The Role of Money in The Transmission Mechanism of Monetary Policy: Evidence from Thailand

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First Version: September 2002
This Version: April 2003

Abstract

Meltzer (2001b) argues that the current trend for downgrading the role of money in standard macro models is erroneous as it masks those monetary transmission channels which operate through changes in relative yields of assets. This paper shows that the scope of these changes can be empirically segregated into (i) the changes in relative prices along the term structure (term-structure effect) and (ii) the changes in relative risk premia component of different kinds/classes of assets (risk-premia effect). Using Thailand data, I found that both effects are significant. I argue from this finding that standard macro models which are based on the two-asset assumption are distorting and that the problem can be alleviated by introducing an explicit role of money in these models.

Keywords: Monetary transmission mechanism, Money, Two-asset world assumption
JEL Classification: E40, E51, E52

1 Introduction

The current trend for downgrading the role of money in small-scale macroeconomic models for monetary policy evaluation is indeed widespread.[1] As emphasised by King (2002) and Meyer (2001), this trend is no longer just an academic phenomenon since it has already been popularised in large scale macro-econometric models employed by various leading central banks, including the Fed and the Bank of England.

The main goal of this paper is to examine whether this trend may have major disadvantages in neglecting important channels of the monetary policy transmission mechanism; specifically, the channels which operate through changes in relative yields on a wide array of assets (Meltzer, 2001b). In doing so, owing to my interest as a Thai citizen, I use Thailand quarterly data as the basis of investigation. Furthermore, as related evidence on this issue is all from developed

*I am most grateful to my supervisor, Charles A.E. Goodhart, for his continuous advice and guidance. I also would like to thank Piti Disyatat, Titanun Mallikamas, Edward Nelson, and Pataporn Sukontamarn for their valuable comments and Metinee Hemrit and Sakkapop Panyanukul for their help on the data. All remaining errors are mine.

[1] To name a few, these models range from the forward-looking models with microfoundations of McCallum and Nelson (1999) and Rotemberg and Woodford (1997) to the pure backward-looking model without microfoundations of Rudebusch and Svensson (2002).

countries, it should be interesting to see whether consistent results would be obtained for a developing country such as Thailand.[2]

Although Nelson (2002a) attempted a similar type of empirical exercise for the U.S. and U.K., I argue below that his empirical methodology does not allow for the optimal forward-looking consumption behaviour typically encapsulated in models with microfoundations. In particular, the novel feature of this paper is that it tests for the significance of the role of the real monetary stock in a *hybrid* IS equation, which essentially allows for both forward looking and backward looking behaviour of rational agents. As I shall argue, this allows us to identify separately the two distinct forms of changes in relative yields of assets that money is conventionally found to proxy; one being changes along the term structure of interest rate (the term-structure effect) and the other being changes in relative risk premia amongst different kinds and classes of assets (the risk premia effect). Given that the risk premia effect is found to be strong and statistically significant, the two-asset world assumption which has long been underpinning conventional macro models, including the class of models with microfoundations, becomes inherently distorting. This problem can be ameliorated by introducing an explicit role of money into the model.

The paper is organised as follows. Section 2 illustrates a literature review on the independent role of money in the monetary transmission mechanism. Section 3 discusses the theoretical background. Section 4 illustrates the empirical methodology while section 5 shows the empirical evidence. Section 6 provides policy implications and concluding remarks.

2 A Literature Review

2.1 A conventional macro model with no explicit role of money

A version of the standard closed economy macro model with microfoundations in the spirit of Clarida, Gali and Gertler (1999) can be described as follows;

$$\tilde{y}_t = -a_1[R_t - E_t(\pi_{t+1})] + E_t\tilde{y}_{t+1} + \varepsilon_t^y \tag{1}$$
$$\pi_t = b_1\tilde{y}_t + b_2E_t(\pi_{t+1}) + \varepsilon_t^\pi \tag{2}$$
$$R_t = c_1\tilde{y}_t + c_2(\pi_t - \pi^*) + \varepsilon_t^i \tag{3}$$
$$m_t = d_1 + d_2[R_t - E_t(\pi_{t+1})] + d_3\tilde{y}_t + \varepsilon_t^m \tag{4}$$

where $\tilde{y}_t$ denotes the output gap[3], π_t denotes inflation, π^* denotes the inflation target, R_t denotes the (nominal) short-term interest rate, m_t denotes the real money stock, $\varepsilon_t^y, \varepsilon_t^\pi, \varepsilon_t^i, \varepsilon_t^m$ are *i.i.d.* disturbance terms with zero mean and σ^2 variance, and $E_t(\cdot)$ is the rational expectation operator conditional on the information available in period t.

Equations (1) and (2) are a standard forward-looking IS equation and a standard forward-looking Phillip curve equation, respectively. Equation (3) is a Taylor-type rule. Equation (4) is the derived real money demand equation. The transmission mechanism of monetary policy in

[2]The fact that financial markets in developing countries are immaturely established implies that the transmission process in these countries should rely less on the standard channel via money and bond markets and may therefore rely more on the non-standard channels via changes in relative prices of various assets. As will be elaborated below, it is precisely these non-standard channels for which Meltzer (2001b) argues that money may serve as an auxilary proxy. In this light, it is natural to expect strong evidence in support of an independent role of money in a developing country such as Thailand.

[3]In the standard optimisation-based IS-LM framework, the output gap is defined as the deviation of output from its natural level, which in turn is defined as the output level at the flexible price.

this typical model works as follows. The central bank sets the nominal policy rate via equation (3). Due to nominal rigidity in price setting, an increase in the policy rate increases the real interest rate. Consequently, rational agents demand more bonds and less money, and reduce aggregate consumption and output. The equilibrium money stock is supplied by the central bank to satisfy the demand for money (equation (4)).

This transmission mechanism represents the standard interest rate channel. Apparently, equations (1) to (3) sufficiently determine the dynamic behaviour of output, inflation and interest rate without requiring further information on the money stock. In other words, the LM curve, equation (4), is not part of the simultaneous structure of the model and the real money stock, therefore, does not play an independent role beyond that summarised by the interest rate.

In the literature, several arguments have been proposed concerning the plausibility that money may have an independent role in the monetary transmission process. These are the real balance effect, the transaction cost effect and the argument that money serves as an auxiliary proxy for unidentified transmission channels.

2.2 The real balance effect

The idea that the money stock is part of agents' net wealth can be traced back to Pigou (1943) and Patinkin (1965). The underlying idea is that, with the presence of nominal rigidity in price adjustment, an increase in the nominal money stock also increases the 'real' money stock. As the real money stock, which is part of agents' net wealth, increases aggregate output should expand by more than the conventional interest rate channel suggests. In other words, equation (1) is misspecified as it should have incorporated the real money stock as one of the right hand side variables. Ireland (2001b) has formalised 'the real balance effect' into an otherwise standard dynamic stochastic general equilibrium model. The main result shows that there is no liquidity trap and monetary policy remains effective through the real balance effect even when the nominal interest rate hits the zero bound.

Although the real balance effect is ultimately likely to prevail, its magnitude is arguably small. As pointed out by King (2002), the only part of money supply which constitutes the economy's net wealth is monetary base. Since it accounts for a very small fraction of financial wealth, the quantitative significance of the real balance effect is likely to be of second order importance. Moreover, as argued by Metzler (1951), a monetary expansion usually requires an exchange of money for bonds. As bonds are also part of agents' financial wealth, the initial real balance effect may therefore be mitigated.[4]

2.3 The transaction-cost effect and non-additive separability in the utility function

McCallum (2001) and Ireland (2001a) have formalised the idea that holding money helps reduce the transaction cost into the otherwise standard macro model with microfoundations. While McCallum (2001) captures the idea by explicitly adding a transaction cost term in the representative household's budget constraint, Ireland (2001a) and Svensson (2001) relax the standard assumption of additive separability between money and consumption in the representative agent's utility function. After some algebraic manipulation, it could be shown that a real money term enters the derived IS equation explicitly.

[4]However, the wealth status of bonds has later been challenged by the literature on Ricardian equivalence.

However, McCallum (2001) argues that a reasonable parameterisation in the utility function leads to an insignificantly small value of the coefficient of the real money stock in the derived IS equation. Ireland's (2001a) empirical finding, using M2 as the measure of money, lends support to McCallum's conclusion: the transaction cost effect is arguably small.

2.4 Money as an auxiliary proxy for unidentified monetary transmission channels

> "The transmission of monetary policy from initial impulse to final effect involves changes in many relative prices of assets and output. That last statement may seem obvious to many of you, but it is inconsistent with most, if not all, recent work on quarterly, dynamic models of monetary policy" (Meltzer, 2001a, pp.30)

One critical assumption underlying standard macro models is that assets other than money, both financial and real, are *perfect* substitutes. This implies that all these assets can be treated as a single composite goods and the interest rate on the short-term government bonds is a perfectly accurate *stand-in* for all other yields. Agents in these models can therefore be perceived as if they were living in the two-asset world, money and the short-term riskless bonds.

However, owing to the fact that most assets in agents' portfolio are *gross* substitutes, not *perfect* substitutes, Meltzer (2001b), in line with Friedman and Schwartz (1982), Brunner and Meltzer (1993), argues, as the quote above suggests, that monetary policy operates by changing the *relative* yields of these assets. As the short-term riskless yield is no longer an adequate stand-in for all other yields, the assumption that monetary policy operates within the two-asset world may mask important monetary policy transmission channels. Because the demand for money is generally a function of these yields[5], the monetary stock could arguably serve as a good proxy for these unidentified monetary transmission channels.

Meltzer (2001b), following Koenig (1990), tested a two-stage backward looking model of changes in consumption, with changes in real money balances, real interest rates, income, and other variables as arguments of the consumption function using U.S. quarterly data. Similar to Koenig's result, he finds that changes in real money balances have a positively significant effect on changes in consumption even after the short-term interest rate is included as one of the explanatory variables. Meltzer (2001b) concludes from his finding that money plays an independent role in determining aggregate demand even when the role of the *short-term* interest rate has been taken into account. He further argues that the evidence lends support to the idea that money is serving as a proxy for relative prices of other assets that are relevant to aggregate demand.

Nelson (2002a) employs variant versions of Rudebusch and Svensson's (2002) pure backward-looking IS equation to test for the independent role of money using U.S. and U.K. quarterly data. His specification for the U.S. is given as follows;

$$\begin{aligned} \tilde{y}_t &= \psi_1 + \psi_2 \tilde{y}_{t-1} + \psi_3 \tilde{y}_{t-2} + \psi_3 r_{t-1} + \sum_{j=1} [\psi_{4,j} \triangle m_{t-j}] + \varepsilon_t \qquad (5) \\ \varepsilon_t &\sim N(0, \sigma^2) \end{aligned}$$

[5] By virtue of the portfolio theory of money demand, see, amongst others, Friedman (1956).

where y_t is the output gap, r_t is the real interest rate, and $\triangle m_t$ is real monetary base growth.

Nelson finds that lags of real monetary base growth enter equation (5) sizably, positively and significantly even when the *short term* interest rate has been explicitly controlled for.[6] In Nelson's terminology, real monetary base growth has a *'direct effect'* on aggregate demand. Although his result implies that conventional *backward-looking* IS equations, e.g. equation (5) with no money terms, are clearly misspecified, he argues that forward-looking IS equations derived from the standard optimisation-based framework, e.g. equation (1), are *not*, provided that a portfolio adjustment cost is introduced.[7] However, I shall argue on the contrary; IS equations which are based on the two-asset world assumption, whether or not they have allowed for the forward-looking behaviour of rational agents, are misspecified. In other words, the result that money terms enter equation (5) significantly cannot be *fully* rationalised even within the modified optimising IS-LM framework proposed by Nelson (2002a). This, as I shall argue below, is owing to the empirical significance of the 'risk premia' effect.

3 Theoretical Background: The term structure and risk premia effects

According to Meltzer, unidentified monetary transmission channels that the real money stock might be proxying are the channels which arise from changes in relative prices of a wide array of assets. There are two distinct aspects of changes in these relative prices; one being the changes along the term structure (the term-structure effect) and the other being the changes in relative risk premia (the risk premia effect) amongst different kinds and classes of financial assets.

3.1 The term-structure effect

The term structure effect captures the fact that an initial monetary impulse, i.e. a change in the short-term policy rate, changes relative yields along the term structure of interest rate. This implies that aggregate spending should also be a function of longer-term real interest rates, in addition to the real short term rate. Importantly, this effect partially captures the expectation channel of monetary policy transmission.

To elaborate, when the central bank decreases its short-term policy rate, the ultimate effect on aggregate spending, ceteris paribus, depends on agents' belief about the persistence of the initial impulse. If agents believe the impulse to be transitory, a decrease in the short rate would not lead to a significant decline in the long-term rate and hence the effect on aggregate spending will not be as strong as it would have been had the policy been believed to be permanent.[8] In this light, the typical backward looking IS equation is misspecified and, as the work of Nelson (2002a) shows, the statistical significance of the real monetary base growth

[6] For the case of the U.S., in line with Bernanke and Blinder's (1992) conclusion, Rudebusch and Svensson (2002) report that, using M2 as a proxy, real money growth terms enter the backward-looking IS equation insignificantly. However, Nelson (2002a) finds that the conclusion does not hold when the monetary base is used as an alternative proxy.

[7] Given this modification, the derived demand for money becomes a function of both short and long term interest rates. This in turn implies that money growth is highly correlated with the long rate.

[8] In fact, the impact on longer-term yields could go either way. This is because they are influenced by current and expected short-term yields. The outcome therefore depends upon the direction and the extent of the impact of the policy rate changes on the expectation of the future path of interest rates.

term in equation (5) could, in one and *only one* respect, be interpreted as evidence in support of the term structure effect.

3.2 The risk-premia effect

In addition to the term structure effect, monetary policy also operates through changes in the risk premia component of relative prices of various assets. This effect encompasses several monetary policy transmission channels commonly known in the literature, e.g. the balance sheet channel, the asset price channel, the expectation channel etc., all of which are absent in conventional macro models simply because all assets besides money are assumed to be perfect substitutes.

The balance sheet channel[9] **:** An unanticipated increase in the short-term policy rate impairs firms' financial position (e.g. through higher interest rate expenses, and unexpectedly lower return on prior investment). As their net worth deteriorated, a higher external financial premium may be required to compensate lenders (i.e. banks) as the default probability increases. Thus lending rates may not increase on a *one-to-one* basis with the policy rate as the *relative* riskiness of bank loans has been altered. This channel has not been incorporated as part of the transmission process in conventional macro models as risky bank loans are treated as pe mt3ubstiutlemt828.6iorris(le)4.7sas b

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Applying the expectation theory of the term structure, equation (6) can be rewritten as;

$$\tilde{y}_t = -\varphi r_t^l \tag{7}$$

where r_t^l is defined as the real long-term interest rate.

The above equation emphasises the point stressed by Rotemberg and Woodford (1999) and Clarida, Gali and Gertler (1999) in that it is the real *long-term* interest rate that matters for aggregate demand in optimisation-based forward looking macro models. Hence, except for the pure backward looking type, conventional macro models have already *implicitly* taken into account the term structure effect. However, as all assets other than money are treated as perfect substitutes in these models, the risk premia effect has not been incorporated as part of the monetary policy transmission mechanism.

In order to identify the risk premia effect, I estimate an equation which adds money terms into the otherwise standard *hybrid* IS equation. As the hybrid IS equation allows for both forward and backward looking behaviours of rational agents, following the above line of argument, if the money terms enter the hybrid IS equation sizably and significantly, I interpret the results as evidence in support of the prevalence of the risk premia effect.

The above line of argument, as equations (6) and (7) clearly show, depends largely on the validity of the expectation theory of the term structure. As its empirical justification is largely controversial[10], to ensure the validity of my result, I also *explicitly* control for the term structure effect by adding a proxy for the real long-term interest rate into my hybrid IS specification. The detail will be given in the next section.

Indeed, if the risk premia effect can be identified and is found to be empirically *in*significant, we could then infer that the interest rate channel currently identified in conventional macro models is sufficient to capture the main transmission process. Moreover, the widely adopted two-asset world assumption would be a justifiable simplifying assumption. Another implication is that real monetary growth would have no independent role in the *forward-looking* class of models as the term structure effect has already been encapsulated.

In contrast, if the risk premia effect is found to be empirically and sizably significant, the validity and completeness of conventional macro models which are based on the two-asset world assumption become seriously doubtful, particularly in light of its being a tool to identify and understand the transmission mechanism of monetary policy. As typical IS equations derived from the standard optimising agent framework are based on the two-asset world assumption, they are misspecified. Thus, the claim made by Nelson (2002b) and McCallum and Nelson (1999) that *"while recognizing many distinct assets 'is clearly correct for some purposes..., disaggregation provides benefits but also costs, so two-asset models will often prove convenient and satisfactory"'* (Nelson, 2002b, page 22-23) would become unjustified and that the problem imposed by the two-asset world assumption could be ameliorated by explicitly taking into account the independent role of money in the model.

4 Empirical Methodology

4.1 The backward looking IS specifications: *The direct effect of the money stock*

I first estimate a version of pure backward looking IS equations along the line of Nelson (2002a) in order to investigate whether the conclusion that he obtained for the U.S. and U.K., i.e. the

[10] See, amongst others, Thornton (2000).

real money stock contains information content over and above that captured by the real *short-term* rate, holds when using Thailand data. The sample covers from the period 1993:Q1 to 2002:Q2, dictated by the availability of Thailand quarterly GDP series.[11] However, as Thailand is a small-open economy, the baseline specification has to be modified in order to allow for open-economy factors. Specifically, I estimate the following backward looking IS equation;

$$\tilde{y}_t = \beta_1 + \beta_2\tilde{y}_{t-1} + \beta_3\tilde{y}_{t-2} + \beta_4\tilde{y}_{t-3} + \beta_5 r_{t-1} + \beta_6\triangle y^w_{t-1} + \beta_7\triangle q_{t-1} + \beta_8\triangle m_{t-1} + \varepsilon_t \quad (8)$$

$$r_t \equiv \frac{1}{4}\left(\sum_{i=0}^{3} R_{t-i}\right) - \triangle_4 p_t \quad (9)$$

$$\triangle y^w_t \equiv \frac{tr_{J,t}}{tr_{J,t} + tr_{US,t} + tr_{S,t}}\triangle y^J_t + \frac{tr_{US,t}}{tr_{J,t} + tr_{US,t} + tr_{S,t}}\triangle y^{US}_t + \frac{tr_{S,t}}{tr_{J,t} + tr_{US,t} + tr_{S,t}}\triangle y^S_t \quad (10)$$

$$m_t = M_t - p_t \quad (11)$$

$$\varepsilon_t \sim N(0, \sigma^2)$$

$\tilde{y}_t$ is Thailand output gap, defined as the deviation of (log) seasonally adjusted real GDP of Thailand (y_t) from the potential output (y^*_t). As the potential output is not observable and alternative detrending filters may plausibly extract different types of information from the data (Canova, 1998), I use four methods to estimate y^*_t (and therefore $\tilde{y}_t$) as a means to check for robustness. These are linear detrending (LT), quadratic detrending (QT), Hodrick-Prescott filtering (HP), and Beveridge and Nelson's (1981) decomposition (BN) methods.[12] Figure 1 shows the results of estimated y^*_t and $\tilde{y}_t$ obtained from the four detrending methods. r_t is the real short-term interest rate which is explicitly defined in equation (9). R_t is the short-term policy rate, defined as the quarterly averaged RP14 rate. $\triangle_4$ is the fourth-difference operator and p_t is (log) core consumer price index. Thus the real short-term interest rate, r_t, that I use here, following Nelson (2002a) and Rudebusch and Svensson (2002), is a smoothed version of the pseudo-real interest rate. $\triangle y^w_t$ is a proxy for the world output growth, and is defined in equation (10). Specifically, $\triangle y^w_t$ is the weighted average of first difference of (log) seasonally adjusted real GDP of the top-three trading partners of Thailand, namely Japan (J), U.S. (US) and Singapore (S).[13] $tr_{i,t}$ is the total value of export plus import between Thailand and country i, where $i = J, US, S$. $\triangle q_t$ is the first difference of (log) Thailand real effective exchange rate (REER), where an increase in q_t indicates a real appreciation in Thai baht.[14] M_t is the (log) quarterly average of the (seasonally adjusted) monetary stock. I use three proxies for this variable, namely M0 (monetary base), M1 and M2, as an additional means to check for robustness. Given these definitions, equation (8) is estimated using Ordinary Least Square (OLS) method.[15]

[11] Unless stated otherwise, the source of data is from the Bank of Thailand.

[12] For the BN method, I use a quick computational procedure proposed by Cuddington and Winters (1987) where the initial value of the potential output is taken to be that estimated by the QT method. Various ARMA(p,q) models are initially estimated on the changes in log seasonally adjusted real GDP up to ARMA(3,3) and the Akaike Info Criterion is used to select the best model, which turned out to be ARMA(2,2).

[13] The value of trade (export+import) between Thailand and the top three trading partners accounts, on average, for approximately 45 percent of Thailand's total external trading.

[14] I use $\triangle q_t$ instead of q_t in equation (8) because, as Table 1 shows, the null hypothesis that q_t is I(1) cannot be rejected at the 10 percent level of significance.

[15] Higher order lags of $\triangle m_t$ are included in the preliminary regressions analogous to equation (8) (not re-

As shown in Table 1, Augmented Dickey –Fuller (ADF) and Phillips-Perron (PP) tests indicate that the null hypothesis of the series being nonstationary I(1) can be rejected at the 10 percent level of significance for all variables included in equation (8) except for r_t. In the case of r_t, the result is ambiguous as ADF test could reject the null that the series is I(1) while PP test could not. To ensure that the empirical result obtained from equation (8) is not sensitive to the ambiguous stationarity property of r_t, I also regress the following equation, equation (12), using OLS method where r_{t-1} in equation (8) is replaced by its first difference, $\triangle r_{t-1}$.

$$\begin{aligned} \tilde{y}_t &= \gamma_1 + \gamma_2 \tilde{y}_{t-1} + \gamma_3 \tilde{y}_{t-2} + \gamma_4 \tilde{y}_{t-3} + \gamma_5 \triangle r_{t-1} + \gamma_6 \triangle y^w_{t-1} + \gamma_7 \triangle q_{t-1} \\ &\quad + \gamma_8 \triangle m_{t-1} + \varepsilon_t \\ \varepsilon_t &\sim N(0, \sigma^2) \end{aligned} \tag{12}$$

As will be shown in the next section, the main results obtained from regressing equations (8) and (12) are not sensitive to the specification of the interest rate term. Thus, throughout the rest of the paper, I shall assume that r_t is a stationary series.

4.2 The Hybrid IS Specifications: *The risk premia effect*

In order to investigate the risk premia effect, a version of the small-open economy hybrid IS equation is employed. Following Gali and Monacelli (2002) and Clarida, Gali and Gertler (2001), a small-open economy IS equation with microfoundations can be written as follows[16];

$$\tilde{y}_t = E_t(\tilde{y}_{t+1}) + \delta_1[R_t - E_t(\pi_{t+1})] + \delta_2 E_t(\triangle y^w_{t+1}) \tag{13}$$

where, as usual, $\tilde{y}_t$ is the domestic-economy output gap, R_t is the nominal short term rate, π_t is CPI inflation, and y^w_t is the (log) world output.

Equation (13) is similar to a standard optimisation-based IS equation found in its closed-economy counterpart (i.e Clarida, Gali and Gertler, 1999) except that elements representing 'the rest of the world' are factored in.[17] More specifically, the coefficients in the open-economy equilibrium, δ_1 and δ_2, also depend on parameters that are specific to the open economy (the index of openness and the elasticity of substitution between domestic and foreign goods), while fluctuations in world output also matter for domestic aggregate demand. The key assumption underpinning the derivation of equation (13) is that the uncovered interest parity (UIP) relationship holds. Given this assumption, the real exchange rate term does not *explicitly* appear as a determinant of the output gap in the reduced-form IS equation, equation (13). In particular, the UIP relationship is used to substitute the term away, and the effect of the real exchange rate on aggregate demand is *implicitly* captured by the coefficient of the real interest rate, δ_1. Given that the central bank uses the interest rate as its instrument in conducting monetary policy operation, the real exchange rate becomes *endogenously* determined in the model and its movement is *fully* dictated by the UIP relationship.[18] However, the empirical

ported), but are found to be statistically insignificant in most specifications. They are therefore dropped.

[16] Other open economy optimisation-based models include Svensson (2000) and Obsfield and Rogoff (2000), among others.

[17] For simplicity, I assume that the discount factor of a representative agent in the domestic economy is equal to unity and the domestic production technology parameter follows a random noise process.

[18]

evidence on the UIP relationship has been mostly discouraging (see amongst others, Froot and Thaler, 1990). This implies that, as the central bank changes the interest rate, its effect on aggregate demand via the exchange rate channel may not be *fully* captured by the coefficient of the real interest rate term and the standard 'imported inflation' effect via CPI inflation (π_{t+1}). To account for the remaining effect, I *explicitly* add the expected lead of real exchange rate growth ($E_t(\triangle q_{t+1})$) as one of the determinants of the output gap. This is given in the following equation.

$$\widetilde{y}_t = E_t(\widetilde{y}_{t+1}) + \sigma_1[R_t - E_t(\pi_{t+1})] + \sigma_2 E_t(\triangle q_{t+1}) + \sigma_3 E_t(\triangle y^w_{t+1}) \tag{14}$$

Furthermore, to improve the empirical fit, I assume that the output gap is a convex combination of lagged output gap and the right hand side of equation (14). This gives the following *hybrid* IS equation;

$$\widetilde{y}_t = \varpi \widetilde{y}_{t-1} + (1-\varpi)\Big[E_t(\widetilde{y}_{t+1}) + \sigma_1[R_t - E_t(\pi_{t+1})] + \sigma_2 E_t(\triangle q_{t+1}) + \sigma_3 E_t(\triangle y^w_{t+1})\Big] \tag{15}$$

In order to test for the existence of the risk premia effect, I add both contemporaneous and lagged real money growth terms in equation (15). After some algebraic manipulation, the following speci

$$E_t[\widetilde{y}_t - \phi_1 \widetilde{y}_{t-1} - \phi_2 \widetilde{y}_{t+1} - \phi_3 r_t - \phi_4 \triangle q_{t+1} - \phi_5 \triangle m_t - \phi_6 \triangle m_{t-1} - \phi_7 \triangle y^w_{t+1} \mid Z_t] = 0 \quad (18)$$

The instrument set Z_t includes two lags of each variable in equation (17).[20] Since the potential instrument set-and hence the number of orthogonality conditions-exceeds the number of parameters to be estimated, the model is over-identified, in which case I employ Hansen's (1982) J-statistic to test for the validity of the over-identifying restriction. If the null hypothesis is violated, it implies that the hypothesis of the model that had led to the moment equations in the first place is incorrect and at least some of the sample moment conditions are systematically violated. It is worth noting that the J-test is based on an asymptotic property. As the sample size taken in this paper is not very large, the interpretation of the test result must be done with this caution in mind.

As mentioned, identifying the risk premia effect by estimating equation (17) relies on the validity of the expectation theory of the term structure. To guard my result against the plausibility that the theory may not hold, I also *explicitly* incorporate a proxy for the real long-term interest rate into equation (17) as an *additional* control for the term structure effect. Ideally, the yields of riskless long term government bonds, e.g. 7 or 10 year riskless T-bonds issued by the Thai government, should be used. However, the series on such yields only began in 1999:Q3, which is obviously too short to be used in any empirical work.[21] I therefore use the quarterly average of state-enterprise (SE) bond yield series released by the Bank of Thailand as an alternative.[22] Although SE bonds are not as default free as T-bonds, judging from the fact that most SE bonds are fully guaranteed by the government and that their yields are highly correlated with those of 7 year T-bonds over the available sample periods[23], I argue that they could serve as a reasonably good proxy for the riskless long term yields.[24]

Analogous to the definition of the real short term rate, the 'pseudo' real SE bond yield is defined as $r^l_t \equiv \frac{1}{4}(\sum_{i=0} R^l_{t-i}) - \triangle_4 p_t$, where R^l_t is the nominal SE bond yield. In the preliminary regressions (not reported), I directly include r^l_t as an additional regressor in equation (17). However, the results suffer from the multicollinearity problem as r^l_t is highly correlated with r_t.[25] To attenuate the problem, I use percentage deviations of r^l_t from r_t, $\frac{(r^l_t - r_t)}{r_t}$, as an alternative *additional* control for the term structure effect. More specifically, the following equation is regressed using GMM method;

[20] Specifically, $Z_t = [\widetilde{y}_{t-1}, \widetilde{y}_{t-2}, r_{t-1}, r_{t-2}, \triangle m_{t-1}, \triangle m_{t-2}, \triangle y^w_{t-1}, \triangle y^w_{t-2}, \triangle q_{t-1}, \triangle q_{t-2}]$.

[21] One primary reason is that the Thai government had not issued any new government bonds from 1990 to 1997, owing to the long and continuous period of government budget surplus. In 1997, in response to the breakdown of the financial crisis, the Thai government has begun to reissue government bonds. However, the secondary bond market has not been formally developed until 1999.

[22] The series is calculated by weighted averaging the yields of new issues in each month, where the weight is taken to be the face value of the issuance. Almost all state-enterprise bonds have initial maturities of 3-10 years (mode is equal to 7).

[23] The correlation coefficient = 0.95, see Figure 2.

[24] As of 2001, approximately 85 percent of the outstanding values of state-enterprise bonds are completely guaranteed by the government. (Source: Thai Bond Dealer Club)

[25] Their correlation over the sample is equal to 0.95.

$$
\begin{aligned}
\widetilde{y}_t &= \lambda_1 \widetilde{y}_{t-1} + \lambda_2 \widetilde{y}_{t+1} + \lambda_3 r_t + \lambda_4 \triangle q_{t+1} + \lambda_5 \triangle m_t + \lambda_6 \triangle m_{t-1} \\
&\quad + \lambda_7 \triangle y^w_{t+1} + \lambda_8 \frac{(r^l_t - r_t)}{r_t} + \xi_t \qquad (19) \\
\xi_t &\equiv \lambda_2 [E_t(\widetilde{y}_{t+1}) - \widetilde{y}_{t+1}] + \lambda_4 [E_t(\triangle q_{t+1}) - \triangle q_{t+1}] + \lambda_7 [E_t(\triangle y^w_{t+1}) - \triangle y^w_{t+1}] + \varepsilon^y_t
\end{aligned}
$$

As before, the instrument set, Z_t, composes of two lags of all variables in equation (19).

5 Empirical Results

This section reports the estimation results of various equations outlined in the previous section.[26] For each equation, the results of 12 specifications using four different detrending methods (LT, QT, HP, BN) and 3 proxies for the monetary stock (M0 (monetary base), M1, and M2) are shown.

5.1 The backward-looking specifications: *The direct effect of the monetary stock*

Table 2 reports the estimation results of equation (8). For comparison, the first block shows the results for the baseline equation which does not include any monetary term. The three remaining blocks give the results when lagged real money growth is added. The values of the reported R^2 in all specifications which include lagged real money growth are reasonably high and are noticeably higher compared to their baseline counterparts. This implies that adding lagged real money growth in the baseline specification significantly improves the overall goodness of fit. Using Ramsey's RESET test, the null hypothesis of model misspecification cannot be rejected at the 5 percent level in all specifications. Moreover, based on the Ljung-Box Q statistic, the estimation results using OLS method are statistically efficient as no serial correlation is found up to 16 lags. As the sample includes the financial crisis period, structural changes in the IS equation may be suspected. I therefore conduct CUSUM tests and the results indicate that the null hypothesis of no structural instability cannot be rejected at the 5 percent level in all specifications (see Figure 3 for the results of CUSUM tests).

One crucial feature that can be seen from Table 2 is that the coefficients of lagged real money growth are statistically significant at the 5 percent level in *all* specifications. On the contrary, though correctly signed (negative), the coefficients of lagged real short term rate (r_{t-1}) are statistically significant only in 4 out of 16 specifications. Moreover, their magnitude is much smaller compared to those of the lagged money growth terms. Turning to the variables which represent 'open-economy' factors, the coefficients of $\triangle y^w_{t-1}$ are positive and statistically significant at the 10 percent level in 8 out of 16 specifications. The coefficients of lagged real exchange rate growth ($\triangle q_{t-1}$) are statistically significant at the 10 percent level in approximately 70 percent of the specifications. However, they are of the wrong sign (positive).[27]

[26] Throughout the paper, ***, ** and * denote statistical significance at the 1, 5, and 10 percent level, respectively.

[27] One plausible explanation for this adverse result could be because the sample taken in this paper includes the crisis period. As Figure 4 shows, the Bank of Thailand decided to float Thai baht exchange rate in 1997:Q3, which had led to an instantaneous sharp depreciation in the real value of Thai Baht. The exchange rate 'shock' coincided with a subsequent fall in aggregate demand. Statistically, the pairwise correlation between the output

The next table, Table 3, shows the estimation results of equation (9) where r_{t-1} in equation (8) is replaced by $\triangle r_{t-1}$.[28] Compared to the results shown in Table 2, the coefficients of lagged real money growth remain positively significant at the 5 percent level in the $m = m0$ and $m = m1$ specifications and is positively significant at the 10 percent level in the $m = m2$ specification. Crucially, this confirms that the evidence found in Table 2 in that lagged real money growth enters the aggregate demand equation sizably, positively and significantly is not sensitive to the ambiguous stationarity property of the real interest rate. On the contrary, in none of the specifications does $\triangle r_{t-1}$ enters significantly at the 10 percent level.[29] [30] For $\triangle y^w_{t-1}$, its effect on aggregate demand is much less strong compared to that shown in Table 2 as its coefficient is statistically significant at the 10 percent in only one specification. Lastly, $\triangle q_{t-1}$ remains wrongly signed and statistically significant at the 10 percent level in most specifications.

All in all, the results obtained from Table 2 and 3 signify the strong prevalence of the so-called 'direct effect' of lagged real monetary growth on aggregate demand. This implies that the monetary stock has information content concerning aggregate demand fluctuations *over and above* that captured by the short-term interest rate. In contrast, the real *short-term* interest rate (both in level and its first difference) performs much poorly as a direct determinant of aggregate demand. These results are consistent and if anything more forceful than those found by Nelson (2002a) for the U.S. and U.K. as the results shown here are robust against alternative detrending methods and different proxies for real monetary growth.

5.2 The hybrid IS specifications: *The risk premia effect*

The empirical results reported in this section show that the finding of the strong existence of a direct effect found in the previous subsection can partly be attributed to the 'risk-premia' effect. Table 4 shows the estimation results of equation (17). The evidence of high values of the reported R^2 across all specifications indicates that the specification of the hybrid IS equation is appropriately reasonable.[31] Moreover, the reported value of J-statistic implies

gap $\widetilde{y}_t$(HP) and the (log) real effective exchange rate q_t, over the full sample is 0.356. If one restricts the sample to the post-crisis period, 1998:Q1-2002:Q2, for which the exchange rate arguably behaved less abnormally, the correlation becomes correctly signed, -0.651.

[28] Similar to Table 2, the overall goodness of fit and all relevant diagnostic checking tests [RESET test, Ljung-Box Q statistics, CUSUM test] justify the validity of statistical inference made using the estimated results shown in Table 3.

[29] The evidence that interest rate terms generally enter IS equations insignificantly is indeed consistent with what have been found for the U.S. and U.K. In particular, Nelson (2002a) reported that, when removing the pre-1982 sample, the interest rate terms enter his backward looking IS specification insignificantly and wrongly signed. This conclusion holds for both the U.S. and U.K. economies.

[30] Although the real short term rate (the central bank's monetary policy instrument) is consistently found to have very little, in several cases no, *direct* effect on aggregate demand, monetary policy could at least in principle remains effective in affecting aggregate demand via its *indirect* effect on the relative yields of other assets. To the extent that money serves as a good proxy for these yields, the evidence found in this paper suggests that it is this *'indirect effect'* that matters for aggregate demand.

[31] On the surface, it may appear that inconsistency has arisen as the two basic specifications of aggregate demand, namely the pure backward looking IS specification [equation (8)] and the hybrid IS specification [equation (17)], simultaneously exhibit a high degree of goodness of fit. However, with the assumption that rational agents form their expectation for future and contemporaneous variables based on the past data (i.e. via the instrument set), the hybrid version of aggregate demand nests the backward looking version. In particular, it implies that rational agents utilise past relevant variables not only as determinants of aggregate demand but also as indicators for forecasting future variables. For example, rational agents' consumption may be a function of lagged interest rate. On the one hand, it could be interpreted that the agents use lagged interest rate as an indicator for their opportunity cost of fund (backward looking argument). On the other hand, it could mean

that the overidentifying restrictions can be rejected at the 1 percent level in all specifications. This implies that the moment conditions specified and exploited for estimation are reasonably appropriate, though it has to be stressed that the results are based on a large-sample property. The appropriateness of the *hybrid* IS specification is also confirmed by the result that the coefficients of both *lead* and *lagged* output gap are statistically significant in all specifications and that their sum is approximately equal to 1, which is consistent with the value suggested by the theory.[32] Importantly, the significance of the lead terms and the reasonably large values of their coefficients across all specifications, with the value ranging from 0.284 to 0.558, could be interpreted as evidence in favour of the existence of the term structure effect, i.e. agents are reasonably forward looking and therefore take into account the expected future path of interest rates in formulating their decisions.

Consistent with the evidence found by Nelson (2002a) for the U.S. and U.K., *contemporaneous* real money growth enters the IS equation insignificantly in most specifications. However, the same is not true for lagged real money growth. The coefficients of *lagged* real money growth are sizably positive and highly significant (at the 1 percent level) in all specifications. The coefficients of the contemporaneous real interest rate term are statistically significant at the 10 percent level in 6 out of 12 specifications, and are correctly signed (negative). The coefficients of lead world output growth ($\triangle y^w_{t+1}$) and those of lead real exchange rate growth ($\triangle q_{t+1}$) are not statistically significant in all specifications.

In all, given that the term structure effect has been *implicitly* controlled for under the *hybrid* IS specification, the results reported in Table 4 suggest a very strong prevalence of 'the risk premia effect'; *lagged real money growth evidently serves as an indicative proxy for changes in the risk premia component of relative prices of various kinds and classes of assets.*

Table 5 shows the estimation results of equation (19) which essentially adds percentage deviations of r^l_t from r_t in equation (17) as an *additional and explicit* control for the term structure effect.[33] The results are generally the same as those reported in Table 4. Most importantly, the coefficients of lagged money growth remain statistically significant at the 1 percent level in all specifications. Their magnitude is reasonably large and invariably comparable to that reported in Table 4. Moreover, the coefficients of $\frac{r^l_t - r_t}{r_t}$ are found to be insignificant in most specifications. As the term structure effect has been at least partially captured by the lead output gap term (which is reported to be consistently significant in most specifications), the insignificance of this *additional* control should not be interpreted as evidence against the importance of the term structure effect.

Although using three proxies for the monetary stock and four alternative detrending methods provide reasonable means for robustness checking, it is interesting to see if the results obtained thus far are sensitive to the inclusion of the financial crisis period in the sample. To examine this, I re-estimate equation (19), restricting the sample period to 1997:Q3-2002:Q2. The result is shown in Table 6.

Strikingly, the results show that the coefficients of lagged real money growth remain statistically significant at the 1 percent level in *all* specifications and their magnitude is greater compared to that shown in the previous two tables in most specifications. This implies that

that the agent use lagged interest rate as part of their information set in determining the future interest rate path (forward looking argument).

[32] From equation (17), $\phi_1 + \phi_2 = 1$.

[33] Note that the results from the formal unit root tests on $\frac{(r^l_t - r_t)}{r_t}$ is ambiguous (see Table 1). However, as the estimation results reported in Table 2 is insensitive to the stationarity property of the interest rate series. I shall assume that $\frac{(r^l_t - r_t)}{r_t}$ is I(0).

the strong evidence of the existence of the risk premia effect found thus far is robust, and if anything stronger, when the pre-crisis period is excluded from the sample. Three additional points are worth noting from the results of this subsample regression. Firstly, the coefficients of the lead output gap term turn out to be statistically significant in only 3 out of 12 specifications. If anything, this casts doubt on the robustness of the existence of the term structure effect. Secondly, the coefficients of the real short-term interest rate turns out to be statistically significant at the 5 percent level as well as correctly signed (negative) in most specifications (10 out of 12). This strengthens my prior conclusion on the sign and the significance of the real interest rate terms in that they appear to be much less consistent across different specifications (and subsamples) compared to those of the money growth terms. Thirdly, while the exchange rate term enters the IS equation insignificantly in all specifications in the previous two tables, when the subsample period in which the exchange rate arguably behaved less abnormally is considered, it turns out to be statistically significant as well as correctly signed (negative) in 6 out of 12 specifications.

6 Policy Implications and Concluding Remarks

Using Thailand data, this paper provides another piece of empirical evidence favouring the independent role of money as one of the determinants of aggregate demand. The key finding is that the effect of lagged real monetary growth on aggregate demand remains positive, sizable and statistically significant even when one controls for the term structure effect, both implicitly and explicitly. Thus the scope of changes in relative prices that money is conventionally found to proxy in the empirical literature is not limited to the changes in relative prices along the term structure of interest rate (the term structure effect). Instead, it also extends to the changes in relative risk premia among different kinds and classes of asset (the risk premia effect). This implies that the two-asset world assumption typically assumed in standard macro models, both with and without microfoundations, is distorting.

Given that the two-asset world assumption is not empirically justified, the transmission mechanism of monetary policy in reality becomes far more complicated than has traditionally been implied by standard macro models. To understand more on how the transmission process works, future work is needed to embed more microfoundations into the optimisation-based macro model so that imperfect substitution amongst assets takes place in equilibrium. These additional frictions would take the model away from the two-asset assumption as assets other than money can no longer be treated as a single composite goods and monetary policy in this world would operate by changing the relative risk premia of these assets. Until this ambitious task is fully developed, the results in this paper suggest that taking into account the explicit role of money in these models can mitigate the problem. This is because the transmission process from its initial impulse to its ultimate response involves various changes in relative yields of various financial assets, and real monetary growth could serve as a justifiable *stand-in* for these relative yields. At the very least, the monetary stocks should be monitored closely and the information attained has to be utilised as important informative indicators in the

Table 1: Unit-Root Test

	Augmented Dickey-Fuller (ADF) test	Phillips-Perron (PP) test
$\tilde{y}_t$ (LT)	-2.47**	-2.26**
$\tilde{y}_t$ (QT)	-2.68***	-2.52**
$\tilde{y}_t$ (HP)	-2.48**	-2.13**
$\tilde{y}_t$ (BP)	-2.15**	-1.90*
r_t	-3.26**	-1.41
Δr_t	-3.31***	-2.43**
$\Delta m0$	-5.60***	-5.64***
$\Delta m1$	-3.84***	-5.35***
$\Delta m2$	-3.31**	-4.00***
q_t	-1.94	-1.54
Δq_t	-4.49***	-4.56***
Δy_t^w	-3.76***	-4.65***
r_t^l	-3.10**	-1.18
$(r_t^l - r_t)/ r_t$	-2.78*	-1.30

Note: ADF tests for all variables include one lagged dependent variable. For PP tests, the number of lag truncation is set to 3. Except for $\tilde{y}_t$ (LT, QT, HP,BN) and Δr_t , all tests include a constant term. ***, **,* indicate statistical significance at the 1, 5, and 10 percent level.

Table 2: $\tilde{y}_t = \beta_1 + \beta_2 \tilde{y}_{t-1} + \beta_3 \tilde{y}_{t-2} + \beta_4 \tilde{y}_{t-3} + \beta_5 r_{t-1} + \beta_6 \Delta y^W_{t-1} + \beta_7 \Delta q_{t-1} + \beta_8 \Delta m_{t-1} + \varepsilon_t$

	Baseline model (no money stock)				*m=m0* (monetary base)				*m=m1*				*m=m2*			
	LT	QT	HP	BN	LT	QT	HP	BN	LT	QT	HP	BN	LT	QT	HP	BN
Constant	0.007 (0.008)	0.006 (0.008)	0.009 (0.008)	0.010 (0.012)	0.001 (0.008)	-0.001 (0.008)	0.003 (0.007)	0.001 (0.011)	-0.001 (0.007)	-0.004 (0.007)	0.0001 (0.007)	-0.001 (0.011)	0.004 (0.008)	0.003 (0.008)	0.006 (0.007)	0.004 (0.011)
$\tilde{y}_{t-1}$	1.151 (0.171)***	1.164 (0.172)***	1.056 (0.172)***	1.111 (0.184)***	1.001 (0.165)***	1.011 (0.166)***	0.912 (0.165)***	0.966 (0.176)***	1.011 (0.150)***	1.039 (0.152)***	0.922 (0.149)***	0.955 (0.166)***	0.978 (0.173)***	1.005 (0.174)***	0.881 (0.172)***	0.873 (0.189)***
$\tilde{y}_{t-2}$	-0.304 (0.268)	-0.299 (0.270)	-0.317 (0.255)	-0.268 (0.281)	-0.242 (0.244)	-0.239 (0.245)	-0.256 (0.232)	-0.239 (0.255)	-0.327 (0.226)	-0.319 (0.230)	-0.340 (0.214)	-0.296 (0.243)	-0.262 (0.247)	-0.263 (0.251)	-0.272 (0.235)	-0.155 (0.258)
$\tilde{y}_{t-3}$	0.054 (0.184)	0.032 (0.178)	0.114 (0.185)	0.029 (0.199)	0.109 (0.168)	0.096 (0.163)	0.156 (0.168)	0.115 (0.184)	0.262 (0.165)	0.215 (0.162)	0.330 (0.166)*	0.277 (0.189)	0.148 (0.173)	0.128 (0.170)	0.183 (0.172)	0.066 (0.180)
r_{t-1}	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)*	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.002 (0.001)**	-0.002 (0.001)*	-0.002 (0.001)**	-0.003 (0.001)**
Δy^w_{t-1}	0.505 (0.511)	0.536 (0.518)	0.493 (0.483)	0.663 (0.718)	0.983 (0.497)*	1.037 (0.504)**	0.913 (0.464)*	1.332 (0.703)*	0.875 (0.443)*	0.918 (0.457)*	0.822 (0.414)*	1.162 (0.640)*	0.430 (0.471)	0.474 (0.481)	0.385 (0.444)	0.582 (0.650)
Δq_{t-1}	0.136 (0.069)*	0.133 (0.070)*	0.118 (0.066)*	0.191 (0.097)*	0.106 (0.063)	0.103 (0.064)	0.088 (0.061)	0.151 (0.090)	0.162 (0.058)***	0.160 (0.060)**	0.141 (0.056)**	0.233 (0.085)**	0.149 (0.064)**	0.148 (0.065)**	0.127 (0.060)**	0.217 (0.088)**
Δm_{t-1}					0.274 (0.103)**	0.279 (0.104)**	0.258 (0.096)**	0.373 (0.146)**	0.406 (0.115)***	0.396 (0.117)***	0.388 (0.108)***	0.547 (0.174)***	0.734 (0.297)**	0.704 (0.301)**	0.698 (0.276)**	1.215 (0.465)**
R^2	0.874	0.875	0.824	0.849	0.900	0.902	0.862	0.880	0.914	0.912	0.881	0.891	0.897	0.896	0.858	0.881
Adj-R^2	0.847	0.848	0.787	0.814	0.874	0.876	0.826	0.846	0.891	0.889	0.851	0.861	0.870	0.869	0.821	0.848
RESET test (*p*-value)	0.715	0.846	0.756	0.889	0.730	0.962	0.995	0.959	0.996	0.991	0.792	0.917	0.764	0.472	0.698	0.343

Note: OLS estimates; Sample (unadjusted):1993:Q1-2002:Q2; Numbers in parenthesis are standard errors; ***,**,* indicate statistically significant at the 1, 5 and 10 percent, respectively.

Table 3: $\tilde{y}_t = \gamma_1 + \gamma_2 \tilde{y}_{t-1} + \gamma_3 \tilde{y}_{t-2} + \gamma_4 \tilde{y}_{t-3} + \gamma_5 \Delta r_{t-1} + \gamma_6 \Delta y^W_{t-1} + \gamma_7 \Delta q_{t-1} + \gamma_8 \Delta m_{t-1} + \varepsilon_t$

	Baseline model (no money stock)				*m=m0* (monetary base)				*m=m1*				*m=m2*			
	LT	QT	HP	BN	LT	QT	HP	BN	LT	QT	HP	BN	LT	QT	HP	BN
Constant	-0.0003 (0.005)	-0.0001 (0.005)	-0.0001 (0.005)	0.0002 (0.007)	-0.006 (0.005)	-0.006 (0.005)	-0.006 (0.005)	-0.008 (0.007)	-0.008 (0.005)	-0.007 (0.005)	-0.007 (0.004)	-0.010 (0.007)	-0.007 (0.006)	-0.007 (0.006)	-0.006 (0.006)	-0.010 (0.009)
$\tilde{y}_{t-1}$	1.182 (0.170)***	1.179 (0.171)***	1.113 (0.169)***	1.147 (0.184)***	1.021 (0.165)***	1.014 (0.165)***	0.954 (0.162)***	0.991 (0.177)***	1.039 (0.150)***	1.051 (0.152)***	0.957 (0.146)***	0.988 (0.167)***	1.080 (0.174)***	1.071 (0.174)***	1.023 (0.171)***	1.011 (0.192)***
$\tilde{y}_{t-2}$	-0.241 (0.272)	-0.247 (0.272)	-0.233 (0.260)	-0.220 (0.288)	-0.177 (0.246)	-0.183 (0.245)	-0.168 (0.235)	-0.184 (0.262)	-0.287 (0.231)	-0.297 (0.233)	-0.272 (0.216)	-0.261 (0.250)	-0.179 (0.264)	-0.182 (0.262)	-0.173 (0.254)	-0.117 (0.282)
$\tilde{y}_{t-3}$	-0.021 (0.170)	-0.024 (0.166)	0.073 (0.184)	-0.046 (0.187)	0.046 (0.155)	0.053 (0.151)	0.131 (0.167)	0.053 (0.174)	0.196 (0.157)	0.181 (0.154)	0.316 (0.166)*	0.208 (0.182)	-0.005 (0.164)	0.003 (0.159)	0.085 (0.178)	-0.076 (0.180)
Δr_{t-1}	-0.003 (0.003)	-0.002 (0.003)	-0.005 (0.003)	-0.002 (0.005)	-0.003 (0.003)	-0.003 (0.003)	-0.005 (0.003)	-0.003 (0.004)	-0.001 (0.003)	-0.001 (0.002)	-0.004 (0.003)	-0.001 (0.004)	-0.004 (0.003)	-0.004 (0.003)	-0.006 (0.003)	-0.003 (0.004)
Δy^w_{t-1}	0.302 (0.526)	0.373 (0.524)	0.200 (0.500)	0.468 (0.751)	0.794 (0.508)	0.888 (0.505)*	0.634 (0.474)	1.124 (0.728)	0.752 (0.465)	0.854 (0.471)*	0.593 (0.427)	1.025 (0.675)	0.147 (0.514)	0.212 (0.509)	0.029 (0.493)	0.308 (0.726)
Δq_{t-1}	0.127 (0.070)*	0.125 (0.071)*	0.111 (0.068)	0.183 (0.100)*	0.095 (0.065)	0.092 (0.064)	0.078 (0.062)	0.139 (0.092)	0.158 (0.060)**	0.158 (0.061)**	0.134 (0.057)**	0.227 (0.088)**	0.133 (0.068)*	0.131 (0.068)*	0.116 (0.066)*	0.197 (0.096)*
Δm_{t-1}					0.283 (0.104)**	0.289 (0.103)***	0.270 (0.097)***	0.383 (0.149)**	0.409 (0.118)***	0.401 (0.120)***	0.401 (0.108)***	0.553 (0.179)***	0.523 (0.292)*	0.549 (0.291)*	0.475 (0.275)*	0.832 (0.461)*
R^2	0.870	0.874	0.818	0.843	0.898	0.902	0.859	0.876	0.910	0.911	0.880	0.887	0.884	0.889	0.836	0.861
$Adj\text{-}R^2$	0.843	0.847	0.779	0.807	0.872	0.877	0.822	0.841	0.887	0.888	0.848	0.855	0.854	0.860	0.794	0.822
RESET test (*p*-value)	0.850	0.890	0.665	0.931	0.644	0.833	0.376	0.671	0.877	0.987	0.340	0.783	0.553	0.116	0.244	0.273

Note: OLS estimates; Sample (unadjusted):1993:Q1-2002:Q2; Numbers in parenthesis are standard errors; ***,**,* indicate statistically significant at the 1, 5 and 10 percent, respectively.

Table 4: $\tilde{y}_t = \phi_1 \tilde{y}_{t-1} + \phi_2 \tilde{y}_{t+1} + \phi_3 r_t + \phi_4 \Delta q_{t+1} + \phi_5 \Delta m_t + \phi_6 \Delta m_{t-1} + \phi_7 \Delta y^w_{t+1} + \upsilon_t$

	m=m0				*m=m1*				*m=m2*			
	LT	QT	HP	BN	LT	QT	HP	BN	LT	QT	HP	BN
$\tilde{y}_{t-1}$	0.673	0.652	0.671	0.636	0.568	0.577	0.554	0.565	0.487	0.486	0.508	0.498
	(0.083)***	(0.088)***	(0.077)***	(0.099)***	(0.086)***	(0.108)***	(0.056)***	(0.084)***	(0.077)***	(0.083)***	(0.054)***	(0.085)***
$\tilde{y}_{t+1}$	0.311	0.336	0.283	0.302	0.371	0.357	0.365	0.351	0.558	0.577	0.498	0.490
	(0.129)**	(0.143)**	(0.146)*	(0.166)*	(0.144)**	(0.192)*	(0.100)***	(0.132)**	(0.130)***	(0.145)***	(0.115)***	(0.152)***
r_t	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.0003)**	(0.0003)*	(0.0003)*	(0.0004)*	(0.0004)	(0.0004)	(0.0003)*	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)*
Δq_{t+1}	-0.033	-0.031	-0.036	-0.065	-0.107	-0.121	-0.119	-0.149	0.068	0.078	0.037	0.064
	(0.087)	(0.100)	(0.095)	(0.139)	(0.151)	(0.189)	(0.120)	(0.185)	(0.068)	(0.078)	(0.059)	(0.110)
Δm_t	0.066	0.053	0.077	0.058	-0.058	-0.064	-0.056	-0.019	-0.370	-0.365	-0.248	-0.240
	(0.092)	(0.090)	(0.091)	(0.152)	(0.072)	(0.072)	(0.064)	(0.103)	(0.210)*	(0.198)*	(0.229)	(0.329)
Δm_{t-1}	0.171	0.168	0.176	0.241	0.133	0.133	0.153	0.181	0.465	0.460	0.464	0.680
	(0.037)***	(0.035)***	(0.034)***	(0.055)***	(0.035)***	(0.039)***	(0.034)***	(0.051)***	(0.110)***	(0.098)***	(0.126)***	(0.164)***
Δy^w_{t+1t}	0.174	0.143	0.128	0.367	0.199	0.274	0.168	0.414	0.300	0.266	0.271	0.520
	(0.358)	(0.370)	(0.366)	(0.477)	(0.651)	(0.771)	(0.477)	(0.825)	(0.346)	(0.367)	(0.328)	(0.607)
R^2	0.947	0.950	0.916	0.930	0.945	0.944	0.918	0.927	0.942	0.942	0.923	0.934
Adj-R^2	0.935	0.939	0.898	0.914	0.932	0.931	0.899	0.910	0.930	0.930	0.906	0.919
J-Statistic	0.079	0.086	0.077	0.089	0.107	0.101	0.108	0.109	0.083	0.081	0.081	0.085
p- value	0.442	0.404	0.452	0.401	0.303	0.327	0.300	0.310	0.420	0.430	0.432	0.422

Note: GMM estimates; Sample (unadjusted): 1993:Q1-2002:Q2; Numbers in parenthesis are standard errors; ***, **, * indicate statistically significant at the 1, 5 and 10 percent, respectively; Instrument set includes $\tilde{y}_{t-1}$, $\tilde{y}_{t-2}$, r_{t-1}, r_{t-2}, Δm_{t-1}, Δm_{t-2}, Δy^w_{t-1}, Δy^w_{t-2}, Δq_{t-1}, Δq_{t-2}; standard errors are corrected for autocorrelation problem using Newey and West's (1987) asymptotic covariance matrix (Bandwidth =3 as suggested by Newey and West).

Table 5: $\tilde{y}_t = \lambda_1 \tilde{y}_{t-1} + \lambda_2 \tilde{y}_{t+1} + \lambda_3 r_t + \lambda_4 \Delta q_{t+1} + \lambda_5 \Delta m_t + \lambda_6 \Delta m_{t-1} + \lambda_7 \Delta y^w_{t+1} + \lambda_8 [(r^l_t - r_t)/ r_t] + \xi_t$

	m=m0				m=m1				m=m2			
	LT	QT	HP	BN	LT	QT	HP	BN	LT	QT	HP	BN
$\tilde{y}_{t-1}$	0.700 (0.100)***	0.689 (0.116)***	0.721 (0.089)***	0.667 (0.119)***	0.558 (0.054)***	0.572 (0.057)***	0.558 (0.053)***	0.502 (0.055)***	0.563 (0.058)***	0.548 (0.061)***	0.557 (0.045)***	0.532 (0.069)***
$\tilde{y}_{t+1}$	0.332 (0.171)*	0.352 (0.203)*	0.273 (0.173)	0.306 (0.203)	0.503 (0.058)***	0.528 (0.074)***	0.459 (0.062)***	0.530 (0.061)***	0.350 (0.100)***	0.394 (0.111)***	0.303 (0.084)***	0.393 (0.120)***
r_t	-0.001 (0.0003)**	-0.001 (0.0003)**	-0.001 (0.0003)**	-0.001 (0.0004)*	-0.0002 (0.0002)	-0.0003 (0.0002)	-0.0002 (0.0002)	-0.0002 (0.0003)	-0.002 (0.001)***	-0.001 (0.001)***	-0.002 (0.0004)***	-0.002 (0.001)**
Δq_{t+1}	-0.007 (0.100)	-0.003 (0.117)	-0.021 (0.092)	-0.038 (0.148)	0.010 (0.041)	0.026 (0.053)	-0.010 (0.042)	0.025 (0.059)	0.013 (0.050)	0.024 (0.054)	-0.003 (0.047)	0.014 (0.082)
Δm_t	0.090 (0.142)	0.082 (0.155)	0.106 (0.142)	0.164 (0.238)	0.008 (0.057)	-0.002 (0.064)	0.035 (0.062)	-0.026 (0.079)	0.151 (0.207)	0.026 (0.197)	0.217 (0.188)	0.129 (0.373)
Δm_{t-1}	0.173 (0.043)***	0.173 (0.046)***	0.171 (0.045)***	0.279 (0.072)***	0.172 (0.037)***	0.163 (0.037)***	0.175 (0.034)***	0.256 (0.048)***	0.614 (0.117)***	0.574 (0.116)***	0.617 (0.131)***	0.742 (0.189)***
Δy^w_{t+1}	0.025 (0.241)	0.016 (0.287)	0.104 (0.209)	-0.083 (0.386)	-0.058 (0.178)	-0.009 (0.171)	-0.104 (0.195)	-0.181 (0.266)	0.421 (0.236)*	0.397 (0.272)	0.401 (0.200)*	0.435 (0.329)
$(r^l_t - r_t)/ r_t$	-0.00004 (0.001)	-0.0002 (0.001)	-0.0001 (0.001)	-0.001 (0.002)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)*	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.002 (0.001)
R^2	0.942	0.940	0.910	0.925	0.955	0.949	0.935	0.936	0.961	0.957	0.941	0.943
Adj-R^2	0.925	0.923	0.884	0.903	0.941	0.934	0.916	0.917	0.949	0.944	0.924	0.926
J-Statistic	0.082	0.089	0.077	0.072	0.156	0.166	0.149	0.146	0.084	0.108	0.070	0.077
p- value	0.455	0.416	0.485	0.510	0.172	0.149	0.189	0.198	0.440	0.328	0.525	0.481

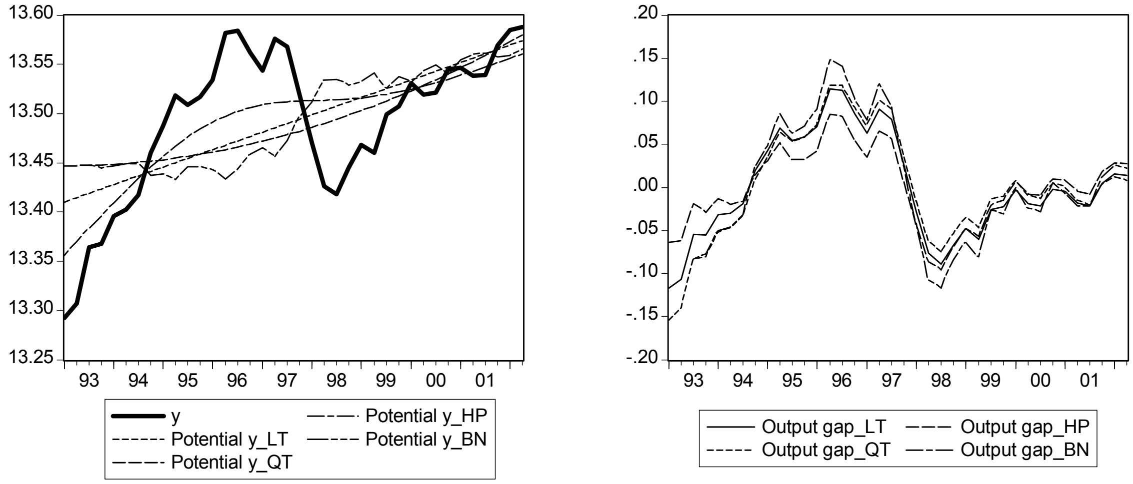
Note: GMM estimates; Sample (unadjusted): 1993:Q1-2002:Q2; Numbers in parenthesis are standard errors; ***, **, * indicate statistically significant at the 1, 5 and 10 percent, respectively; Instrument set includes $\tilde{y}_{t-1}$, $\tilde{y}_{t-2}$, r_{t-1}, r_{t-2}, Δm_{t-1}, Δm_{t-2}, Δy^w_{t-1}, Δy^w_{t-2}, Δq_{t-1}, Δq_{t-2}, $(r^l_{t-1} - r_{t-1})/ r_{t-1}$, $(r^l_{t-2} - r_{t-2})/ r_{t-2}$;standard errors are corrected for autocorrelation problem using Newey and West's (1987) asymptotic covariance matrix (Bandwidth =3 as suggested by Newey and West).

Table 6: $\tilde{y}_t = \lambda_1 \tilde{y}_{t-1} + \lambda_2 \tilde{y}_{t+1} + \lambda_3 r_t + \lambda_4 \Delta q_{t+1} + \lambda_5 \Delta m_t + \lambda_6 \Delta m_{t-1} + \lambda_7 \Delta y^w_{t+1} + \lambda_8 [(r^l_t - r_t)/ r_t] + \xi_t$

	m=m0				m=m1				m=m2			
	LT	QT	HP	BN	LT	QT	HP	BN	LT	QT	HP	BN
$\tilde{y}_{t-1}$	0.701 (0.060)***	0.720 (0.057)***	0.647 (0.045)***	0.637 (0.042)***	0.643 (0.053)***	0.670 (0.050)***	0.610 (0.051)***	0.410 (0.0520)***	0.613 (0.044)***	0.612 (0.050)***	0.551 (0.020)***	0.557 (0.046)***
$\tilde{y}_{t+1}$	-0.086 (0.185)	-0.130 (0.137)	0.029 (0.220)	0.351 (0.205)	0.047 (0.126)	-0.057 (0.119)	0.044 (0.134)	0.956 (0.188)***	0.173 (0.113)	0.101 (0.142)	0.161 (0.081)*	0.310 (0.106)**
r_t	-0.001 (0.0004)***	-0.001 (0.0003)***	-0.001 (0.001)**	-0.001 (0.001)	-0.001 (0.0004)**	-0.001 (0.0003)**	-0.001 (0.0004)**	0.001 (0.001)*	-0.003 (0.001)***	-0.003 (0.001)***	-0.004 (0.0004)***	-0.003 (0.001)**
Δq_{t+1}	-0.193 (0.071)**	-0.197 (0.052)***	-0.145 (0.081)*	-0.048 (0.077)	-0.210 (0.056)***	-0.234 (0.059)***	-0.201 (0.056)***	0.021 (0.085)	0.006 (0.036)	-0.009 (0.046)	0.105 (0.045)**	0.024 (0.061)
Δm_t	0.163 (0.082)*	0.166 (0.054)**	0.118 (0.087)	0.042 (0.094)	0.183 (0.050)***	0.216 (0.044)***	0.190 (0.051)***	-0.204 (0.107)*	0.273 (0.176)	0.115 (0.168)	0.654 (0.121)***	0.299 (0.267)
Δm_{t-1}	0.229 (0.034)***	0.227 (0.030)***	0.213 (0.035)***	0.271 (0.032)***	0.279 (0.024)***	0.288 (0.026)***	0.281 (0.025)***	0.263 (0.054)***	0.776 (0.154)***	0.753 (0.152)***	1.228 (0.164)***	0.889 (0.266)***
Δy^w_{t+1}	-0.154 (0.270)	0.092 (0.271)	-0.181 (0.264)	-0.434 (0.335)	-0.272 (0.240)	-0.121 (0.281)	-0.344 (0.228)	-0.092 (0.400)	0.934 (0.243)***	1.026 (0.272)***	0.797 (0.161)***	0.897 (0.440)*
$(r^l_t - r_t)/ r_t$	-0.003 (0.001)**	-0.002 (0.001)***	-0.001 (0.001)	-0.001 (0.001)	-0.004 (0.001)***	-0.004 (0.001)***	-0.003 (0.001)***	0.001 (0.002)	-0.002 (0.001)**	-0.002 (0.001)*	-0.004 (0.001)***	-0.003 (0.001)*
R^2	0.843	0.833	0.870	0.855	0.854	0.834	0.862	0.864	0.931	0.914	0.927	0.901
Adj-R^2	0.743	0.727	0.787	0.763	0.761	0.728	0.775	0.777	0.886	0.860	0.881	0.838
J-Statistic	0.124	0.112	0.138	0.120	0.149	0.130	0.158	0.193	0.090	0.082	0.116	0.084
p- value	0.500	0.547	0.454	0.515	0.417	0.482	0.392	0.300	0.633	0.671	0.530	0.661

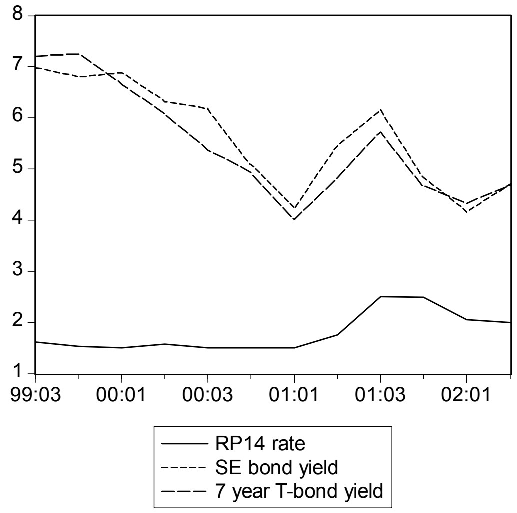
Note: GMM estimates; Sample (unadjusted): 1997:Q3-2002:Q2; Numbers in parenthesis are standard errors; ***, **, * indicate statistically significant at 1, 5 and 10 percent, respectively; Instrument set includes $\tilde{y}_{t-1}$, $\tilde{y}_{t-2}$, r_{t-1}, r_{t-2}, Δm_{t-1}, Δm_{t-2}, Δy^w_{t-1}, Δy^w_{t-2}, Δq_{t-1}, Δq_{t-2}, $(r^l_{t-1} - r_{t-1})/ r_{t-1}$, $(r^l_{t-2} - r_{t-2})/ r_{t-2}$;standard errors are corrected for autocorrelation problem using Newey and West's (1987) asymptotic covariance matrix (Bandwidth =3 as suggested by Newey and West).

Figure 1: Estimated potential output and output gap from four detrending methods



Note: LT, QT, HP, and BN denote Linear Detrending, Quardratic Detrending, Hodrick-Prescott Filtering, and Beveridge-Nelson Decomposition, respectively.

Figure 2: State Enterprise (SE) bond yields, 7-year risk-free T Bond yields, and RP14 day rates



Note: Sample period is dictated by the availability of the 7 year riskless T bond series. Value on the Y-axis is percent.

Figure 3: CUSUM Test

Figure 3.1: CUSUM Test (Equation (8), Table 2)

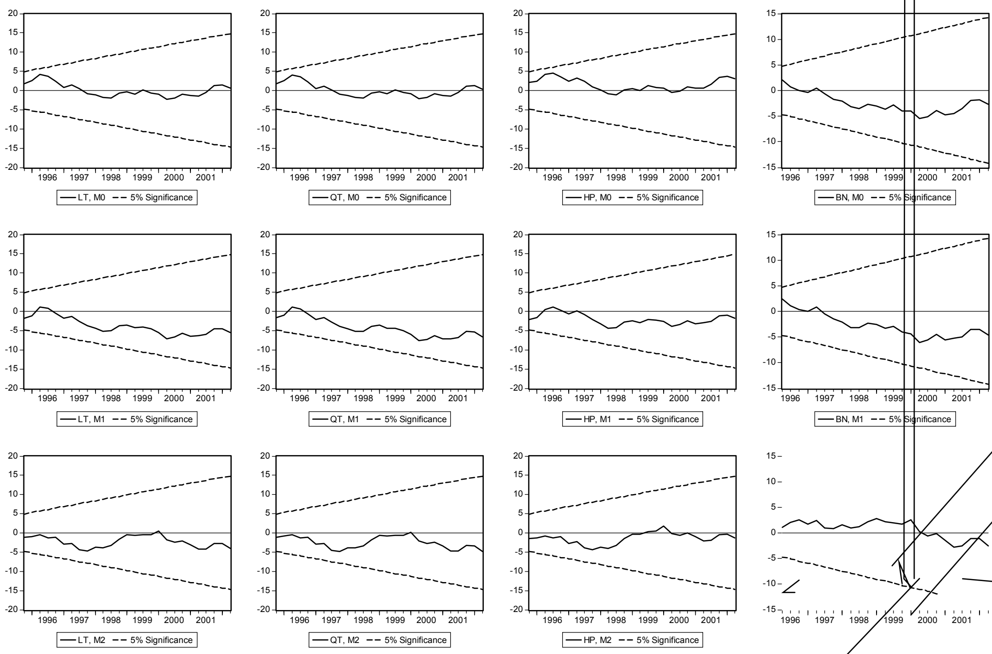
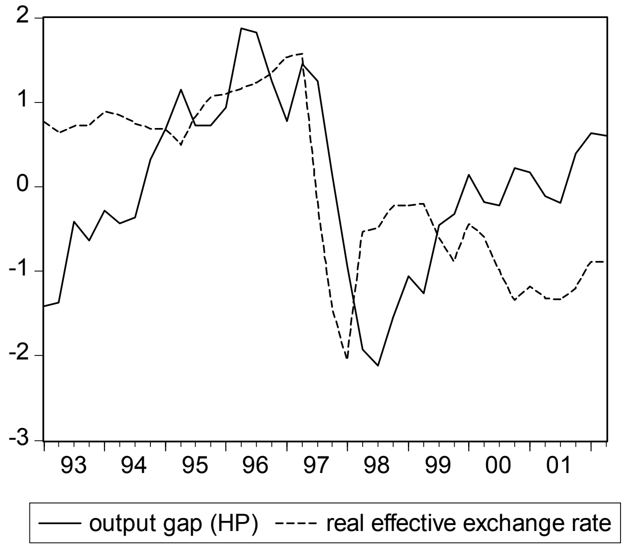


Figure 4: (log) Real effective exchange rate (q_t) and Output gap ($\tilde{y}_t$)



Note: Normalised scale on the Y-axis

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