policy in the sample of developing economies considered in the paper can, in principle, be explained by a simple monetary

[28] According to the definition used by Clarida et al. (1998), inflation targeting regime is defined as a regime where the nominal interest rates are raised sufficiently to increase real rates whenever expected inflation goes above its target. Svensson (1999), however argues that this is not the precise interpretation of inflation targeting.

policy reaction function. That is, the sample economies seem to be quite consistently following a certain rule in setting their monetary policy. Three general observations emerge from the findings. First, the estimated policy reaction functions are doing a reasonable job in explaining the setting of monetary policy of the sample economies, in the sense that they are capturing movements in the actual interest data very well. They further indicate that the conduct of monetary policy has typically supported the price stabilisation objective of the monetary authorities of most economies under consideration; i.e. the coefficient of the nominal interest rate on inflation is typically greater than unity. In other words, the nominal rates are raised sufficiently to increase the real rates whenever expected inflation goes above target. Therefore, monetary policy reacts to expected inflation and tends to stabilise fluctuations in both inflation and output.

Second, although moderated by an interest rate partial adjustment mechanism, the directions in the setting of monetary policy in the sample countries are mainly driven by movement of the inflation expectation with typically some allowance for output stabilisation. With regard to the debate about the importance of an exchange rate variable in driving monetary policy of the small open economy, our findings suggest that exchange rate does not direct the setting of interest rates explicitly. It is, however, acting to be part of the important background information utilised by the central bank in determining monetary policy stance.

Third, albeit the fact that changes in monetary policy regime have been conceptually introduced within the sample period, the behaviour in conducting monetary policy in Thailand, Malaysia and the Philippines does not appear to change significantly. However, in the case of Indonesia, the findings indicate a significant shift in the conduct of monetary policy. The country seems to have significantly switched its monetary policy orientation from being mainly driven by changes in the exchange rate into being directed by inflation expectation and the cyclical variable.

The individual assessment of the approximate conduct of monetary policy in each country is summarised as follows. Monetary policy in Indonesia within the sample period has experienced a switch from a pure exchange rate targeting regime to a regime that is consistent with the Taylor principle, but with particular attention to output stabilisation. In Malaysia, the conduct of monetary policy over the sample period has mainly been consistent with the Taylor principle with a relatively small allowance for output stabilisation. The case of Thailand suggests that the country has effectively been focusing only at the forecast of inflation in setting up its monetary policy during the sample period. However, the regime tends to be highly driven by inertia in the off-crisis sample. Monetary policy in Singapore is mainly driven by inertia. That is, although expected inflation and the output gap signal directions for the setting of Singapore's monetary policy, the interest rate adjusts very slowly to its projected target level. Finally, monetary policy in the case of the Philippines is found to put more weight on output stabilisation and marginally fails to follow the Taylor principle. This finding may be justified considering that the Philippines economy is more unstable relative to the other four economies considered in this paper.

References

Bank Indonesia, *Annual Report 1999*, Jakarta: Bank Indonesia, 2000.

Bank Negara Malaysia, *The Central Bank and the Financial System in Malaysia: A Decade of Change*, Kuala Lumpur: Bank Negara Malaysia, 1999.

Batini, N. and A. Haldane, "Forward Looking Rules for Monetary Policy," in John B Taylor, ed., *Monetary Policy Rules*, NBER, Chicago, 1999, pp. 157–192.

__ **and** __ , "Monetary Policy Rules and Inflation Forecasts," *Bank of England Quarterly Bulletin*, 1999, *39* (1), 60–67.

Bernanke, Ben S. and Alan S. Blinder, "The Federal Funds Rate and the Channels of Monetary Transmission," *American Economic Review*, 1992, *82* (4), 901–21.

__ **and Ilian Mihov**, "Measuring Monetary Policy," *The Quarterly Journal of Economics*, 1998, *113* (3), 869–902.

Bryant, R.C., P. Hooper, and C. Mann, "Stochastic Simulation with Simple Policy regimes," in R.C. Bryant, P. Hooper, and C. Mann, eds., *Evaluating Policy Regimes: New Research in Empirical Macroeconomics*, Brookings Institution Press, 1993, pp. 375–415.

Cheong, Latifah M., "Globalisation and the Operation of Monetary Policy in Malaysia," *BIS papers*, 2005, *23*, 209–215.

Clarida, Richard, Jordi Gali, and Mark Gertler, "Monetary Policy Rules in Practice: Some International Evidence," *European Economic Review*, 1998, *42* (6), 1033–1067.

__ **,** __ **, and** __ , "The Science of Monetary Policy: A New Keynesian Perspective," *Journal of Economic Literature*, 1999, *37* (4), 1661–1707.

__ **,** __ **, and** __ , "Monetary Policy Rules And Macroeconomic Stability: Evidence And Some Theory," *The Quarterly Journal of Economics*, 2000, *115* (1), 147–180.

__ **,** __ **, and** __ , "Optimal Monetary Policy in Open versus Closed Economies: An Integrated Approach," *American Economic Review*, 2001, *91* (2), 248–252.

Coe, David T. and C. John McDermott, "Does the Gap Model Work in Asia?," IMF Working Papers 96/69, International Monetary Fund 1996.

de Brouwer, Gordon and James Gilbert, "Monetary Policy Reaction Functions in Australia," *The Economic Record*, 2005, *81* (253), 124–134.

__ **and James O'Regan**, "Evaluating Simple Monetary Policy Rules for Australia," in Phillip Lowe, ed., *Monetary Policy and Inflation Targeting*, Proceedings of a Conference, Reserve Bank of Australia, 1997, pp. 244–76.

Devakula, M. R. P., "Thailand's Monetary Policy - Its Obstacles and Challenges," *BIS Review*, 2001, *81.*

Dickey, D.A. and W.A. Fuller, "Distribution of the Estimators for Autoregressive Time Series With a Unit Root," *Journal of the American Statistical Association*, 1979, *74* (366), 427–431.

Favero, C.A., *Applied Macroeconometrics*, Oxford University Press, 2001.

Filosa, R., "Monetary Policy Rules in Some Mature Emerging Economies," *BIS Papers*, 2001, *8*, 39–68.

Fuhrer, Jeffrey C., "Inflation/Output Variance Trade-offs and Optimal Monetary Policy," *Journal of Money, Credit and Banking*, 1997, *29* (2), 214–34.

Gerlach, Stefan and Matthew S. Yiu, "Estimating output gaps in Asia: A cross-country study," *Journal of the Japanese and International Economies*, 2004, *18* (1), 115–136.

Goodfriend, Marvin, "Interest Rates and the Conduct of Monetary Policy," *Carnegie-Rochester Conference Series on Public Policy*, 1991, *34*, 7–30.

Goodhart, CAE, *The Central Bank and the Financial System*, MIT Press, 1995.

Hamilton, James D, *Time Series Analysis*, Princeton: Princeton University Press, 1994.

Kim, C.J. and J.W. Lee, "Exchange Rate Regimes and Monetary Independence in East Asia," in Gordon de Brouwer and Masahiro Kawai, eds., *Exchange Rate Regimes in East Asia*, Routledge, London, 2004, pp. 302–319.

Kocherlakota, Narayana R., "On Tests of Representative Consumer Asset Pricing Models," *Journal of Monetary Economics*, 1990, *26* (2), 285–304.

Kwiatkowski, Denis, Peter C. B. Phillips, Peter Schmidt, and Yongcheol Shin, "Testing the Null Hypothesis of Stationarity Against the Alternative of a Unit Root : How Sure are We that Economic Time Series Have a Unit Root?," *Journal of Econometrics*, 1992, *54* (1-3), 159–178.

Lamberte, Mario B., "Central Banking in the Philippines: Then, Now and the Future," PIDS Discussion Paper Series 2002-10, PIDS 2002.

McCallum, Bennett T., "Singapore's Exchange Rate-Centered Monetary Policy Regime and its Relevance for China," MAS Staff Paper 43, Monetary Authority of Singapore 2006.

Nelson, Edward, "UK Monetary Policy 1972-97: A Guide Using Taylor Rules," Bank of England working papers 120, Bank of England 2000.

Parrado, E., "Singapore's Unique Monetary Policy: How Does it Work?," IMF Working Papers WP/04/10, International Monetary Funds 2004.

Phuvanatnaranubala, Thirachai, "Globalisation, Financial Markets and the Operation of Monetary Policy: The Case of Thailand," *BIS papers*, 2005, *23*, 269–274.

Poole, William, "Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model," *The Quarterly Journal of Economics*, 1970, *84* (2), 197–216.

—, "Interest Rates and the Conduct of Monetary Policy : A Comment," *Carnegie-Rochester Conference Series on Public Policy*, 1991, *34*, 31–39.

Svensson, Lars E. O., "Inflation Targeting as a Monetary Policy Rule," *Journal of Monetary Economics*, 1999, *43* (3), 607–654.

Tauchen, George, "Statistical Properties of Generalized Method-of-Moments Estimators of Structural Parameters Obtained from Financial Market Data," *Journal of Business & Economic Statistics*, 1986, *4* (4), 397–416.

Taylor, John B., "Discretion Versus Policy Rules in Practice," *Carnegie-Rochester Conference Series on Public Policy*, 1993, *39*, 195–214.

—, "A Historical Analysis of Monetary Policy Rules," in John B Taylor, ed., *Monetary Policy Rules*, NBER, Chicago, 1999, pp. 319–341.

—, "The Role of the Exchange Rate in Monetary-Policy Rules," *American Economic Review*, 2001, *91* (2), 263–267.

Woodford, Michael, "The Taylor Rule and Optimal Monetary Policy," *American Economic Review*, 2001, *91* (2), 232–237.

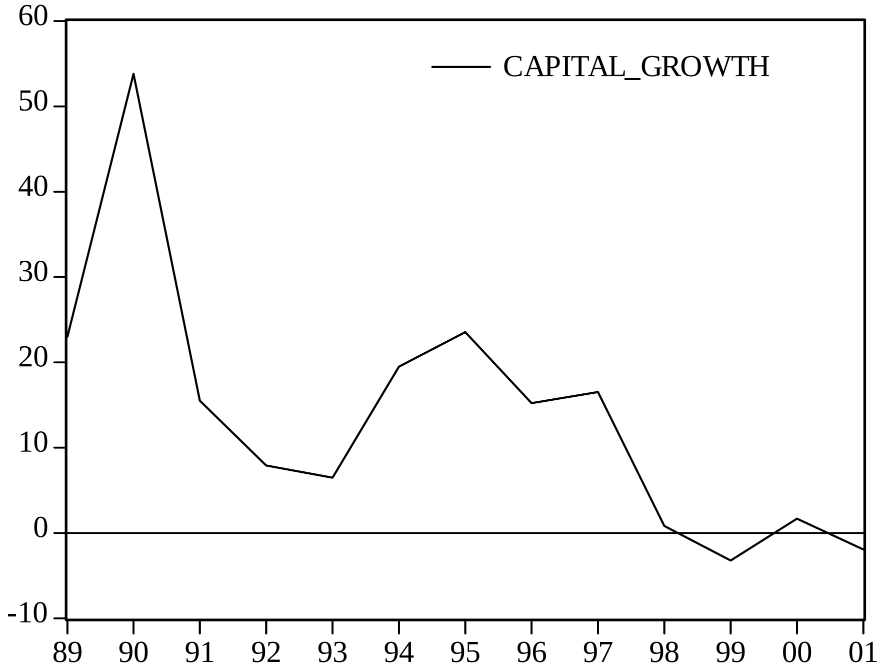
—, *Interest and Prices*, Princeton and Oxford: Princeton University Press, 2003.

APPENDIX

A Data description and sources

Variable	Country	Description	Source
Interest rate	Indonesia	Quarterly average of 30 days SBI (Bank Indonesia certificate) rate	CEIC Asia database; ID:SBI Rate: Auction Target: 30 Days
	Malaysia	Quarterly average of 3-month TB (treasury bills) rate	CEIC Asia database; MY: Discount Rate 3 Month: Treasury Bills
	Philippines	Quarterly average of 90-days of Manila reference rate	CEIC Asia database; PH: Manila Reference Rate 90
	Singapore	Quarterly average of 3-month interbank rate	CEIC Asia database; SG: Interbank Rate: SGD: Month End: 3 Month
	Thailand	Quarterly average of 14-days repo rate	CEIC Asia database; TH: Repurchase Rate: Month Average: 14 Day
Price index	Indonesia	Quarterly CPI (consumer price index); 1993=100	CEIC Asia database; ID: Consumer Price Index
	Malaysia	Quarterly CPI (consumer price index); 2000=100	CEIC Asia database; MY: Consumer Price Index (CPI)
	Philippines	Quarterly CPI (consumer price index); 1988=100	CEIC Asia database; PH: Consumer Price Index
	Singapore	Quarterly CPI (consumer price index); 2004=100	CEIC Asia database; SG: Consumer Price Index
	Thailand	Quarterly CPI (consumer price index); 2000=100	CEIC Asia database; TH: Consumer Price Index
Output	Indonesia	Quarterly real GDP (gross domestic product) at 1993 prices	1988-1992: Bank Indonesia; 1993-2004: CEIC Asia database; ID: Gross Domestic Product (GDP): 1993p
	Malaysia	Quarterly real GDP (gross domestic product) at 1987 prices	1988-1990: Bank Negara Malaysia; 1991-2004: CEIC Asia database: MY: Gross Domestic Product (GDP): 1987p
	Philippines	Quarterly real GDP (gross domestic product) at 1985 prices	CEIC Asia database; PH: Gross Domestic Product (GDP): 1985p
	Singapore	Seasonally adjusted quarterly real GDP at 1995 prices	CEIC Asia database; SG: Gross Domestic Product: 95p: sa
	Thailand	Quarterly real GDP (gross domestic product) at 1988 prices	CEIC Asia database; TH: Gross Domestic Product (GDP): 1988p
Exchange rate	Indonesia	Quarterly average of US dollar exchange rate	CEIC Asia database; ID: Spot FX Rate: Bank Indonesia: Rupiah to USD
	Malaysia	Quarterly index of REER (real effective exchange rate) based on relative CPI	IFS (International Financial Statistics); 548..RECZF...
	Philippines	Quarterly index of REER based on relative CPI	IFS (International Financial Statistics); 566..RECZF...
	Singapore	Quarterly index of REER based on relative CPI	IFS (International Financial Statistics); 576..RECZF...
	Thailand	Quarterly average of US dollar exchange rate	CEIC Asia database; TH: Forex: Thai Baht to US Dollar: Mid

Figure 2: Capital growth for Indonesia: 1989-2001 (in %)



Note: The stock of capital is calculated by the perpetual inventory method (PIM) using 1969 as the base period.

A.1 Interest rate

Figure 3: Interest rate (in %)

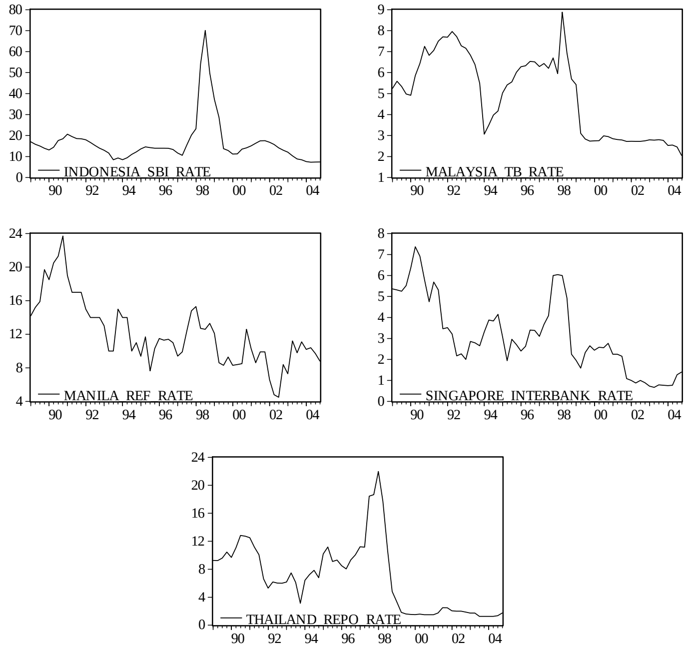


Table 3: Stationarity tests for interest rates: 1989-2004

Country	ADF-unit root test			KPSS-stationarity test[1]		
	t-stat	p-value	lag length (AIC)	LM-stat	Critical values[2] 5%	Critical values[2] 10%
Indonesia[3]	-2.63	0.09	5	0.10	0.46	0.35
Malaysia[4]	-3.60	0.04	3	0.11	0.15	0.12
Philippines[4]	-3.30	0.07	4	0.11	0.15	0.12
Singapore[4]	-3.11	0.11	1	0.08	0.15	0.12
Thailand[4]	-3.16	0.10	2	0.11	0.15	0.12

Notes:
1. Bandwith selection is conducted by Newey-West using Bartlett kernel.
2. Based on Kwiatkowski-Phillips-Schmidt-Shin (1992).
3. Includes intercept in the test.
4. Includes intercept and trend in the test.

A.2 Inflation rates

Figure 4: Inflation rates (in %)

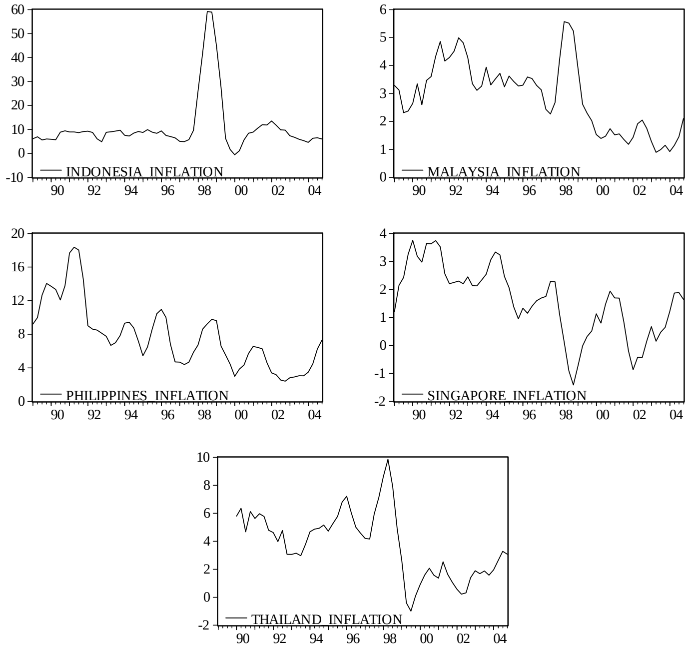


Table 4: Stationarity tests for annual inflation rates: 1989-2004

Country	ADF-unit root test			KPSS-stationarity test[1]		
	t-stat	p-value	lag length (SIC)	LM-stat	Critical values[2] 5%	Critical values[2] 1%
Indonesia[3]	-5.62	0.00	1	0.12	0.46	0.74
Malaysia[4]	-3.41	0.06	1	0.15	0.15	0.22
Philippines[4]	-4.07	0.01	5	0.07	0.15	0.22
Singapore[4]	-3.70	0.03	1	0.09	0.15	0.22
Thailand[4]	-3.24	0.09	1	0.10	0.15	0.22

Notes:
1. Bandwith selection is conducted by Newey-West using Bartlett kernel.
2. Based on Kwiatkowski-Phillips-Schmidt-Shin (1992).
3. Includes intercept in the test.
4. Includes intercept and trend in the test.

A.3 Annual change in the exchage rates

Figure 5: Annual changes in the exchange rate (in %)

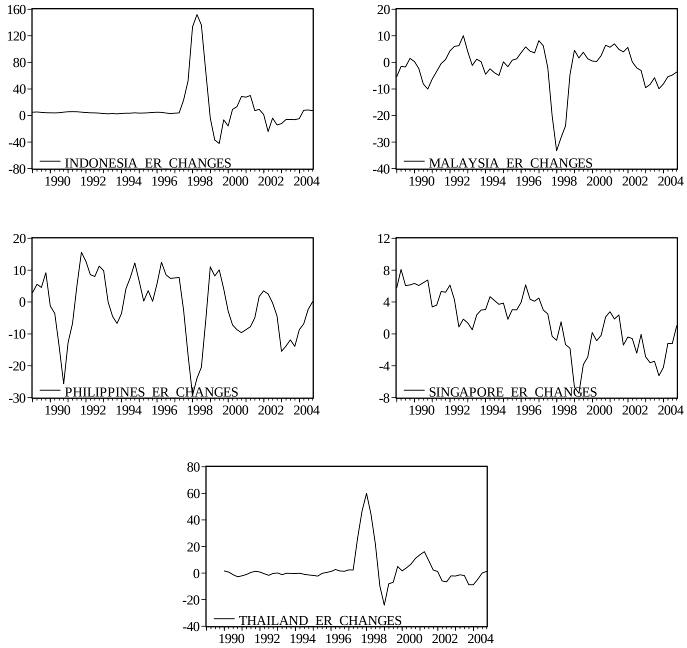


Table 5: Stationarity tests for annual changes in the exchange rates: 1989-2004

Country	ADF-unit root test			KPSS-stationarity test[1]		
	t-stat	p-value	lag length (SIC)	LM-stat	Critical values[2] 5%	1%
Indonesia[3]	-4.68	0.00	1	0.09	0.46	0.74
Malaysia[3]	-4.24	0.001	1	0.07	0.46	0.74
Philippines[3]	-4.57	0.00	1	0.26	0.46	0.74
Singapore[4]	-4.08	0.01	6	0.05	0.15	0.22
Thailand[3]	-5.07	0.00	1	0.11	0.46	0.74

Notes:
1. Bandwith selection is conducted by Newey-West using Bartlett kernel.
2. Based on Kwiatkowski-Phillips-Schmidt-Shin (1992).
3. Includes intercept in the test.
4. Includes intercept and trend in the test.

A.4 Output gap measures

Figure 6: Output gap measures (in %)

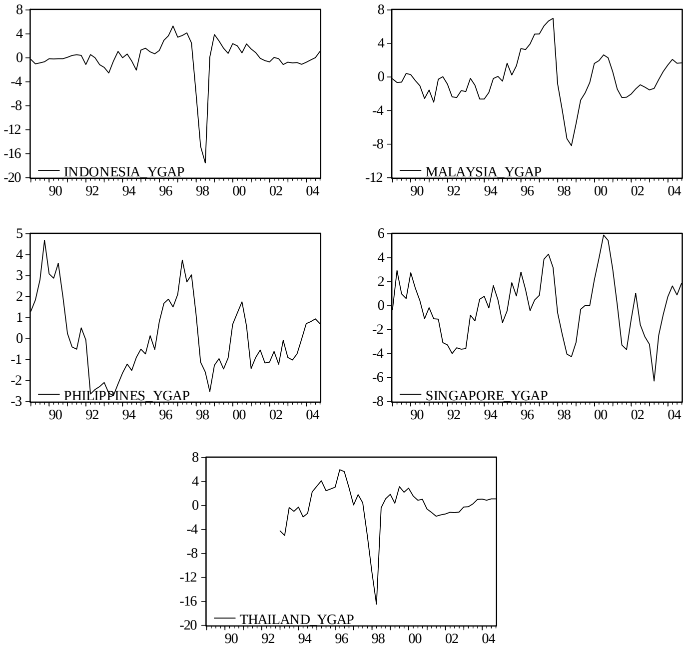


Table 6: Stationarity tests for output gap measures: 1989-2004

Country	ADF-unit root test			KPSS-stationarity test[1]		
	t-stat	p-value	lag length (SIC)	LM-stat	Critical values[2] 5%	Critical values[2] 1%
Indonesia[3]	-5.71	0.00	1	0.04	0.46	0.74
Malaysia[3]	-3.41	0.00	1	0.07	0.46	0.74
Philippines[3]	-2.24	0.02	0	0.12	0.46	0.74
Singapore[3]	-3.75	0.00	1	0.06	0.46	0.74
Thailand[3]	-3.23	0.002	0	0.06	0.46	0.74

Notes:
1. Bandwith selection is conducted by Newey-West using Bartlett kernel.
2. Based on Kwiatkowski-Phillips-Schmidt-Shin (1992).
3. No intercept and trend in the test.

B Baseline estimation results

Table 7: Indonesia reaction function (1989-2004)

Alternative Horizons	α_i	κ_1	κ_2	ρ_i	Adj. R^2	$J - test$
$n = 0$	7.99	0.81	-0.35	-0.31	0.822	2.99
	(1.45)	(0.07)	(0.32)	(0.24)		[0.70]
$n = 1$	4.18	1.15	-0.24	0.536	0.893	2.63
	(1.62)	(0.11)	(0.45)	(0.05)		[0.75]
$n = 2$	-2.62	1.79	-2.22	0.83	0.865	4.19
	(4.71)	(0.44)	(1.73)	(0.05)		[0.52]
$n = 3$	-10.31	2.88	-2.16	0.77	0.640	3.54
	(8.43)	(0.98)	(1.40)	(0.03)		[0.62]
$n = 4$	-98.13	13.25	-2.74	0.94	0.184	4.02
	(135.43)	(15.44)	(3.38)	(0.05)		[0.55]

Note: 1. Numbers in brackets are the relevant standard errors.

2. Numbers in square brackets are the p-values for the J-test.

3. Target horizons for the output gap are fixed at $m = 0$.

4. The set of instruments includes: lag 1 and 2 of inflation; lag 1 and 4 of output gap; lag 1 and 2 of real USD exchange rate; and lag 1 to 3 of interest rate.

5. The covariances are prewhitened and weighted by applying a Bartlett kernel and fixed Newey-West method to determine the bandwith selection.

Table 8: Malaysia reaction function (1989-2004)

Alternative Horizons	α_i	κ_1	κ_2	ρ_i	Adj. R^2	$J-test$
$n=0$	0.71	1.60	0.17	0.68	0.866	3.63
	(0.32)	(0.10)	(0.08)	(0.12)		[0.60]
$n=1$	0.56	1.66	0.19	0.69	0.873	4.31
	(0.39)	(0.12)	(0.05)	(0.076)		[0.51]
$n=2$	0.38	1.75	0.10	0.71	0.867	3.77
	(0.52)	(0.165)	(0.08)	(0.09)		[0.58]
$n=3$	0.10	1.83	-0.15	0.69	0.837	4.71
	(0.15)	(0.24)	(0.096)	(0.15)		[0.45]
$n=4$	1.33	1.68	-0.41	0.89	0.826	6.17
	(4.45)	(0.79)	(0.33)	(0.23)		[0.29]

Note: 1. Numbers in brackets are the relevant standard errors.
2. Numbers in square brackets are the p-values for the J-test.
3. Target horizons for the output gap are fixed at $m = 0$.
4. The set of instruments includes: lag 1 and 2 of inflation; lag 1 and 4 of output gap and real effective exchange rate; and lag 2 and 4 of interest rate.
5. The covariances are prewhitened and weighted by applying a Bartlett kernel and fixed Newey-West method to determine the bandwith selection.

Table 9: Philippines reaction function (1989-2004)

Alternative Horizons	α_i	κ_1	κ_2	ρ_i	Adj. R^2	$J-test$
$n=0$	0.07	0.59	1.40	0.57	0.779	1.27
	(0.01)	(0.12)	(0.59)	(0.10)		[0.53]
$n=1$	0.07	0.72	1.22	0.55	0.791	3.02
	(0.01)	(0.18)	(0.60)	(0.12)		[0.22]
$n=2$	0.06	0.76	1.15	0.57	0.791	6.34
	(0.015)	(0.19)	(0.56)	(0.12)		[0.04]
$n=3$	0.13	-0.34	5.12	0.87	0.742	8.74
	(0.10)	(1.52)	(5.24)	(0.11)		[0.01]
$n=4$	0.11	0.05	3.84	0.84	0.754	10.41
	(0.06)	(0.80)	(2.63)	(0.09)		[0.005]

Note: 1. Numbers in brackets are the relevant standard errors.
2. Numbers in square brackets are the p-values for the J-test.
3. Target horizons for the output gap are fixed at $m = 0$.
4. The set of instruments includes: lag 1 and 2 of inflation; lag 4 of output gap; lag 2 of real effective exchange rate; and lag 1 to 2 of interest rate.
5. The covariances are prewhitened and weighted by applying a Bartlett kernel and Andrews parametric method to determine the bandwith selection.

Table 10: Singapore reaction function (1989-2004)

Alternative Horizons	α_i	κ_1	κ_2	ρ_i	Adj. R^2	$J - test$
$n = 0$	0.82	1.27	0.94	0.85	0.879	6.80
	(0.87)	(0.49)	(0.46)	(0.05)		[0.34]
$n = 1$	1.21	0.90	0.755	0.83	0.874	5.80
	(0.77)	(0.43)	(0.39)	(0.06)		[0.45]
$n = 2$	1.42	0.71	0.90	0.845	0.869	5.94
	(0.88)	(0.49)	(0.46)	(0.06)		[0.43]
$n = 3$	1.50	0.68	0.98	0.85	0.867	6.47
	(0.905)	(0.50)	(0.43)	(0.05)		[0.37]
$n = 4$	1.12	0.95	1.07	0.85	0.871	7.43
	(0.89)	(0.50)	(0.41)	(0.05)		[0.28]

Note: 1. Numbers in brackets are the relevant standard errors.
2. Numbers in square brackets are the p-values for the J-test.
3. Target horizons for the output gap are fixed at $m = 0$.
4. The set of instruments includes: lag 1 and 4 of inflation; lag 1 and 4 of output gap; lag 1 and 2 of real effective exchange rate; and lag 1 to 4 of interest rate.
5. The covariances are prewhitened and weighted by applying a Bartlett kernel and Andrews parametric method to determine the bandwith selection.

Table 11: Thailand reaction function (1994-2004)

Alternative Horizons	α_i	κ_1	κ_2	ρ_i	Adj. R^2	$J - test$
$n = 0$	-0.37	1.865	0.34	0.84	0.848	5.08
	(2.25)	(0.92)	(0.58)	(0.10)		[0.53]
$n = 1$	-2.82	2.65	0.575	0.76	0.884	4.55
	(1.46)	(0.51)	(0.33)	(0.06)		[0.60]
$n = 2$	-1.56	2.04	0.18	0.73	0.911	4.69
	(0.78)	(0.25)	(0.21)	(0.04)		[0.58]
$n = 3$	-3.61	2.65	0.09	0.70	0.917	4.13
	(0.82)	(0.30)	(0.24)	(0.04)		[0.66]
$n = 4$	-4.34	2.74	-0.41	0.68	0.882	6.77
	(4.45)	(0.48)	(0.42)	(0.05)		[0.34]

Note: 1. Numbers in brackets are the relevant standard errors.
2. Numbers in square brackets are the p-values for the J-test.
3. Target horizons for the output gap are fixed at $m = 0$.
4. The set of instruments includes: lag 1 and 3 of inflation; lag 1, 2 and 4 of output gap; lag 1 and 2 of real USD exchange rate; and lag 1 to 3 of interest rate.
5. The covariances are prewhitened and weighted by applying a Bartlett kernel and Andrews parametric method to determine the bandwith selection.

Table 12: Parameters for the estimates of the extended policy reaction function

Country	α_i	κ_1	κ_2	κ_3	ρ_i	Adj. R^2	$J-test$
Indonesia	4.10	1.17	-0.26	-0.01	0.52	0.892	2.60
	(1.79)	(0.19)	(0.56)	(0.10)	(0.08)		[0.63]
Malaysia	0.52	1.64	0.13	0.03	0.61	0.868	3.52
	(0.40)	(0.12)	(0.07)	(0.03)	(0.17)		[0.47]
Philippines	0.07	0.71	1.39	-0.04	0.56	0.776	2.10
	(0.01)	(0.16)	(0.68)	(0.05)	(0.12)		[0.15]
Singapore	0.47	1.49	0.91	-0.25	0.86	0.869	5.24
	(1.37)	(1.00)	(0.59)	(0.38)	(0.07)		[0.39]
Thailand	-2.14	2.31	0.16	0.01	0.75	0.918	2.38
	(1.30)	(0.36)	(0.21)	(0.01)	(0.05)		[0.79]

Note: 1. Numbers in brackets are the relevant standard errors.

2. Numbers in square brackets are the p-values for the J-test.

Table 13: Estimated parameters for the extended specification in the subsample period

Country	Sub sample	α_i	κ_1	κ_2	κ_3	ρ_i	Adj. R^2	$J-test$
Indonesia:	(1998-2004)	-3.75	1.92	1.19	-0.06	0.47	0.82	2.50
		(1.79)	(0.15)	(0.45)	(0.08)	(0.08)		[0.64]
Malaysia:	(1989-1997)	1.01	1.53	0.17	0.00	0.62	0.71	1.75
		(2.17)	(0.58)	(0.13)	(0.06)	(0.14)		[0.78]
Philippines	(1995-2004)	0.07	0.44	0.78	0.06	0.34	0.50	1.91
		(0.01)	(0.17)	(0.51)	(0.03)	(0.14)		[0.17]
Thailand	(1994-1999)	1.68	1.60	0.10	0.02	0.71	0.85	1.93
		(4.70)	(0.93)	(0.21)	(0.02)	(0.05)		[0.86]

Note: 1. Numbers in brackets are the relevant standard errors.

2. Numbers in square brackets are the p-values for the J-test.