

A MODEL OF POLITICAL RISK PREMIUM

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ABSTRACT

This study intends to estimate political risk premium, given the prospect of future capital controls on outflows. We construct a theoretical model of political risk premium based on a modified version of the monetary equilibrium model by Dooley et al (1997).

It is difficult to distinguish empirically the political risk premium attributable to potential future capital controls on outflows from the interest differential that results from deliberate policies. This study, by allowing a feedback mechanism from capital outflows (in pursuit of higher expected return abroad) to the interest differential and explicitly incorporating macroeconomic variables that characterize international shocks and sterilization intervention policies, provides a complementary measure to measure the risk attributable solely to future capital controls and takes into consideration a macro framework that is lacking in common methods relying solely on covered interest differentials.

INTRODUCTION

How exchange risk premium contributes to interest rate disparities between assets denominated in different currencies has been well documented. However, the extent to which political risk premium contributes to interest rate disparities between assets denominated in different political jurisdictions has not received equal attention. Aliber (1973, p.1453) defines political risk as "the probability of that the authority of the state will be interposed between investors in one country and investment opportunities in other countries". In other words, he refers to political risk as the probability of controls on capital flows. Dooley and Isard (1980) point out that this risk, given the prospect of future capital controls must be separated from an interest differential resulting from existing capital controls. This study intends to estimate this political risk premium, given the prospect of future capital controls on outflows. We construct a theoretical model of political risk premium based on a modified version of the monetary equilibrium model by Dooley et al (1997).

At the onset of the Asian currency crisis that erupted toward the end of 1996, speculative sales of Malaysian currency, Ringgit in the forward market together with intervention purchase of Ringgit in the spot market by the Central Bank of Malaysia (BNM) opened up a covered interest differential in favor of foreign assets. Assuming

imperfect capital mobility, this differential did not disappear instantaneously and arbitrage profits existed. Arbitrageurs buy foreign currency spot, purchase foreign deposits and sell foreign currency forward, contributing to further capital outflows and downward pressure on the spot value of Ringgit. In light of free fall of Ringgit, massive capital outflows, depletion of international reserves holding to defend the exchange rate, and adverse effects of high domestic interest rates on the domestic credit market with non-sterilized intervention, the risk of capital controls on outflows increased. Investors, taking this risk into consideration, incorporated a political risk premium into Malaysian assets.

One of the key arguments against capital controls on outflows is that a political risk premium, in anticipation of imminent capital controls on outflows, raises domestic interest rates, thus further undermining the domestic credit market, rendering capital controls counterproductive *ex ante*. Therefore, it is important to identify the component that is attributable only to this particular form of risk if one is to conduct any meaningful cost and benefit analysis of imposing capital controls on outflows in times of crisis.

This study attempts to address two empirical difficulties of political risk premium associated with using interest differential to measure political risk premium:

1. It is a common practice to model capital as flowing to the asset that offers higher expected yield. Meanwhile, capital outflows increase the probability of capital controls on outflows, thus increasing the political risk premium. It is difficult to distinguish empirically the political risk premium attributable to potential future capital controls on outflows from the interest differential that induces or discourages capital outflows in the first place. This study, by allowing a feedback mechanism from capital outflows (in pursuit of higher expected return abroad) to the interest differential (suggested by Gros (1987)) can focus on the political risk premium in the before-control period.
2. Interest differentials could result if domestic and foreign assets are not perfect substitutes as a result of existing capital controls, prospective defaults, exchange risk premium and other influences. Policymakers often heavily intervene in foreign exchange markets during a crisis. Some policymakers may find it necessary to deliberately tighten the money supply to raise interest rates hoping to mitigate capital flights. Some prefer otherwise. Without a formal theoretical model, it is not possible to empirically distinguish the effect on actual interest differential of these deliberate official policies from that of an anticipation of future capital controls on outflows. Therefore, a model that

explicitly takes into account the monetary authorities' decision is in order.

The rest of this study is structured as the following. Section 1 contains Dooley et al's (1997) model. Section 2 lays out a political risk premium model modified from Dooley et al's, sets up an econometric model and reports the results. Section 3 concludes the study.

1. DETERMINATION OF POLITICAL RISK PREMIUM

This framework borrows heavily from characteristics of a typical developing country. It assumes a small open economy under a fixed/managed float exchange rate regime. It assumes at least partial sterilized intervention and various moderate existing financial repressions including interest rate ceiling that contribute to imperfect substitutability between domestic and foreign assets. It also assumes incomplete market separation in the form of disguised capital flows in the presence of capital controls.

This study assumes that the main goal of capital controls on outflows is to keep domestic interest rates relatively lower than their foreign counterparts. Even in the presence of capital controls, capital outflows may take place in disguised forms such as over-invoicing imports and under-invoicing exports by incurring the cost of circumventing the legislations given enough arbitrage profits. Bachetta (1996) formulates such cost as a function of past differentials while Gros (1987) and Dooley et al. (1997) formulate it as a function of future differentials. All of them assume a quadratic form of cost function. For the purpose of measuring interest differentials due to prospective capital controls on outflows, this study adopts the forward-looking cost function of Gros (1987) and Dooley et al. (1997).

It is noteworthy to mention the distinction between quantitative capital controls and market-based controls. Market-based controls usually involve the use of required reserve ratios or withholding taxes on certain targeted types of asset stocks instead of flows. Such controls are expected to maintain a constant yield differential even in the long run because the differential approximates a (tax) cost of investing in certain type of asset (Gros, 1987). Quantitative capital controls impose limits on the amount of funds that can be invested in foreign assets (in the case of controls on outflows). Examples include caps on foreign asset positions by domestic residents, deferring repatriation of profits to non-residents, to name a few. In the 1998 episode, capital controls in Malaysia are mainly directed at banning speculative activities against Ringgit in offshore markets such as Singapore. These controls practically abolish forward purchase/sale of foreign currency/Ringgit.¹

¹ Examples include requiring non-resident sellers of Malaysian securities to hold on to their ringgit proceeds for at least one year; limiting the export of foreign currency by

The advantage of market-based controls is that investors are able to include them into risk-return calculation of their portfolio and thus introduce relatively low degree of investor risk. The disadvantage is that they are not useful in case of large capital surges in response to sudden changes in expected returns because the tax payable may be very small compared to the gains (losses) to investors from changing their portfolio composition swiftly. As a result, quantitative restrictions are often used in extreme times. The disadvantage of these controls is that they are subject to administrative discretion and their costs are hard to be calculated in risk-return trade-off. Their scope and application are often uncertain, introducing a tremendous unknown risk (Fitzgerald, 1999). Because of these reasons that complicate precise measurement of controls, quantitative controls are modeled simplistically as a ceiling on foreign capital asset holdings by residents or/and withdrawal of non-resident investors from domestic asset markets. For example, see Bachetta (1996), Wyplosz (1986). This paper considers quantitative capital controls that were emphasized in Malaysian case in 1998.

The model is divided into two sub-samples: before and after capital controls. For the after-control period, the model follows Dooley et al's (1997) closely except that it assumes a constant money multiplier and abstracts from the difficulty of measuring differential tax treatment of holding foreign assets by assuming no market-based controls. For the before-control period, this paper assumes perfect foresight and uses ex post variables as the proxy of expected variables. It then estimates the political risk premium in the before-control period based on the future expected values of variables derived from a money equilibrium in the after-control period.

The structure of the analysis can be illustrated in Figure 1 as follows. Suppose capital controls on outflows are imposed at time t . For a given foreign interest rate, r_F , the solution to the maximization problem in this model implies the above broad money supply, $M_0^{S,B}$ and money demand curve, $M_0^{D,B}$ where disguised capital flows, DCF , is zero. Capital controls create a wedge between the domestic interest rate, \bar{r}_B and the foreign interest rate, r_F , resulting in an excess supply of money. As investors engage in disguised capital flight, the cost of moving funds which is assumed to be a nonlinear function of real disguised capital flows increases, reducing the gap between the return of foreign assets and domestic assets, shifting the money demand right to $M_1^{D,B}$ at $DCF_1 > 0$, reducing the excess supply of money.

Also shown in Figure 1, the equilibrium money stock (if there were no capital controls) decreases from A to B and the domestic interest rate needed to clear the market

residents to RM10,000. For detailed description of Malaysian capital controls in 1998, refer to the appendix .

is lower as disguised capital flows take place. Because this process is costly under capital controls, investors who anticipate a high probability of capital controls at time t will choose to withdraw at time $t-1$ to avoid incurring the cost of disguised capital flows. As a result, higher risk premium is required to induce investors to hold on to domestic assets at time $t-1$. The associated decline in reserves, depreciation of the exchange rate and increase in domestic prices may cause the money supply to decline, shifting the money supply curve to the left. This implies incomplete sterilization. The final equilibrium is characterized by an observed interest differential and a change in the stock of disguised capital. Other things equal, a narrowing of the spread between international interest rates and “targeted” domestic interest rates (adjusted for changes in exchange rates and the cost of disguised capital flows) can be interpreted as the central bank being forced away from its policy target. This implies a decline in the cost of private disguised capital flows, reducing the incentive to withdraw capital outflows ex ante at time $t-1$.

Implications of capital controls on outflows to facilitate expansionary monetary policy through sterilized intervention on monetary equilibrium and political risk premium can be studied within the above structure. Figure 2 shows one possible situation. Expected free fall of domestic currency leads to depletion of international reserves holding by the monetary authorities as the crisis worsens, shifting the money supply curve to the left, reducing the excess supply, reducing the domestic interest rate that is needed to clear the market (from A to C). This implies incomplete sterilization. In this case, the amount of disguised capital flows needed to reduce the excess supply of money is smaller (from 1 to 2). Consequently, the political risk premium to restore monetary equilibrium ex ante at time $t-1$ is smaller. If sterilization is complete, that is, the money supply is fixed at $M_0^{S,B}$. A larger amount of disguised capital flows should occur to close the gap between foreign and domestic asset returns (from 1 to 3). Consequently, the political risk premium to restore monetary equilibrium ex ante is larger. The more effective the sterilization, the higher political risk premium is ex ante.

Figure 3 illustrates the implication of the response function of the monetary authorities under capital controls on political risk premium. Assuming that the economy starts $M_0^{S,B}$ and $M_0^{D,B}$. Suppose that real output contracts, domestic currency loses value, prices of non-traded goods fall relative to traded goods. If the monetary authorities are not expected to react to these variables, the gap between domestic and foreign assets return and the amount of disguised capital flows needed to restore equilibrium are smaller (from 1 to 2). Consequently, the ex ante political risk premium at time $t-1$ needed to induce investors to hold domestic assets are smaller. If the authorities are expected to increase the money supply (to $M_1^{S,B}$) in response to the above shocks, the gap between the domestic and foreign

assets return and the amount of disguised capital flows needed to restore equilibrium are larger (from 1 to 3). Accordingly, the ex ante political risk premium needed to induce investors to hold domestic assets are larger.

At time $t-1$, while capital controls are not in place yet, investors form expectations about relevant variables at time t such as variables that enter the reaction function of the authorities while conducting sterilized intervention and the cost of disguised capital flows if capital controls are imposed, both in terms of the direct cost and opportunity cost of not withdrawing the capital at time $t-1$, thus being trapped with a potential lower return onshore.² The more effective the sterilized intervention is expected to be, the lower the expected return of domestic assets compared with foreign assets, thus the higher incentive to increase capital outflows in both the authorized and disguised form. All these feed back to the money equilibrium to reduce the equilibrium money demand at time $t-1$. As a result, higher risk premium is required from the domestic asset at time $t-1$.

1.1. Dooley et al's Model

This framework models explicitly the behavior of two parties: private investors and monetary authorities.

A. Private Sector Behavior

Private agents' behavior is captured by an inter-temporal model in which private agents maximize their expected utility over consumption of traded and non-traded goods. Each period consists of two sub-periods: the “beginning” and the “end”³. In the beginning of each period, consumers can use cash (M1) to purchase goods. Consumers are faced with a cash-in-advance (CIA) constraint as the following:

$$M_{t-1} \geq P_{1,t}C_{1,t} + P_{2,t}C_{2,t} \quad (1.1)$$

where $P_{1,t}$ denotes the vector of domestic prices of a vector of traded goods, $C_{1,t}$ in period t . $P_{2,t}$ denotes the vector of domestic prices of a vector of non-traded goods,

² The direct cost here is referred as cost that is incurred in circumventing the legislation. In this model, the fixed cost and the marginal cost are given as d_0 and $d_1 \frac{\theta_t DCF_t}{P_t}$.

The opportunity cost is referred to the potential difference between the foreign and domestic asset return in favor of foreign assets.

³ This time line design is not essential as long as consumers are subject to cash-in-advance constraints.

$C_{2,t}$ in period t . This formulation implies current account convertibility.

This constraint means that in selecting his optimal asset allocation, a consumer will want to ensure that his cash holding at the end of period t is at least as large as his expenditure on goods in period $t+1$:

$$M_t \geq E_t(P_{1,t+1}C_{1,t+1} + P_{2,t+1}C_{2,t+1}) \quad (1.2)$$

where E_t is the expectation operator

Consumers' utility functions, U are assumed to be well-defined, differentiable and separable between traded and non-traded goods:

$$U_t = U(C_{1,t}, C_{2,t})$$

$$\text{where } \frac{\partial U_t}{\partial C_{i,t}} \geq 0, \frac{\partial^2 U_t}{\partial C_{1,t} \partial C_{2,t}} = 0, \frac{\partial^2 U_t}{\partial^2 C_{i,t}} \leq 0$$

$$\text{where } i=1,2 \quad (1.3)$$

At the end of each period, consumers receive income from output as well as various assets and make their optimal asset decisions as asset markets open. At the end of each period, consumers start out with income, Y_t , cash, M_{t-1} (what is left over after their purchase of goods in the beginning of the period), time deposit in domestic banks, B_{t-1} , authorized net foreign assets in domestic currency, $\theta_t F_{t-1}^A$ where θ_t denotes current exchange rate and net foreign position from cumulative disguised capital flows, $\theta_t F_{t-1}^D + \theta_t DCF_t$, where DCF_t is the disguised capital flows through under or over invoicing imports and exports in the beginning-period when goods markets are open. Interest income on domestic deposits is $r_{B,t-1} B_{t-1}$ where $r_{B,t-1}$ is the interest rate on domestic time deposits. Interest income on authorized net foreign assets equals $(1 - \phi)r_{F,t-1} \theta_t F_{t-1}^A$, where $r_{F,t-1}$ is the previous period's foreign interest rate and ϕ is the tax rate on foreign interest income. The domestic currency value of the authorized net foreign asset position will also be changed by the exchange rate gains (losses) equal to $\frac{\theta_t - \theta_{t-1}}{\theta_{t-1}} \theta_t F_{t-1}^A$.

With capital controls on outflows, the authorized net foreign asset position is limited by a level imposed by the monetary authorities. Therefore,

$$F_t^A \leq \bar{F}_t^A \quad (1.4)$$

In the presence of binding capital controls on outflows that creates a wedge between domestic and foreign rate of return in favor of the latter, consumers have incentive to create disguised capital flows through over or under invoicing of imports and exports. Such flows occur at the beginning of each period when good markets are open. These flows incur costs (in terms of consumption forgone)

that is equal to $P_{2,t}d_0 + P_{2,t}(d_1/2)(\frac{\theta_t DCF_t}{P_{2,t}})^2$, where

DCF_t denotes disguised capital flows. The stock of cumulative disguised capital flows at the end of period t is:

$$\theta_t F_t^D = \theta_t F_{t-1}^D + \theta_t DCF_t + (r_{F,t-1} + \varepsilon_t) \theta_t F_{t-1}^D \quad (1.5)$$

where

$$\varepsilon_t = \frac{\theta_t - \theta_{t-1}}{\theta_{t-1}}$$

In the beginning of each period, consumers decide on the level of their consumption of goods and disguised capital flows. In the end of each period, consumers decide on the level of their cash holding, M_t , time deposits, B_t , and authorized net foreign assets, F_t^A .⁴ The budget constraint is given by:

$$\begin{aligned} M_t + B_t + \theta_t F_t^A + \theta_t F_t^D &= M_{t-1} + (1 + r_{B,t-1})B_{t-1} \\ &+ (1 + (1 - \phi)r_{F,t-1} \\ &+ \varepsilon_t) \theta_t F_{t-1}^A + (1 + r_{F,t-1} \\ &+ \varepsilon_t) \theta_t F_{t-1}^D + Y_t - P_{2,t}d_0 \\ &- P_{2,t}(\frac{d_1}{2})(\frac{\theta_t DCF_t}{P_{2,t}})^2 \\ &- P_{1,t}C_{1,t} - P_{2,t}C_{2,t} \end{aligned} \quad (1.6)$$

A consumer maximizes the expected utility function subject to CIA constraint, the capital controls and the budget constraint. Thus, a consumer's problem can be solved by maximizing the value function, $V(t)$:

⁴ Given the previous cumulative stock of disguised capital flows and rate of return on them, a choice of disguised capital flows this period will determine the cumulative stock of disguised capital flows in this period.

$$\begin{aligned}
V(t) = & \text{Max} E_t \{ U_t + \beta V(t+1) \\
& + \lambda_{1,t} [M_t/P_{2,t+1} - P_{1,t+1} C_{1,t+1}/P_{2,t+1} - C_{2,t+1}] \\
& + \lambda_{2,t} [\theta_t F_t^A / P_{2,t} - \theta_t \bar{F}_t^A / P_{2,t}] \\
& + \lambda_{3,t} [M_t / P_{2,t} + B_t / P_{2,t} \\
& + \theta_t F_t^A / P_{2,t} + \theta_t F_t^D / P_{2,t} - M_{t-1} / P_{2,t} \\
& - (1 + r_{B,t-1}) B_{t-1} / P_{2,t} \\
& - (1 + (1 - \phi) r_{F,t-1} + \varepsilon_t) \theta_t F_{t-1}^A / P_{2,t} \\
& - (1 + r_{F,t-1} + \varepsilon_t) \theta_t F_{t-1}^D / P_{2,t} - Y_t / P_{2,t} \\
& + d_0 + (d_1/2) (\theta_t DCF_t / P_{2,t})^2 \\
& + P_{1,t} C_{1,t} / P_{2,t} + C_{2,t}] \\
& + \lambda_{4,t} [\theta_t F_t^D / P_{2,t} - \theta_t DCF_t / P_{2,t} \\
& - (1 + r_{F,t-1} + \varepsilon_t) \theta_t F_{t-1}^D / P_{2,t}] \}
\end{aligned} \tag{1.7}$$

where β is the consumer's rate of time preference.

The first order conditions by solving the above problem with respect to $C_{1,t}, C_{2,t}, M_t/P_{2,t}, B_t/P_{2,t}, \theta_t DCF_t / P_{2,t}, (\theta_t F_t^D / P_{2,t})$ and $\theta_t F_t^A / P_{2,t}$ along with the CIA constraint and the budget constraint can be used to find optimal consumption and asset allocation. The solutions are worked out in Appendix 3.1.

The solution of the optimal level of disguised capital flows is given by

$$E_t \left(\frac{\theta_t DCF_t}{P_t} \right) = E_t \left(\frac{-1}{d_1} + \frac{(1 + r_{F,t} + \varepsilon_{t+1})(1 + \varepsilon_{t+1})}{d_1(1 + r_{B,t})} \right) \tag{1.8}$$

Disguised capital flows depend positively on the expected return on foreign assets relative to domestic assets.

Assuming a log-linear utility function (as in Appendix 3.1), then the demand for real broad money is:

$$\begin{aligned}
\frac{M_t^B}{P_{2,t}} = & \frac{M_t}{P_{2,t}} + \frac{B_t}{P_{2,t}} = (1 + r_{B,t-1}) \frac{B_{t-1}}{P_{2,t}} - \frac{\theta_t F_t^A}{P_{2,t}} - \frac{\theta_t F_t^D}{P_{2,t}} \\
& + (1 + (1 - \phi) r_{F,t-1} + \varepsilon_t) \frac{\theta_t F_{t-1}^A}{P_{2,t}}
\end{aligned}$$

$$\begin{aligned}
& + (1 + r_{F,t-1} + \varepsilon_t) \frac{\theta_t F_{t-1}^D}{P_{2,t}} + \frac{Y_t}{P_{2,t}} - d_0 \\
& - (d_1/2) \left(\frac{\theta_t DCF_t}{P_{2,t}} \right)^2
\end{aligned} \tag{1.9}$$

B. Official Behavior

The change in the money base, ΔH_t is equal to the change in the Central bank's net domestic assets, ΔD_t and the change in its foreign exchange reserves, $\theta_t \Delta R_t$.

$$\Delta H_t = \Delta D_t + \theta_t \Delta R_t \tag{1.10}$$

Sterilized Intervention function of the following form is assumed:

$$\frac{\Delta D_t}{P_{2,t}} = \alpha_0 - \alpha_1 \frac{\theta \Delta R_t}{P_{2,t}} - \alpha_2 GAP_t - \alpha_3 \pi_t - \alpha_4 REER_t \tag{1.11}$$

$$0 < \alpha_1 < 1, \alpha_2, \alpha_3, \alpha_4 > 0$$

where GAP_t is the gap between the actual and the trend output⁵, π_t is the inflation rate, $REER_t$ is the real exchange rate. The function means that the authorities sterilize α_1 percent of each percentage change in foreign exchange reserve and reduce the growth of central domestic credit as the actual output rises above the trend, inflation increases and/or prices of non-traded goods rise relative to traded goods.

The change in broad money stock, ΔM_t^B is given by:

$$\frac{\Delta M_t^B}{P_{2,t}} = \frac{m_t \Delta H_t}{P_{2,t}} \tag{1.12}$$

where m_t is the money multiplier.

⁵ Trend nominal GDP is the predicted nominal GDP obtained from the regression of the log of output on time.

The change in foreign exchange reserves in balance of payment equilibrium is equal to the current account balance, CA_t and authorized capital flows, ΔF_t^A .

$$\theta_t \Delta R_t = \theta_t CA_t - \theta_t \Delta F_t^A \quad (1.13)$$

C. Money Market Equilibrium, Current Account and Disguised Capital Flows

We can now obtain an empirically testable linkage between the money market equilibrium, current account and disguised capital flows in the presence of sterilized intervention. By assuming perfect foresight, we drop the expectation operators. Substituting equation (1.11) into equation (1.10) and then substituting equation (1.13) into equation (1.10), the change in real money base is

$$\frac{\Delta H_t}{P_{2,t}} = \alpha_0 + (1 - \alpha_1) \left(\frac{\theta_t CA_t}{P_{2,t}} - \frac{\theta_t \Delta F_t^A}{P_{2,t}} \right) - \alpha_2 GAP_t - \alpha_3 \pi_t - \alpha_4 REER_t \quad (1.14)$$

Thus, by substituting equation (1.14) into equation (1.12)

and substituting $\frac{\theta_t \Delta F_t^A}{P_{2,t}} = \frac{\theta_t F_t^A}{P_{2,t}} - \frac{\theta_t}{\theta_{t-1}} \cdot \frac{\theta_{t-1} F_{t-1}^A}{P_{2,t}}$, the change in real broad money supply is:

$$\frac{\Delta M_t^B}{P_{2,t}} = m_t \left(\alpha_0 + (1 - \alpha_1) \left(\frac{\theta_t CA_t}{P_{2,t}} - \frac{\theta_t F_t^A}{P_{2,t}} + \frac{\theta_t}{\theta_{t-1}} \cdot \frac{\theta_{t-1} F_{t-1}^A}{P_{2,t}} \right) - \alpha_2 GAP_t - \alpha_3 \pi_t - \alpha_4 REER_t \right) \quad (1.15)$$

Equating money demand to money supply and because $\Delta M_t^B = M_t + B_t - M_{t-1} - B_{t-1}$, we have

$$\begin{aligned} & r_{B,t-1} \frac{B_{t-1}}{P_{2,t}} - \frac{\theta_t F_t^A}{P_{2,t}} \\ & + (1 + (1 - \phi)r_{F,t-1} + \varepsilon_t) \frac{\theta_t F_{t-1}^A}{P_{2,t}} + \frac{Y_t}{P_{2,t}} - \frac{M_{t-1}}{P_{2,t}} \\ & = m_t \alpha_0 + d_0 + \frac{\theta_t DCF_t}{P_{2,t}} + \left(\frac{d_1}{2} \right) \left(\frac{\theta_t DCF_t}{P_{2,t}} \right)^2 \\ & + (1 - \alpha_1) \left\{ m_t \left(\frac{\theta_t CA_t}{P_{2,t}} - \frac{\theta_t F_t^A}{P_{2,t}} + \frac{\theta_t}{\theta_{t-1}} \cdot \frac{\theta_{t-1} F_{t-1}^A}{P_{2,t}} \right) \right\} \\ & - m_t \alpha_2 GAP_t - m_t \alpha_3 \pi_t - m_t \alpha_4 REER_t \end{aligned} \quad (1.16)$$

From equation (1.8),

$$\frac{\theta_t DCF_t}{P_t} = \frac{-1}{d_1} + \frac{(1 + r_{F,t} + \varepsilon_{t+1})(1 + \varepsilon_{t+1})}{d_1(1 + r_{B,t})}$$

Thus,

$$\begin{aligned} & \frac{\theta_t DCF_t}{P_{2,t}} + \left(\frac{d_1}{2} \right) \left(\frac{\theta_t DCF_t}{P_{2,t}} \right)^2 \\ & = \frac{1}{d_1} \left(-1 + \frac{(1 + r_{F,t} + \varepsilon_{t+1})(1 + \varepsilon_{t+1})}{(1 + r_{B,t})} \right. \\ & \left. + \frac{1}{2} \left(-1 + \frac{(1 + r_{F,t} + \varepsilon_{t+1})(1 + \varepsilon_{t+1})}{(1 + r_{B,t})} \right)^2 \right) \end{aligned} \quad (1.17)$$

Substituting equation (2.17) into equation (2.16), we have:

$$\begin{aligned} Z_1 = & m_t \alpha_0 + d_0 + \frac{1}{d_1} \left(-1 + \frac{(1 + r_{F,t} + \varepsilon_{t+1})(1 + \varepsilon_{t+1})}{(1 + r_{B,t})} \right) \\ & + \frac{1}{2} \left(-1 + \frac{(1 + r_{F,t} + \varepsilon_{t+1})(1 + \varepsilon_{t+1})}{(1 + r_{B,t})} \right)^2 \\ & + (1 - \alpha_1) m_t Z_2 - \alpha_2 m_t GAP_t - \alpha_3 m_t \pi_t - \alpha_4 m_t REER_t \end{aligned} \quad (1.18)$$

where

$$Z_1 = r_{B,t-1} \frac{B_{t-1}}{P_{2,t}} - \frac{\theta_t F_t^A}{P_{2,t}} + (1 + (1 - \phi)r_{F,t-1} + \varepsilon_t) \frac{\theta_t F_{t-1}^A}{P_{2,t}} + \frac{Y_t}{P_{2,t}} - \frac{M_{t-1}}{P_{2,t}}$$

$$Z_2 = \frac{\theta_t CA_t}{P_{2,t}} - \frac{\theta_t F_t^A}{P_{2,t}} + \frac{\theta_t}{\theta_{t-1}} \cdot \frac{\theta_{t-1} F_{t-1}^A}{P_{2,t}}$$

Z_1 can be interpreted as the change in real broad money demand excluding the disguised capital flows and the cost associated with them. Z_2 can be interpreted as the change in real international reserves. Thus, there are six parameters on the right hand side of equation (2.18) to estimate: the constant, $m_t \alpha_0 + d_0$, the inverse of the unit cost of undertaking disguised capital flows, $\frac{1}{d_1}$, the sterilization

offset coefficient, $1 - \alpha_1$, the response coefficient to a deviation from trend output, α_2 , inflation rate, α_3 , and real exchange rate, α_4 .

2. REFORMULATED MODEL

The main objective of this model is to estimate political risk premium in face of potential quantitative controls on capital outflows.

The time frame is broken into two sub-samples: before and after capital controls. At time t , capital controls are imposed. The quantity of authorized capital flows is restricted ($F_t^A \leq \bar{F}_t^A$). In my model, I assume away qualitative capital controls in the form of tax ($\phi = 0$) and assume a constant money multiplier ($\Delta m_t = 0$). After capital controls:

$$Z_1 = m_t \alpha_0 + d_0 + \frac{1}{d_1} \left[-1 + \frac{(1 + r_{F,t} + \varepsilon_{t+1})(1 + \varepsilon_{t+1})}{(1 + r_{B,t})} + \frac{1}{2} \left(-1 + \frac{(1 + r_{F,t} + \varepsilon_{t+1})(1 + \varepsilon_{t+1})}{(1 + r_{B,t})} \right)^2 \right] \quad (2.1)$$

$$+ (1 - \alpha_1)m_t Z_2 - \alpha_2 m_t GAP_t - \alpha_3 m_t \pi_t - \alpha_4 m_t REER_t$$

where

$$Z_1 = r_{B,t-1} \frac{B_{t-1}}{P_{2,t}} - \frac{\theta_t F_t^A}{P_{2,t}} + (1 + r_{F,t-1} + \varepsilon_t) \frac{\theta_t F_{t-1}^A}{P_{2,t}} + \frac{Y_t}{P_{2,t}} - \frac{M_{t-1}}{P_{2,t}}$$

$$Z_2 = \frac{\theta_t CA_t}{P_{2,t}} - \frac{\theta_t F_t^A}{P_{2,t}} + \frac{\theta_t}{\theta_{t-1}} \cdot \frac{\theta_{t-1} F_{t-1}^A}{P_{2,t}}$$

At time $t-1$, no capital controls are in place. The risk of capital being trapped onshore with potentially lower domestic returns results in a political risk premium. The rate of return on domestic assets should be equal to the one on foreign assets plus a political risk premium, $r_{F,t-1} + \varepsilon_t + RP_{t-1}$. Thus, equation (1.16) becomes:

$$(r_{F,t-1} + \varepsilon_t + RP_{t-1}) \frac{B_{t-1}}{P_{2,t}} - \frac{\theta_t F_t^A}{P_{2,t}} + (1 + r_{F,t-1} + \varepsilon_t) \frac{\theta_t F_{t-1}^A}{P_{2,t}} + \frac{Y_t}{P_{2,t}} - \frac{M_{t-1}}{P_{2,t}} = m_t \alpha_0 + d_0 + \frac{\theta_t DCF_t}{P_{2,t}} + \left(\frac{d_1}{2}\right) \left(\frac{\theta_t DCF_t}{P_{2,t}}\right)^2 \quad (2.2)$$

After substituting $\left[\left(\frac{\theta_t CA_t}{P_{2,t}} - \frac{\theta_t F_t^A}{P_{2,t}} + \frac{\theta_t}{\theta_{t-1}} \cdot \frac{\theta_{t-1} F_{t-1}^A}{P_{2,t}} \right) \right]$ into equation (2.2) and $\frac{\theta_t DCF_t}{P_t} = \frac{1}{d_1} + \frac{m_t(\alpha_3 + r_{F,t} + \varepsilon_t) REER_t \varepsilon_{t+1}}{d_1(1 + r_{B,t})}$ and

solving the above equation for RP_{t-1} , we obtain

$$\begin{aligned}
& RP_{t-1} \\
&= \frac{P_{2,t}}{B_{t-1}} [\beta_0 - X_1 + \beta_1 \\
&\left(-1 + \frac{(1 + r_{F,t} + \varepsilon_{t+1})(1 + \varepsilon_{t+1})}{(1 + r_{B,t})} \right) \\
&\left. + \frac{1}{2} \left(-1 + \frac{(1 + r_{F,t} + \varepsilon_{t+1})(1 + \varepsilon_{t+1})}{(1 + r_{B,t})} \right)^2 \right) \\
&+ \beta_2 m_t X_2 + \beta_3 m_t GAP_t + \beta_4 m_t \pi_t \\
&+ \beta_5 m_t REER_t] - (r_{F,t-1} + \varepsilon_t)
\end{aligned} \tag{2.3}$$

where

$$X_1 = -\frac{\theta_t F_t^A}{P_{2,t}} + (1 + r_{F,t-1} + \varepsilon_t) \frac{\theta_t F_{t-1}^A}{P_{2,t}} + \frac{Y_t}{P_{2,t}} - \frac{M_{t-1}}{P_{2,t}}$$

$$X_2 = \frac{\theta_t CA_t}{P_{2,t}} - \frac{\theta_t F_t^A}{P_{2,t}} + \frac{\theta_t}{\theta_{t-1}} \cdot \frac{\theta_{t-1} F_{t-1}^A}{P_{2,t}}$$

X_1 can be interpreted as the change in real narrow money demand excluding disguised capital flows and the cost associated with them. X_2 can be interpreted as the change in real international reserves. Let $\beta_0 = m_t \alpha_0 + d_0$, denote the inverse of the unit cost of undertaking disguised capital flows, $\beta_1 = \frac{1}{d_1}$, the sterilization offset coefficient, $\beta_2 = 1 - \alpha_1$, the response coefficient to a deviation of the actual output from the trend output, $\beta_3 = -\alpha_2$, the inflation rate, $\beta_4 = -\alpha_3$, and the real exchange rate, $\beta_5 = -\alpha_4$. At time t-1, investors form expectations about the probability of capital controls, future interest rates and exchange rate change, $r_{F,t}$, $r_{B,t}$ and ε_{t+1} , the extent of sterilization of money supply and expected values of variables associated with it such as $m_t GAP_t$, $m_t \pi_t$ and $m_t REER_t$. The extent of sterilization affects the expected return on foreign assets relative to domestic assets, $(1 + r_{F,t} + \varepsilon_t)(1 + \varepsilon_t)$ relative to $1 + r_{B,t}$. This in turn affects both expected disguised capital outflows, thus affecting the equilibrium change in money stock at time t-1.

2.1. Comparative Static Analysis

As shown from equation (2.3), several determinants of political risk premium attributable to potential capital controls can be inferred:

1. Political risk premium is positively related to the ratio of the expected future foreign asset return to the domestic asset return. The wider the expected differential in favor of foreign assets, the higher the opportunity cost of staying onshore, the larger the incentive to incur cost to circumvent the controls at time t, thus driving up the political risk premium at time t-1.
2. Political risk premium increases as the extent of sterilization increases in response to an expected decline in the international reserves holding.
3. Political risk premium increases as the extent of sterilization increases in response to an expected decline in the actual output from the trend output.
4. Political risk premium increases as the extent of sterilization increases in response to an expected decline in inflation rate.
5. Political risk premium increases as the extent of sterilization increases in response to an expected decline in real effective exchange rate.

The second through fifth inferences are related to the extent of sterilization of money supply in case of capital controls. The more effective the sterilization to hold expected domestic returns lower relative to foreign returns in response to a decline in the expected output, inflation and real effective exchange rate, the higher the current risk premium investors require from domestic assets.

2.2 Empirical Methodology

By the assumption of perfect foresight, all expected future values are measured by the ex post actual values in the corresponding future period. There are six parameters on the right hand side of equation (2.3) to estimate: the constant, β_0 , the inverse of the unit cost of undertaking disguised capital flows, β_1 , the sterilization offset coefficient, β_2 , the response coefficient to a deviation from trend output, β_3 , inflation rate, β_4 , and real exchange rate, β_5 .

Rearranging the equation, we obtain:

$$\begin{aligned}
lhs_t &= \beta_0 x_t + \beta_1 dcfs_{sum_t} + \beta_2 x_t m_t X_2 \\
&+ \beta_3 x_t m_t GAP_t + \beta_4 x_t m_t \pi_t + \beta_5 x_t m_t REER_t
\end{aligned} \tag{2.4}$$

where

$$x_t = \frac{P_{2,t}}{B_{t-1}}$$

$$lhs_t = RP_{t-1} + x_t X_1 + r_{F,t-1} + \varepsilon_t$$

$$dcfs_{m_t} = -1 + \frac{(1+r_{F,t} + \varepsilon_{t+1})(1+\varepsilon_{t+1})}{(1+r_{B,t})}$$

$$+ \frac{1}{2} \left(-1 + \frac{(1+r_{F,t} + \varepsilon_{t+1})(1+\varepsilon_{t+1})}{(1+r_{B,t})} \right)^2$$

lhs_t can be interpreted as the change in nominal broad money demand (excluding disguised capital flows and the cost associated with them) at time t as a ratio of domestic currency deposits at time t-1. By multiplying x_t to the right-hand-side variables, each of these variables can be interpreted as a variable expressed in nominal term as a ratio of domestic currency deposits at time t-1.

Data

$$RP_t = r_{B,t} - r_{F,t} - \frac{f_{t,t+1} - \theta_{t+1}}{\theta_t} = \text{Covered interest}$$

differential where $f_{t,t+1}$ is the forward exchange rate of a one-period-ahead contract.

$P_{2,t}$ = Malaysian Consumer Price Index is used as the proxy of the country non-traded good price level

B_t = Time deposit

$$\frac{\theta_t F_t^A}{P_{2,t}} - (1+r_{F,t-1} + \varepsilon_t) \frac{\theta_t F_{t-1}^A}{P_{2,t}} = \text{Change in net foreign}$$

assets held by the Central Bank of Malaysia (BNM) plus interpolated current account data using annual current account data due to lack of quarterly current account data⁶

⁶ Data of the change in net foreign assets held by the BNM used here exclude retained earnings, $1+r_{f,t-1} + \varepsilon_t$

Y_t = Nominal GDP is used to measure nominal output

M_t = M1 data is used as a proxy for narrow money demand (currency plus checking account)

ε_{t+1} = Ex post actual change in exchange rate is used as the proxy of expected change in exchange rate

$r_{F,t}$ = US federal fund rate is used as the proxy of foreign interest rate

$r_{B,t}$ = Malaysian time deposit rate is used as the proxy of domestic interest rate

m_t = M2 divided by money base

$$X_2 = \frac{\theta_t CA_t}{P_{2,t}} - \frac{\theta_t F_t^A}{P_{2,t}} + \frac{\theta_t}{\theta_{t-1}} \cdot \frac{\theta_{t-1} F_{t-1}^A}{P_{2,t}} = \text{Change in net foreign assets held by the Central Bank of Malaysia (BNM)}$$

GAP_t = Actual nominal GDP minus trend nominal GDP

π_t = inflation rate is calculated using

$$\frac{CPI_t - CPI_{t-1}}{CPI_{t-1}} \times 100$$

$REER_t$ = real effective exchange rate data

All data are obtained from International Financial Statistics Database (IFS) except for forward exchange rate data that are from Datastream Database. Quarterly data from 1991Q3-1998Q3 are used.

Unit Root Test

Before estimation is carried out, unit root tests are conducted on all of the 6 series in equation (2.4). The results are reported in Table 1. Unit root tests include a constant and a time trend. Each augmented Dickey Fuller test is repeated for up to 5 lags. Whenever Schwarz B.I.C do not vary much across different lags, the shortest lag is chosen. No lag is chosen for all of the above variables except for lhs_t . All of the variables but lhs_t reject the null hypothesis of unit root at 5% significant level.

$$dGAP_t = GAP_t - GAP_{t-1}$$

and $dREER_t = REER_t - REER_{t-1}$ are used instead of GAP_t and $REER_t$ because they are stationary.

Ordinary Least Square Regression (OLS)

Ordinary least square regression is used to estimate the following equation:

$$lhs_t = x_t[\beta_0 + \beta_1 dcfsum + \beta_2 m_t X_2 + \beta_3 m_t dGAP_t + \beta_4 m_t \pi_t + \beta_5 m_t dREER_t] + \beta_6 Dum98 + \mu_t \quad (2.5)$$

where Dum98 takes on the value of 1 for 1997Q3-1998Q2. lhs_t can be interpreted as the change in nominal broad money demand (excluding disguised capital flows and the cost associated with them) at time t as a ratio of domestic currency deposits at time t-1.

$$dcfsum_t = -1 + \frac{(1 + r_{F,t} + \varepsilon_{t+1})(1 + \varepsilon_{t+1})}{(1 + r_{B,t})} + \frac{1}{2} \left(-1 + \frac{(1 + r_{F,t} + \varepsilon_{t+1})(1 + \varepsilon_{t+1})}{(1 + r_{B,t})} \right)^2$$

is the disguised capital flows as a function of the expected foreign return relative to the domestic return. $m_t X_2$, $m_t dGAP_t$, $m_t \pi_t$ and $m_t dREER_t$ is the proportion of real money supply being sterilized in response to a change in the expected international reserve holding, the change in the expected deviation of the actual output from the trend output, the inflation rate and the expected

change in real effective exchange rate respectively. By multiplying $x_t = \frac{P_{2,t}}{B_{t-1}}$ to $m_t X_2$, $x_t m_t dGAP_t$, $x_t m_t \pi_t$

and $x_t m_t dREER_t$, each of these variables can be interpreted as a variable expressed in nominal term as a ratio of domestic currency deposits at time t-1.

From equation (2.5), in anticipation of an increase in the opportunity cost of being trapped onshore (more disguised capital), depletion of international reserves, output contraction, decreasing inflation and real exchange rate, the use of capital controls and sterilized intervention to hold domestic interest rate relatively low becomes more imminent. All these exacerbate capital outflows, reducing the demand for domestic deposits. In order to induce investors to hold domestic assets, higher return is required, thus pushing up the political risk premium. This forward-looking characteristics should give rise to coefficients as predicted in section 2.1.

In estimating equation (2.5), simultaneity problem may arise especially among the political risk premium, the change in money demand and international reserves. To address this problem, instrumental variable regressions are run to estimate $x_t X_1$, the change in nominal narrow money demand excluding disguised capital flows and the cost associated with them at time t (expressed as a ratio of domestic currency deposit at time t-1) and $x_t m_t X_2$, the proportion of nominal money supply sterilized in response to a change in the foreign exchange reserves (expressed as a ratio of domestic currency deposit at time t-1):

$$x_t X_1 = a_1 + b_1 RP_{t-1} + v_{1,t} \quad (2.6)$$

$$x_t m X_2 = a_2 + b_2 RP_{t-1} + v_{2,t} \quad (2.7)$$

where v_1 and v_2 are error terms. Lagged values of $x_t X_1$ and RP_{t-1} , $x_t m X_2$ and RP_{t-1} are used as instruments in the above equations respectively. Predicted values of dependent variables are substituted into equation (2.5). The results are reported in Table 3.

As shown in column (1) in Table 2, the data fit the model well. R-square indicates that the model explains 98% of the variations of the dependent variable. β_1 is within the feasible range from 0 to 1. The monetary authorities sterilize 84% of international flows. β_5 is of the right sign and significant at 5% level. Political risk premium increases as the monetary authorities increase domestic credit in response to a decline in the real effective exchange rate

(measured as the ratio of the price of non-trade good to the price of traded good) decreases. Alternative variations of equation (2.5) are estimated to account for possible multicollinearity among $x_t m_t dGAP_t, x_t m_t \pi_t, xmdREER_t$. Results are shown in column (2)-(6). They are not significantly different from that in column (1).

For comparison, Table 3 shows regression results without substituting for predicted variables from instrument variable regressions. As seen from column (1) in Table 3, β_1 is within feasible range. The monetary authorities sterilize 66% of change in international reserves. β_3 is significant at 5% level but is of the opposite sign of that predicted by the model.

As seen in Figure 4 the predicted political risk premium in the run-up to capital controls in 1998 in Malaysia clearly anticipates capital controls. This model also successfully predicts the imposition of capital controls on inflows in February 1994-the only other significant episode of capital controls in the history of Malaysia in 1990s.

3. CONCLUSION

As brought up in the introductory section, it is difficult to distinguish empirically the political risk premium attributable to potential future capital controls on outflows from the interest differential that results from deliberate policies. This study, by allowing a feedback mechanism from capital outflows (in pursuit of higher expected return abroad) to the interest differential and explicitly taking into account monetary authorities' decision provides a method to measure the portion of interest differential attributable to the risk of capital controls and the effect on actual interest differential of these deliberate monetary policies.

As reported in Table 2, Malaysian authorities sterilized a large portion of the change in foreign exchange reserves. They also reacted to a decline in real exchange rate by increasing the money supply. These potentially widened the gap between domestic and foreign interest rate in favor of the latter in case of capital controls on outflows, thus driving up political risk premium ex ante.

In sum, this simple monetary equilibrium explains the variation in political risk premium that measures the risk of future capital controls by incorporating macroeconomic variables that characterize international shocks and sterilization intervention policies. It provides a complementary measure to measure the risk attributable solely to future capital controls and takes into consideration a macro framework that is lacking in common methods relying solely on covered interest differentials.

APPENDIX

Optimal Consumption and Portfolio Decisions

Solving the maximization problem of equation (2.7) by assuming $\phi = 0$,

$$\begin{aligned} V(t) = & \text{Max} E_t \{ U_t + \beta V(t+1) \\ & + \lambda_{1,t} [M_t / P_{2,t+1} - P_{1,t+1} C_{1,t+1} / P_{2,t+1} - C_{2,t+1}] \\ & + \lambda_{2,t} [\theta F_t^A / P_{2,t} - \theta \bar{F}_t^A / P_{2,t}] \\ & + \lambda_{3,t} [M_t / P_{2,t} + B_t / P_{2,t} + \theta F_t^A / P_{2,t} \\ & + \theta F_t^D / P_{2,t} - M_{t-1} / P_{2,t} - (1 + r_{B,t-1}) B_{t-1} / P_{2,t} \\ & - (1 + r_{F,t-1} + \varepsilon_t) \theta F_{t-1}^A / P_{2,t} - (1 + r_{F,t-1} + \varepsilon_t) \\ & \theta F_{t-1}^D / P_{2,t} - Y / P_{2,t}] \\ & + d_0 + (d_1/2)(\theta_t DCF_t / P_{2,t})^2 \\ & + P_{1,t} C_{1,t} / P_{2,t} + C_{2,t}] \\ & + \lambda_{4,t} [\theta F_t^D / P_{2,t} - \theta_t DCF_t / P_{2,t} - (1 + r_{F,t-1} + \varepsilon_t) \\ & \theta F_{t-1}^D / P_{2,t}] \} \end{aligned}$$

we obtain the following first order conditions:

$$\frac{\partial V(t)}{\partial C_{1,t}} = E_t \left\{ \frac{\partial U_t}{\partial C_{1,t}} + \lambda_{3,t} \left(\frac{P_{1,t}}{P_{2,t}} \right) \right\} = 0 \quad (\text{A1})$$

$$\frac{\partial V(t)}{\partial C_{2,t}} = E_t \left\{ \frac{\partial U_t}{\partial C_{2,t}} + \lambda_{3,t} \right\} = 0 \quad (\text{A2})$$

$$\begin{aligned} \frac{\partial V(t)}{\partial (M_t / P_t)} = & E_t \left\{ \beta \frac{\partial V(t+1)}{\partial (t+1)} \cdot \frac{P_{2,t}}{P_{2,t+1}} + \lambda_{1,t} \frac{P_{2,t}}{P_{2,t+1}} \right. \\ & \left. + \lambda_{3,t} \right\} = 0 \end{aligned} \quad (\text{A3})$$

$$\begin{aligned} \frac{\partial V(t)}{\partial (B_t / P_t)} = & E_t \left\{ \beta \frac{\partial V(t+1)}{\partial (t+1)} \cdot \frac{P_{2,t}}{P_{2,t+1}} \cdot (1 + r_{B,t}) + \lambda_{3,t} \right\} \\ = & 0 \end{aligned} \quad (\text{A4})$$

$$\frac{\partial V(t)}{\partial (\theta_t DCF_t / P_{2,t})} = E_t \left\{ \lambda_{3,t} d_1 \frac{\theta_t DCF_t}{P_{2,t}} - \lambda_{4,t} \right\} = 0 \quad (\text{A5})$$

$$\frac{\partial V(t)}{\partial \theta_t F_t^D / P_{2,t}} = E_t \left\{ \beta \frac{\partial V(t+1)}{\partial (t+1)} \cdot \frac{P_{2,t}}{P_{2,t+1}} \right\}$$

$$\frac{\theta_{t+1}}{\theta_t} (1 + r_{F,t} + \varepsilon_{t+1})$$

$$+ \lambda_{3,t} + \lambda_{4,t} \} = 0$$

(A6)

$$\frac{\partial V(t)}{\partial \theta_t F_t^A / P_{2,t}} = E_t \left\{ \beta \frac{\partial V(t+1)}{\partial (t+1)} \cdot \frac{P_{2,t}}{P_{2,t+1}} \cdot \frac{\theta_{t+1}}{\theta_t} (1 + r_{F,t} + \varepsilon_{t+1}) \right\}$$

(A7)

$$+ \lambda_{2,t} + \lambda_{3,t} \} = 0$$

where

$$(t) = \frac{P_{1,t}}{P_{2,t}} C_{1,t} + C_{2,t} + \frac{\theta_t F_t^A}{P_{2,t}} + \frac{\theta F_t^D}{P_{2,t}} + \frac{B_t}{P_{2,t}} + \frac{M_t}{P_{2,t}}$$

$$(t+1) = \frac{P_{1,t+1}}{P_{2,t+1}} C_{1,t+1} + C_{2,t+1}$$

$$+ \frac{\theta_{t+1} F_{t+1}^A}{P_{2,t+1}} + \frac{\theta_{t+1} F_{t+1}^D}{P_{2,t+1}} + \frac{B_{t+1}}{P_{2,t+1}} + \frac{M_{t+1}}{P_{2,t+1}}$$

$$= \frac{M_t}{P_{2,t+1}} + \frac{\theta_{t+1} F_t^A}{P_{2,t+1}} (1 + r_{F,t} + \varepsilon_{t+1})$$

$$+ (1 + r_{B,t}) \frac{B_t}{P_{2,t+1}} + \frac{Y_{t+1}}{P_{2,t+1}}$$

$$+ \frac{\theta_{t+1} F_t^D}{P_{2,t+1}} (1 + r_{F,t} + \varepsilon_{t+1})$$

$$- d_0 - \frac{d_1}{2} \left(\frac{\theta_{t+1} DCF_{t+1}}{P_{2,t+1}} \right)^2$$

$$\frac{\partial V(t+1)}{\partial (t+1)} = \frac{\partial U_{t+1}}{\partial C_{2,t+1}}$$

Equation (1.8) is derived by solving equation (A4) for $\lambda_{3,t}$ and then plugging the solution of $\lambda_{3,t}$ into equation (A6) to solve for $\lambda_{4,t}$. Substituting these values of $\lambda_{3,t}$ and $\lambda_{4,t}$ into equation (A5), we obtain equation (1.8).

To derive the optimal holdings of narrow money, a log linear utility function is assumed. The cash-in-advance (CIA) constraint implies that:

$$E_t \left\{ \frac{M_t}{P_{2,t}} \cdot \frac{P_{2,t}}{P_{2,t+1}} \right\} = E_t \left\{ \frac{P_{1,t+1}}{P_{2,t+1}} C_{1,t+1} + C_{2,t+1} \right\}$$

Solving equations A1 and A2 simultaneously and the log linear utility function implies that :

$$E_t \left\{ \frac{\partial U_t}{\partial C_{1,t}} \bigg/ \frac{\partial U_t}{\partial C_{2,t}} \right\} = \frac{C_{2,t}}{C_{1,t}} = \frac{P_{1,t}}{P_{2,t}}$$

Thus,

$$E_t \left(\frac{C_{2,t+1}}{C_{1,t+1}} \right) = E_t \left(\frac{P_{1,t+1}}{P_{2,t+1}} \right)$$

As a result,

$$E_t \left\{ \frac{M_t}{P_{2,t}} \cdot \frac{P_{2,t}}{P_{2,t+1}} \right\} = E_t \left\{ \frac{C_{2,t+1}}{C_{1,t+1}} C_{1,t+1} + C_{2,t+1} \right\} = 2E_t C_{2,t+1}$$

Thus,

$$E_t \left(\frac{M_t}{P_{2,t}} \right) = 2E_t \left\{ \frac{P_{2,t+1}}{P_{2,t}} C_{2,t+1} \right\} \quad (A11)$$

From equation (A2), $E_t \left(\frac{\partial U_t}{\partial C_{2,t}} \right) = \lambda_{3,t}$. Substituting this

into equation (A4), we obtain

$$\begin{aligned} 0 &= E_t \left\{ \beta (1 + r_{B,t}) \frac{\partial U_{t+1}}{\partial C_{2,t+1}} \cdot \frac{P_{2,t}}{P_{2,t+1}} - \frac{\partial U_t}{\partial C_{2,t}} \right\} \\ &= E_t \left\{ \beta (1 + r_{B,t}) \frac{1}{C_{2,t+1}} \cdot \frac{P_{2,t}}{P_{2,t+1}} - \frac{1}{C_{2,t}} \right\} \end{aligned}$$

Thus,

$$E_t \left(\frac{C_{2,t+1}}{C_{2,t}} \right) = \beta E_t \left\{ (1 + r_{B,t}) \frac{P_{2,t}}{P_{2,t+1}} \right\} \quad (A12)$$

From equation (A11),

$$E_t \left(\frac{C_{2,t+1}}{C_{2,t}} \right) = E_t \left\{ \frac{M_t}{P_{2,t+1}} \bigg/ \frac{M_{t-1}}{P_{2,t}} \right\} \quad (A13)$$

Combining equation (A12) and (A13), we infer

$$\begin{aligned}
E_t \left\{ \frac{M_t}{P_{2,t+1}} \middle/ \frac{M_{t-1}}{P_{2,t}} \right\} &= \beta E_t \left\{ (1 + r_{B,t}) \frac{P_{2,t}}{P_{2,t+1}} \right\} \\
\Rightarrow E_t \left\{ \frac{M_t}{P_{2,t}} \cdot \frac{P_{2,t}}{P_{2,t+1}} \right\} &= \beta E_t \left\{ (1 + r_{B,t}) \frac{M_{t-1}}{P_{2,t-1}} \cdot \frac{P_{2,t-1}}{P_{2,t}} \cdot \frac{P_{2,t}}{P_{2,t+1}} \right\} \\
\Rightarrow E_t \left\{ \frac{M_t}{P_{2,t}} \right\} &= \beta E_t \left\{ (1 + r_{B,t}) \frac{M_{t-1}}{P_{2,t-1}} \cdot \frac{P_{2,t-1}}{P_{2,t}} \right\}
\end{aligned}$$

The derivation of the optimal holdings of broad money follows directly from the budget constraint by invoking the CIA constraint, and replacing the authorized net foreign assets and disguised capital flows with their optimal levels.

By the CIA constraint, $\frac{M_{t-1}}{P_{2,t}} = \frac{P_{1,t}}{P_{2,t}} C_{1,t} + C_{2,t}$.

Substituting this into the budget constraint, the optimal real holdings of broad money (time deposits plus narrow money) is given by:

$$\begin{aligned}
\frac{M_t}{P_{2,t}} + \frac{B_t}{P_{2,t}} &= (1 + r_{B,t-1}) \frac{B_{t-1}}{P_{2,t}} - \frac{\theta_t F_t^A}{P_{2,t}} - \frac{\theta_t F_t^D}{P_{2,t}} \\
&+ (1 + r_{F,t-1} + \varepsilon_t) \frac{\theta_t F_{t-1}^A}{P_{2,t}} \\
&+ (1 + r_{F,t-1} + \varepsilon_t) \frac{\theta_t F_{t-1}^D}{P_{2,t}} + \frac{Y_t}{P_{2,t}} - d_0 - (d_1/2) \left(\frac{\theta_t DCF_t}{P_{2,t}} \right)^2
\end{aligned}$$

Figure 1 Money market and disguised capital flows

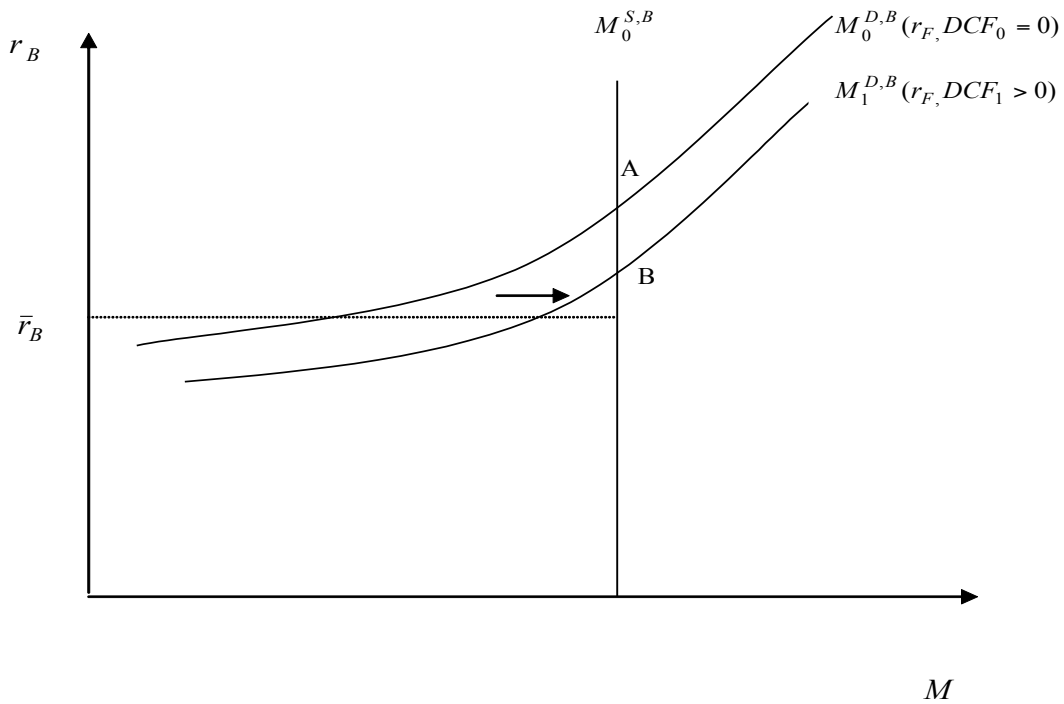


Figure 2 Money market and shocks

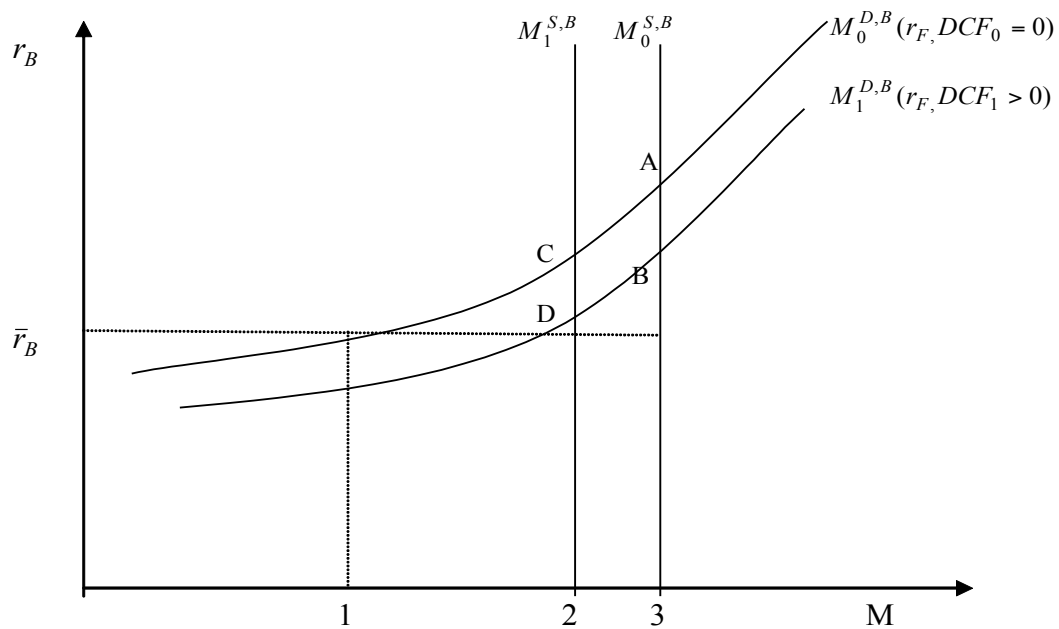


Figure 3 Money market and sterilization policy

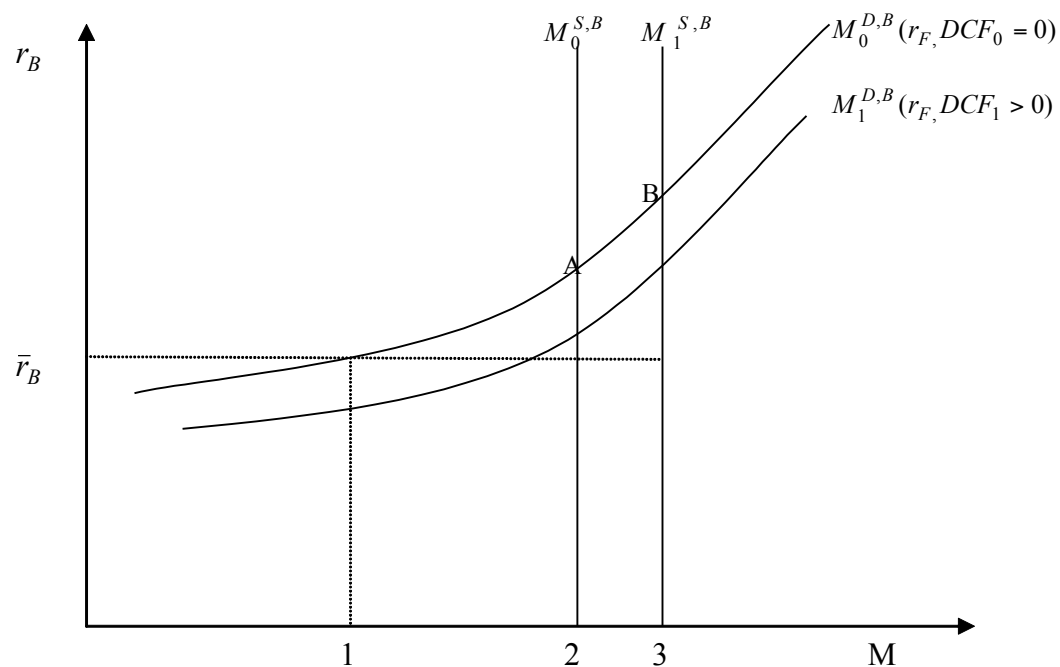


Table 1: Unit root test

Variable	ADF statistic	P-value	No. of lags
lhs_t	-3.17	0.091	1
$x_t dcfsum_t$	-4.30	0.003	0
$x_t m_t X_2$	-3.45	0.045	0
$x_t m_t dGAP_t$	-5.53	0.000	0
$x_t m_t \pi_t$	-5.40	0.000	0
$x_t m_t dREER_t$	-3.47	0.042	0

Table 2 Ordinary Least Square Regression 1

Coefficient of	(1)	(2)	(3)	(4)	(5)	(6)
C	0.08*** [12.49]	0.08*** [11.92]	0.07*** [13.55]	0.07*** [13.46]	0.07*** [11.62]	0.08*** [14.21]
XM2	0.16*** [20.76]	0.17*** [26.90]	0.16*** [19.11]	0.16*** [19.14]	0.16*** [18.68]	0.16*** [20.55]
XDCFSUM	0.67 [0.03]	10.63 [0.52]	2.38 [0.12]	7.08 [0.34]	3.66 [0.16]	-4.53 [-0.23]
XMDGAP	-70.63 [-1.48]	-80.75 [-1.65]		-49.52 [-1.03]		
XMDCPI	-7.45 [-0.07]	-21.35 [-0.21]			17.86 [0.17]	
XMDREER	-45.44** [-2.33]	-50.76** [-2.54]				-39.83* [-2.06]
DUM98	0.02 [1.62]		0.02* [2.00]	0.02* [1.92]	0.02* [1.97]	0.02* [1.80]
LHS(-1)	0.28*** [6.56]	0.31*** [7.93]	0.32*** [7.81]	0.31*** [7.48]	0.32*** [7.43]	0.29*** [7.16]
Adjusted-Rsquared	0.98	0.98	0.98	0.98	0.98	0.98
Likelihood ratio	86.37	84.61	82.29	82.96	82.31	84.78
Durbin's h	0.12	1.10	-0.38	-0.66	-0.35	0.34
LM het.test	3.54	3.04	7.99	10.38	8.38	1.51

1. Figures in brackets indicate t-statistics.
2. *,**,*** indicate significance at 10%,5% and 1% respectively

Table 3: Ordinary Least Square Regression 2

Coefficient of	(1)	(2)	(3)	(4)	(5)	(6)
C	0.05** [2.20]	0.05** [2.50]	0.06*** [2.99]	0.06*** [3.06]	0.07*** [2.89]	0.06*** [3.04]
XM2	0.34*** [5.50]	0.34*** [5.65]	0.30*** [4.83]	0.35*** [5.96]	0.30*** [4.76]	0.29*** [4.63]
XDCFSUM	-152.69 [-1.71]	-148.15 [-1.72]	-131.54 [-1.42]	-162.55* [-1.95]	-148.30 [-1.52]	-134.43 [-1.45]
XMDGAP	483.67** [2.31]	466.01** [2.34]		459.11** [2.64]		
XMDCPI	258.02 [0.47]	260.70 [0.49]			-338.76 [-0.64]	
XMDREER	-38.17 [-0.45]	-51.11 [-0.69]				-88.58 [-1.00]
DUM98	0.01 [0.34]		0.004 [0.11]	0.02 [0.67]	0.01 [0.21]	-0.01 [-0.32]
LHS(-1)	0.32** [2.43]	0.32** [2.46]	0.38*** [3.10]	0.35*** [3.19]	0.42*** [3.04]	0.39*** [3.16]

3. Figures in brackets indicate t-statistics.

4. *, **, *** indicate significance at 10%, 5% and 1% respectively

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