Trilemma Revisited with Special Reference to the Return on Bank Reserves[1]

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ABSTRACT

Can trilemma be overcome? The answer is yes if we altered the way of conducting monetary policy. Instead of increasing the money supply, monetary expansion is here achieved, at the *constant* money supply, by lowering the return on base money to discourage the money demand. But since treasury bonds and bank reserves are to be perfectly substituted, the lower-return induced portfolio reshuffling from bank reserves to treasury bonds could depress the market interest rate, set in the force of capital efflux, and therefore effortlessly reverse the desired monetary stance.

Fortunate enough, the decoupling of open market operation from interest-rate setting has enabled the former to aim for other macroeconomic target. Once the central bank could increase the supply of treasury bills through open market sale to equilibrate the market, the market interest rate will be stabilized, burying the reasons for capital efflux. Financial stability is therefore secured.

Open market sale is restrictive as it contracts the liquidity available in the system for business activities. To preserve the "grease" on the wheel, we need a swap in the central bank's domestic credit composition, namely, *the proceeds of the sales of treasury bills is to be deposited in the banking system*. Accordingly, we will witness a compositional change in the central bank's domestic credits to sustain the initial deposits base and thus the system's liquidity.

Once the money demand has changed in ensuing, the effects will spillover from the money market to other real variables. The demand-driven expansionary money policy bolsters the production of tradable goods, contributing to the current account surplus and hence the accumulation of foreign reserves.

Revisiting the classic internal-external balance tradeoffs from the perspective of this alternative monetary regime, we find that these long haunting internal-external balance contradictions can be easily resolved. For instance, for an economy troubled with inflation and balance-of-payment surplus, one could increase the return on base money to tighten the monetary stance to curb internal inflation, while the resultant real exchange rate appreciation tilts the output contraction and greater consumptions toward tradable goods.

1. INTRODUCTION

Two recent papers by Obtsfeld et al (2004a, 2004b) empirically, with historical data covering more than 130 years, confirm the logic of trilemma. As in their words,

"…disorder often is linked to policies inconsistent with the constraint of the open-economy trilemma – the inability of policymakers simultaneously to pursue a fixed exchange rate, open capital markets, and autonomous monetary policy…as increasingly democratic polities faced pressures to engage in domestic macroeconomic management, however, either currency peg or freedom of capital movements had to yield."

We have no lack of literatures discussing how the inharmonic domestic macroeconomic stances and currency peg may often end in currency and financial crises, and even the collapse of entire international monetary system. For instances, Bordo (1996) argues that the occurrences of currency crises and the ultimate collapse of metallic monetary standard, Bretton Woods arrangement, European ERM and Latin American pegged regime were above all the consequences of inconsistency between government's policies and pegged exchange rates. Eichengreen (1998) documents the historical records of the evolution of international monetary system in corresponding to the development of international capital market and its effects on the choice of exchange rate regimes amid the changing domestic political environments that increasingly emphasize on internal stability.

This issue is particularly important to Asian economies given their loyal adherence to dollar peg, as compellingly argued by Mckinnon (2000), for preserving the exchange rate stability beneficial for international trade amid the bounded and costly hedging opportunities due to the "original sin". Providing that the openness of the economy has already imposed constraints on the effectiveness of monetary policy[1], some sorts of imperfections are then always needed to revive the monetary autonomy. Among others, currency peg with sterilization and capital control top the lists.

The merits of sterilization, however, are in suspect. For example, high interest rates due to sterilization will only help magnifying the cumulative capital inflow. Calvo (1991) makes a case that the high debt service burden generated by sterilization (a swap of low-yielding foreign reserves for high-yielding treasury bill) casts a doubt on its feasibility in the context of fiscal costs. The happenings of Asian financial crises add to the list that the sustaining of high interest rates induces the domestic firms to engage in low-cost external loans. This trend, if not curbed, as the crises has shown, will build up the fragility and breed the seeds of destruction[2].

Even more controversial is the proposal for capital control. The imposition of short-lived capital and exchange controls in Malaysia has stimulated voluminous empirical studies, particularly on whether capital controls enable the retention of monetary independence to strengthen the crises imperviousness[3]. The results are, however, far from consensus.

In this vein, this paper aims to offer an alternative solution to the trilemma without attaching to any kinds of policy-generated imperfections. By employing a simple yet standard flexible price-wage intertemporal optimizing model for small open economy with fixed exchange rate regime, this paper proposes that once the bank reserves are remunerated in which the return on bank reserves operates as the policy instrument to change the monetary stance, "possible trinity" is in no way impossible. Admittedly, this paper is not a description of the current monetary institutions but to offer as a description of how the alternative monetary institution could be more appropriate to serve our purpose.

Monetary policy is impotent in an open economy because it is conducted by changing the quantity of base money to affect the interest rate in order to alter the opportunity cost of holding money that will impact upon the money demand and other variables. But credibly fixed exchange rate regime will always make sure that the induced foreign financial capital flow will spontaneously reverse the monetary stance, restoring the interest rate and so the opportunity cost of holding money, nullifying the real effects.

The following model, however, suggests that monetary policy can be very effective if it is conducted through altering the return on bank reserves to directly impact upon the money demand. Instead of increasing the money supply, monetary expansion is here achieved, at the constant money supply, by lowering the return on bank reserves to discourage the money demand. Identically, monetary stance can be tightened not by subtracting the money supply but by increasing the return on bank reserves so as to induce greater demand for money at the given supply of money[4].

Then, question arises: since treasury bonds and bank reserves are to be perfectly substituted, the lower-return induced portfolio reshuffling from bank reserves to treasury bonds could depress the market interest rate, would not the resultant capital efflux, therefore, effortlessly reverse the desired monetary stance? Fortunate enough, the decoupling of open market operation and interest-rate setting has released an additional policy tool which could be aimed for other macroeconomic target. In this vein, open market operation could easily offset the impact on capital flow: by conducting open market sell to meet the privates' demand for treasury bonds, the market interest rate will remain unchanged, getting rid off the incentive for financial capital flow. The receipts of bonds selling could then be deposited at the banking system, alike a recurrent monetary injection[5]. The swap between central bank's treasury bonds and deposits at banking system not only successfully retains the desirable monetary expansion, but no less important, credibly preserves the external convertibility and thus sustainability of the fixed rate.

Once the money demand has changed in ensuing, the effects will spillover from the money market to other real variables. Intuitively, expansionary money policy, effectuated through the lower return on bank reserves accompanied by deposits injection, will bolster the production; the resultant real exchange rate depreciation will tilt the output expansion inclining toward the tradable goods sector, contributing to the current account surplus and hence the accumulation of foreign reserves.

Revisiting the classic internal-external balance tradeoffs from the perspective of this alternative monetary regime, we find that these long haunting internal-external balance contradictions can be easily resolved. For instance, for an economy troubled with inflation and balance-of-payment surplus, one may need increasing the return on bank reserves to tighten the monetary stance to curb internal inflation, while generating a real exchange rate appreciation that tilt the output contraction and greater consumptions toward tradable goods.

The remainders of the paper are organized as follows: section 2 builds the analytical framework, followed by section 3 that discusses the dynamic effects of expansionary monetary policy via lowering the return on bank reserves on the economy, particularly from the perspectives of output, labor supply, consumption, real balance, real exchange rate, bank's credit, and current account. Section 4 outlines an adapted optimizing IS-LM-BP model, based on the findings in section 3, to propose that the impossible trinity can be overcome once the return on bank reserves is taken as the policy instrument. Section 5 extends the ideas to resolving the internal-external balances contradiction. Section 6 provides final remarks.

2. ANALYTICAL FRAMEWORK

The small perfect-foresight production economy comprises five representative agents: household, firm, bank, treasury, and central bank. The infinitely lived household consumes both tradable and non-tradable goods. He or she offers the labor service to earn the living. In a perfect competition environment, the firm employs labor as the only input for production, while the bank resumes the traditional roles of intermediaries and liquidity creator. The treasury issues bonds not exceeding the value of prospective primary fiscal surplus, while the central bank determines the rate of return on bank reserves. The goods and asset markets are perfectly integrated with the rest of the world in which the law of one price is preserved and the domestic real interest rate is at the equality with world real rate.

The real exchange rate is the relative price of tradable goods. A rise in the relative price of tradable goods implies real exchange rate depreciation, and vice versa. Assuming the foreign inflation rate to be zero, perfectly open economy will ensure that domestic market interest rate will be at the level of world real interest rate minus expected (actual) rate of real currency depreciation, $i = r - \dot{e}$. Lastly, all real terms (in small letter except for the bank reserves, *R*) are in non-tradable goods. Time subscripts are omitted for analytical convenience.

2.1. Firm

Firm employs labor (*x*) as the only input for production (*y*). Output, therefore, is a function of labor. Higher labor employment produces greater output at decreasing rate of return.

$$y = f(x), \qquad f_x > 0, f_{xx} < 0 \tag{1}$$

where $y = y^N + ey^T$.

The production comprises both non-tradable (y^N) and tradable goods (y^T). At the full potential level of output ($\bar{y}$), higher production on non-tradable goods implies lower production on tradable goods. Labor mobility between these two sectors is assumed to be perfect, impliying a zero adjustment cost of productions.

Firm requires bank's credit to finance its working capital: compensation to the labor services (*w*). Equation [2] illustrates the credit-in-advance constraint:

$$wx \leq l. \tag{2}$$

The constraint will be continuously binding given the positive cost of financing.

Equation [3] shows how firm has to finance the labor cost and to service the working capital with the revenue earned:

$$\Omega^f = f(x) - wx - (i^l - p)l \tag{3}$$

The firm's problem, therefore, is to maximize the present value of profit (Ω^f), which will be redistributed to the household, subject to the budget constraint and production structure[6]:

$$\underset{x}{Max} \quad \int_0^\infty e^{-rt}\Omega^f = \int_0^\infty e^{-rt}\{f(x) - wx(1 + r^l)\} \tag{4}$$

$$s.t. \quad \log y^N + e\log y^T = \log \bar{y}$$

The first order conditions are:

$$f_x = w(1 + r^l) \tag{5a}$$

$$\frac{y^T}{y^N} = e \tag{5b}$$

Equation [5a] demonstrates the fact that, at the given real wage, higher cost of financing will reduce the demand for labors, and so, the outputs. Equation [5b] reveals the determinant of production structure: real depreciation will tilt the production structure toward tradable outputs, and vice versa.

2.2. Bank

As financial intermediary, bank receives deposits[7] from household (m^h) and central bank (m^g) to finance the non-liquid loan advances (l). To take care of its liquidity positions, bank will also acquire the interest-bearing liquid bank reserves (R). The bank's balance sheet constraint is hence given by:

$$l + R = m^h + m^g .$$

The profits (Ω^b), which will be redistributed to household, are extracted after paying the interests to depositors (i^m) from the revenues earned through lending (i^l) and holding bank reserves (i^R).

$$\Omega^b = (i^l - p)l + (i^R - p)R - (i^m - p)(m^h + m^g) - \Psi(l, m) \qquad [6]$$

Note that higher rate of inflation will shift the wealth from the creditors to the debtors. The last term of the equation refers to transaction costs incurred in maintaining a certain level of loans and deposits (such as ATM operations, savings book, loans monitoring and assessment, and so on). As in Edwards and Vegh (1997), this transaction cost will appear in the government budget constraint as revenue to reflect the fact that $\Psi(l, m)$ is a private cost for the bank but not a social cost.

The bank's problem is given by

$$\underset{d}{Max} \quad \int_0^\infty e^{-rt}\Omega^b = \int_0^\infty e^{-rt}\{(i^l - i^m)l + (i^R - i^m\}R - \Psi(l, m)\} \qquad [7]$$

The first order conditions are

$$i^l - i^m = \Psi_l \qquad [8a]$$

$$i^R = i^m \qquad [8b]$$

Equation [8a] states that costly banking system requires positive loan-deposit rate differentials. Equation [8b] argues that bank reserves as the most liquid assets in the bank's coffer earn an interest rate (return on bank reserves) similar to the return on bank deposits. Higher return on bank reserves is therefore to be translated immediately into higher bank deposits interest rate.

2.3. Household

Household holds deposits, treasury bonds (b^h), and foreign assets (b^*) in portfolios. The aggregate real financial wealth is therefore given by:

$$a = m^h + b^h + eb^*$$

Household is endowed with one unit of time, devoted for work (x^s) and leisure (L). He earns the wage income, interests on the holding of financial assets, dividends ($\Omega = \Omega^f + \Omega^b$), and government's lump-sum transfer to finance the consumptions and financial assets accumulation[8]. Equation [9] shows this flow constraint:

$$\dot{m}+\dot{b}^{h}+\dot{b}^{*}=r(b^{h}+eb^{*})+wx^{s}+\Omega+\tau+(i^{R}-p)m^{h}-c^{N}-ec^{T} \qquad [9]$$

The household has the following instantaneous utility function:

$$u\left(c^{N},c^{T},x^{s},m^{h}\right)^{9}, \qquad [10]$$

where $u_{c^N}, u_{c^T}, u_m > 0, u_{x^s} < 0, u_{c^N c^N}, u_{c^T c^T}, u_{x^s x^s}, u_{mm} < 0, u_{c^N m} > 0$

Forming the Lagrangian of household's optimization problem, we get

$$\underset{c^N, c^T, L, m}{Max} \qquad \int_0^\infty e^{-rt}u\left(c^N,c^T,x^s,m^h\right)$$

$$s.t. \qquad \lambda\int_0^\infty e^{-rt}\left\{r(b^h+b^*)+wx^s+\Omega+\tau+(i^R-p)m^h-c^N-ec^T\right\} \qquad [11]$$

The necessary and sufficient first order conditions are

$$u_{c^N}=\lambda \qquad [12a]$$

$$u_{c^T}=e\lambda \qquad [12b]$$

$$\frac{u_{c^T}}{u_{c^N}}=e \qquad [12c]$$

$$-u_{x^s}=\lambda w \qquad [12d]$$

$$\dot{\lambda}=\lambda(r-r^R)-u_m \qquad [12e]$$

Equation [12a] shows that the marginal utility of consumption of non-tradable goods equals the marginal utility of wealth. And the marginal utility of consumption of tradable goods, as from [12b], equals the marginal utility of wealth priced at the real exchange rate. Then as [12c] shows, the marginal rate of substitution between tradable and non-tradable goods will be an equivalent to the real exchange rate: a fall in real exchange rate tilts the consumption toward tradable goods.

Equation [12e] is the law of motion, which shows that the marginal utility of wealth rises or falls over time depending on whether the return on bank reserves that directly determines the deposits rate, as in equation [8b], falls below or exceeds the world real interest rate[10]. A fall in the real interest rate increases in the marginal utility of wealth over time.

This relationship can be generalized to the following function:

$$\lambda=\lambda\left(r^R\right), \qquad \lambda'<0 \qquad [12f]$$

To ensure the ultimate attainment of a steady state, it then follows from [12e] that at $\dot{\lambda}=0$, $r-r^R$ equals to the marginal rate of substitution between non-tradable consumption and money, u_m/u_{c^N} .

Equation [12d] implicitly defines the supply function of labor. At the given level of real wage, higher marginal utility of wealth brings about a preference toward providing labor service. Combined with equation [12f], we find that labor supply is endogenously determined by the return on bank reserves:

$$x^s=x\left(r^R\right), \qquad x'<0\,. \qquad [12g]$$

Higher (lower) return on bank reserves improves (worsen) the wealth condition, contributing to lesser (greater) supply of labor.

2.4. Government

Central bank carries the function of contracting and expanding the liquidity in the system. As in the common practice, to credibly fix the exchange rate parity requires the liquidity supply to be the mirror image of the balance of payment adjustment. For instance, if the central bank contracts the base money through open market sale, the ensuing higher treasury-bond interest rate acts to induce the influx of foreign financial capital. The resultant accumulation of foreign reserve stocks, however, will bring about an expansionary monetary policy, which, in turn, will depress the interest rate back to the initial level.

This monetary regime, however, relies on adjusting the return on bank reserves to directly impact upon the demand side instead of changing the supply side as mentioned above. For instance, if the central bank attempts to have contractionary monetary stance, the bank will increase the return on bank reserves, inducing the portfolio reshuffling from lower-yielding treasury bonds to higher-yielding bank reserves at the constant supply of reserves. Since the hike in interest rate triggers the footloose foreign financial capital inflow to exploit the arbitrage opportunities, which in turn, reversing the desired monetary stance, the high-reserve-interest-rate policy is to be conducted together with open market purchase, financed by a reduction in the central bank's deposits at the banking systems, to meet the market response. In this vein, the liquidity in the system is successfully tightened without impacting upon the market interest rate, and so the financial capital flow.

Two very important outcomes should be noted: first, even if the exchange rate is fixed under perfect capital movement, unlike the conventional wisdom, the desired monetary stance is capable to be sustained, signaling the revival of monetary autonomy. Second, the revival of the monetary sovereignty, again, unlike the conventional wisdom, is not at the expense of the credibility of the fixed exchange rate regime: the balance-of-payment adjustment mechanism is undisrupted!

To preserve the external convertibility, the stock of bank reserves is sufficiently backed by the stock of foreign reserves $ef = R$, or otherwise, the real exchange rate will depreciate. Central bank receives interests from the holding of foreign reserves, treasury bonds, and deposits at banking system to finance the interests paid on bank reserves. Equation [13] demonstrates this flow constraint.

$$\dot{f} + \dot{b}^g + \dot{m}^g - \dot{R} = r(ef + b^g) + r^m m^g - r^R R \qquad [13]$$

As mentioned, the conduct of interest-rate policy is coordinated with the swap between treasury bonds and deposits. Lower return on bank reserves is coordinated with open market sale with the receipts credited into the banking system. Conversely, open market purchase with payments debited from the banking system is to accompany the higher return on bank reserves. Therefore, $\dot{b}^g = -\dot{m}^g$.

The function of treasury department is rather simple: raise revenue from providing the services to the banking system, make the lump-sum transfer to the household, and pay the interests to the bondholder. Inadequacy will be financed by issuing bonds.

$$\dot{b} = \tau + rb - \Psi(l, m) \qquad [14]$$

Impose the non-Ponzi condition, the intertemporal budget constraint of the treasury is given by:

$$\frac{B_0}{P^N} = \frac{\Psi(l,m) - \tau}{r}. \qquad [15]$$

where $b_0 = B_0 / P^N$.

Equation [15] reveals the fact that the ability of treasury to issue debt depends on the prospective primary fiscal surplus. Greater primary fiscal surplus allows treasury to issue more bonds at the very beginning. Have the value of nominal bond issuance been inadequately backed by the prospective primary fiscal surplus, the domestic price level will increase. This budget constraint is, therefore, assumed to hold on and off equilibrium so as to highlight the effects of return on bank reserves upon the real exchange rates.

The government's consolidated flow constraint is, hence, given by the combination of [13] and [14]:

$$\dot{f} - \dot{R} - \dot{b} = r(ef - b^h) + r^m(m^g - R) + \Psi - \tau \qquad [16]$$

Imposing the non-Ponzi condition, the government's intertemporal budget constraint is:

$$\frac{r^R(R - m^g)}{r} = ef_0 - b_0 + \frac{\Psi - \tau}{r} \qquad [17]$$

Given equation [15], equation [17] shows that the discounted burden of servicing the interest-bearing bank reserves is constrained by the initial stock of net foreign reserves in domestic value, and the present value of central bank's deposits at banking system.

By combining equation [3], [6], [9], [16], we obtain the economy's resource constraint:

$$\dot{k} = rk + e(y^T - c^T), \qquad [18]$$

Changes in the net external assets will be nil if the flow of current account balances the capital account.

2.5. Market Clearing Conditions

2.5.1. Labor market

Labor market is in equilibrium when the demand for equals to the supply of labor service.

$$x = x^s.$$

Then, from equation [5a], [12d] and [12f], given the sticky real wage, the equilibrium condition can be rewritten as follows:

$$\frac{x^s}{x} = \frac{1 + r^l}{\lambda(r^R)}. \qquad [19]$$

If there is insufficient demand for labor, equilibrium can be obtained by lowering the return on bank reserves.

2.5.2. Non-tradable goods market

The demand for non-tradable goods is governed by its output.

$$c^N = y^N \tag{20}$$

If it happens that $c^N < y^N$, one needs real exchange rate depreciation to direct the resources from non-tradable to tradable output production, and at the same time, to generate a shift in preference toward non-tradable goods.

2.5.3. Credit market

Credit market is in equilibrium when

$$l^s = l^d .$$

The bank's first order condition [8a] in log linear approximation characterizes the supply of credits. The demand function of credits can be obtained by combining the firm's first order condition [5a] and the binding credit-in-advance constraint. Therefore, the credit market equilibrium is given by

$$i^l - i^R = \frac{xf_x}{1 + r^l} . \tag{21}$$

Expansionary monetary stance through lowering return on bank reserves will bring about a credit boom: greater credit supply resulted deposit expansion with greater credit demand fueled by labor market expansion.

2.5.4. Money market

From the law of motion [12e], at steady state,

$$r - r^R = \frac{u_m}{u_{c^N}} . \tag{22}$$

This equation implicitly defines a money demand function:

$$m = L\left(r^R, c^N\right), \qquad L_{r^R}, L_{c^N} > 0 \tag{23}$$

The market is equilibrated when

$$R = L\left(r^R, c^N\right) \tag{24}$$

With constant supply of reserves, monetary expansion $R > L$ is achieved via lowering the return on bank reserves.

2.6. Dynamic Conditions

Differentiate equation [12a] against time, and combine it with the law of motion [12e], we will obtain

$$\dot{c}^N = \frac{u_{c^N}}{u_{c^N c^N}}(r - r^R - \frac{u_m}{u_{c^N}}).$$ [25]

Equation [25] shows that when $r - r^R$ shrinks due to higher return on bank reserves, the marginal rate of substitution declines, and therefore, the consumption of non-tradable goods will be decreasing over time. Equally, a decline in the return on bank reserves will cause higher marginal rate of substitution, increasing the consumption of non-tradable goods over time.

Equation [26] is to capture the determinants of the change in real exchange rate:

$$\dot{e} = \phi(\dot{R} - \dot{f}) + \varphi(f(r^R) - ey^T - c^N)$$ [11] [26]

The first determinant illustrates the monetary effect: excessive growth of reserves over those of foreign reserves brings about real depreciation. The second determinant demonstrates how insufficient demand for non-tradable goods vis-à-vis the steady state supply causes real depreciation.

Insert [20] into [18], we obtain the accumulation of net external assets as follows:

$$\dot{k} = rk + f(r^R) - c^N - ec^T$$ [27]

Equation [25], [26], and [27] constitute the dynamics of the system. The system's steady state is given by

$$r - r^R = \frac{u_{\tilde{m}}}{u_{\tilde{c}^N}}$$ [28a]

$$\tilde{c}^N = y^N$$ [28b]

$$\tilde{e} = \frac{rk + y - \tilde{c}^N}{c^T}$$ [28c]

Linearizing the system around the steady state, we obtain

$$\begin{bmatrix} \dot{c}^N \\ \dot{e} \\ \dot{k} \end{bmatrix} = \begin{bmatrix} r - r^R - u_{mc^N} / u_{c^N c^N} & 0 & 0 \\ -\varphi & -\varphi y^T & 0 \\ -1 & -c^T & r \end{bmatrix} \begin{bmatrix} c^N - \tilde{c}^N \\ e - \tilde{e} \\ k - \tilde{k} \end{bmatrix}$$ [29]

The determinant, $\Delta = \left[r - r^R - \frac{u_{mc^N}}{u_{c^N c^N}} \right] \left[-\varphi y^T r \right] < 0$, implies that the system must be yielding a saddle point.

Let δ_1 be the negative root. To obtain the eigenvector associated with this root we should solve

$$\begin{bmatrix} r - r^R - u_{mc^N} / u_{c^N c^N} - \delta_1 & 0 & 0 \\ -\varphi & -\varphi y^T - \delta_1 & 0 \\ -1 & -c^T & r - \delta_1 \end{bmatrix} \begin{bmatrix} h_{i1} \\ h_{i2} \\ h_{i3} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$ [30]

where h_{i1}, h_{i2} and h_{i3} , $i=1,2$ are the elements of the eigenvector associated with the negative eigenvalues. And hence, the solution to the linear approximation of the dynamic system takes the form:

$$c^N - \tilde{c}^N = A_1 h_{11} e^{\delta_1 t} + A_2 h_{21} e^{\delta_2 t} + A_3 h_{31} e^{\delta_3 t} \quad [31a]$$

$$e - \tilde{e} = A_1 h_{12} e^{\delta_1 t} + A_2 h_{22} e^{\delta_2 t} + A_3 h_{32} e^{\delta_3 t} \quad [31b]$$

$$k - \tilde{k} = A_1 h_{13} e^{\delta_1 t} + A_2 h_{23} e^{\delta_2 t} + A_3 h_{33} e^{\delta_3 t} \quad [31c]$$

where A_1 , A_2 , and A_3 are arbitrary constants.

Setting to zero the constants corresponding, respectively, to the unstable roots A_2 and A_3 , the solutions are reduced to

$$c^N - \tilde{c}^N = A_1 h_{11} e^{\delta_1 t} \quad [32a]$$

$$e - \tilde{e} = A_1 h_{12} e^{\delta_1 t} \quad [32b]$$

$$k - \tilde{k} = A_1 h_{13} e^{\delta_1 t} \quad [32c]$$

Eliminating $A_1 e^{\delta_1 t}$ from these equations and it follows that

$$\frac{c^N - \tilde{c}^N}{e - \tilde{e}} = \frac{h_{11}}{h_{12}} = \frac{-\varphi y^T - \delta_1}{\varphi} = ? \quad [33a]$$

$$\frac{c^N - \tilde{c}^N}{k - \tilde{k}} = \frac{h_{11}}{h_{13}} = \frac{r - \delta_1}{1} > 0 \quad [33b]$$

$$\frac{e - \tilde{e}}{k - \tilde{k}} = \frac{h_{13}}{h_{12}} = \frac{r - \delta_1}{c^T} > 0 \quad [33c]$$

Equation [33] implies that whenever these is a shock to the system, consumption of non-tradable goods and net foreign assets will converge to their steady-state values in the same direction, while the path of real exchange rate associated with non-tradable goods is ambiguous. Judging from the comparative static effects shown in Appendix, however, they should converge to the steady-state values in opposite direction. These dynamic paths are drawn in Figure 1.

3. MONETARY EXPANSION VIA LOWERING THE RETURN ON BANK RESERVES

Suppose that at the initial steady-state, the return on bank reserves is i_H^R. At t = 0, the central bank announces a permanent decrease in the return on bank reserves from i_H^R to i_L^R coordinated with a swap between treasury bonds and deposits. Lower return will have $\dot{c}^N = 0$ shifting upward with both $\dot{k} = 0$ and $\dot{e} = 0$ move outward, as drawn in Figure 2. Figure 2 illustrates that the non-tradable consumption initially declines from steady state A to B before converging toward the new steady state E along the saddle path. The net foreign assets, however, accumulate over time. As in Figure 2(b), the real exchange rate responds by depreciation before appreciating along the saddle path. At new steady state E, greater c^N and k are attained, with a depreciated real exchange rate[12].

The intuition behind this observation is as follows. Lower return prompts households' portfolio adjustments from lower-yielding bank deposits to the relative higher-yielding treasury bonds sold by the central bank. Since the receipts of bonds sales are deposited at the banking system, the resultant expansion in deposit base implies liquidity easing that enables more credits to be advanced through the banking system.

Given the real wage, lower return on bank reserves worsens the wealth condition, and hence, as in [12d], dampens the incentive for leisure, stimulates the supply of labor (see [12g]), which in fact, will be fully absorbed by firms with improved creditworthiness (due to lower borrowing rate (see [8]) and greater credit availability). The credit market is in boom because banks are more willing to lend (see [21]), corresponding to firms' needs of more credits to finance the absorption of additional labor supply. After all, the total output will expand.

Note that lesser time for leisure implies a fall in consumption as well (recall that the complementary between non-tradable consumption and real balance means a lower consumption when the demand for real balance contracts). Combined with an output expansion, the real exchange rate will depreciate, which, in turn, signals a more profitable tradable sector. More resources must be then directed toward the production of tradable outputs (see [5b]). According to [12c], the tradable goods consumption will fall in greater magnitude, enhancing the path to current account surplus, and so the accumulation of net foreign assets.

Following the economic boom, the supply-governed consumption of non-tradable goods should thereafter be increasing to a new high ground. Once the non-tradable consumptions start approaching the potential supply, the inflation rate crawls, which, in turn, appreciating the real exchange rate. Examine from monetary perspective validates these development thanks to the mounting stock of foreign reserves at the prevailing supply of bank reserves. After all, at new steady state, with the augmented liquidity, the economy that experiences a tradable-focused boom will improve the households' welfare. Table I summarizes the effects of lower return on bank reserves.

4. SOME POLICY IMPLICATIONS

4.1. Overcoming Impossible Trinity

Impossible trinity indicates the tradeoff between monetary autonomy and perfectly open economy with fixed exchange rate regime. It has been a standard textbook case that when the central bank raises the interest rate to the level above the world interest rate, massive capital flows will be attracted to exploit this arbitrage opportunity. The resultant non-sterilized intervention of central bank must necessarily cause the money supply to increase to the initial level of money stock. The domestic interest rate is restored equalizing the world rate, and the effect on output vanishes.

Put it differently, the impotency of monetary policy stems from the fact that interest-rate determination and open market operation are coupled. Higher interest rate requires open market sales, lower interest rate is possible only by open market purchases. But unfortunately, capital mobility often nullifies the efforts of open market operation. Evidently from the above discussion, however, the proposed alternative monetary regime that influences the monetary stance not via the intervention in money supply to indirectly alter the opportunity cost spread but by adjusting the return on bank reserves to directly impact upon the opportunity cost spread and so the money demand seems to be capable to overcome the long-haunting tradeoff.

The reserve-interest-cum-domestic-credit-swap regime has decoupled the interest rate determination from the open market operation. Return on bank reserves becomes an instrument to determine the bank's rates, while the open market operation, particularly a change in the composition of domestic credits, aims for the liquidity. By lowering the return on bank reserves, other bank's interest rates are easily anchored without open market purchases. Open market operations, then, could be independently employed to simply make the incentives for financial capital flows disappear. Further, the swap between treasury bonds and deposits at banking system implies a monetary injection. The effect of money multiplier on real economy will then take place without fear of sudden capital reversal. Inversely, the booming economy should be expected to strengthen the confidence of capital to flow in.

To make the case obvious, it is worthy to put the story into the device of conventional IS-LM-BP model (see Figure 3). When the money supply is increased through open market purchase, the LM curve shifts to the right, driving down the market interest rate to point E_1', which, in turn, triggering the capital outflow. The decumulation of foreign reserves causes the money supply to contract, thereby shifting the LM curve back to the origin with no real effects. Obviously, the new equilibrium point E_2' is attainable only when the return on bank reserves is lowered from r_H^R to r_L^R . The LM curve moves outward without impacting upon the market interest rate, thanks to the swap between treasury bonds and central bank's deposits at banks, shown by E_1'E_2', which in turn means that the LM_1 is a stable one. Since the output is determined given the endogenous labor supply, the IS curve will move to the right to reach at the new equilibrium point. At E_2', the real economy grows.

Last but not the least, the monetary revival under this regime is fundamentally different in terms of the fixed rate's credibility to that of sterilized intervention under conventional practice. In the latter, monetary expansion is sustained through the swap between foreign assets and treasury bonds. In other words, the base money has become insufficiently backed by the foreign assets, which could severely undermine the external convertibility and so the confidence on the sustainability of the fixed rate. Plus, the sterilized intervention implies the disappearance of the automatic adjustment mechanism, and therefore, self-reinforcing the confidence crises.

The reserve-interest-cum-domestic-credit-swap regime, however, will not be troubled by the credibility concern because no capital efflux in ensuing, and second, the entailed fiscal burden due to open market sales is financed by the deposit interests earned and the additional funds extracted from the lower return on bank reserves. After all, the external convertibility, and so, the confidence on the fixed rate's sustainability are well preserved.

In this vein, we may derive at the following proposition (see Figure 4):

Proposition 1: *In an open economy with perfect capital mobility and fixed exchange rate regime, the monetary sovereignty can be revived at no expense of fixed rate's credibility once the return on bank reserves becomes the instrument to influence other bank's interest rates, coordinated by the swap between treasury bonds and central bank's deposits at banks.*

4.2. One Instrument, Two Targets

The major policy implication of trilemma, in which capital movement is unrestricted under fixed exchange rates, is of insufficient policy canons to aim for inharmonic internal and external balance. Among others being the inflation surplus and unemployment deficit that require different policy stances.

For instance, an inflationary economy with external suplus that runs contractionary fiscal policy – the only left policy tool – may find itself falling deeper into the external surplus. Inversely, expansionary fiscal policy sought to battle against the domestic unemployment may further aggravate external deficits. Worst still, Riascos and Vegh (2003) find that, unless the financial markets are well developed, fiscal policy is determined to be procyclical in developing countries, therefore announcing the death of possibilities to reconcile the internal-external balance contradictions.

If the return on bank reserves, as in Proposition 1, is capable to overcome the trilemma, would it be able then to accomplish this "mission impossible"? Undoubtedly, discussions on the system's dynamic adjustments in section 3 offer the following propositions:

Proposition 2: *Under perfect capital mobility and fixed exchange rate regime, unemployment and balance of payment deficits can be simultaneously resolved by lowering return on bank reserves.*

Proof: *The proof proceeds by contradiction*
Suppose that $x^s > x$ and $y^T < c^T$. If one increases r^R, as in [8a], banks' willingness for l is depressed. Besides, as in [12g], higher r^R further discourages x, which, in turn, according to [1], brings about a fall in y. From [28b] and [28c], we know that both c^N and e fall. [12c] implies a relatively smaller fall in c^T. As in [5b], contraction in y^T is greater than in y^N. The combined effects of [5b], and [12c], as [18] shows, will deteriorate net foreign assets position, which is in contradiction to the proposition. QED

Proposition 3: *Increasing the return on bank reserves will concurrently overcome the dilemmas of overemployment and balance of payment surplus.*

Proof: *The proof proceeds by contradiction*
Suppose that $x^s < x$ and $y^T > c^T$. If one decreases r^R, then, according to [8a], lower r^R stimulates l, while, as in [12g], encouraging greater x and y. With [28b] and [28c] we know that c^N and e will rise. [12c] implies a relatively smaller increase in c^T. Again, as in [5b], increase in y is y^T-centric. The combined effects of [5b], and [12c], as [18] shows, will improve net foreign assets position, which is in contradiction to the proposition. QED

The intuition is simple: if expansionary monetary policy is attained not via expanding the money supply, but by contracting the money demand, we will observe on impact a resultant domestic de-absorption, particularly on tradable goods. Combined with the tradables-oriented output expansion due to the lower return on bank reserves that stimulates greater labor supply, and more important, demand financed by the credit expansion, this demand-driven expansionary monetary stance will lead to unemployment reduction and current account deficit elimination.

Conversely, increasing the return on bank reserves that tightens the monetary stance that shrivels the credit advances will cut labor demand, and the subsequent output supply. Since improving wealth condition fuels greater consumption of non-tradable goods on impact (which is later on constrained by lower production of non-tradable goods), the subsequent real exchange rate appreciation must be motivating the consumptions of tradable goods to a greater extent (or demotivated to a lesser extent later on along the adjustment path). Joint with the tradables-oriented output contraction, the demand-driven contractionary monetary stance will lead the way toward relaxation in labor market and current accout surplus elimination.

Note that, though the revival of monetary autonomy is not at the expense of the automatic balance-of-payment adjustment mechanism, whether an expansionary monetary policy results in balance-of-payment deficits or surplus is conditional on the driving factor: supply-driven expansionary monetary policy causes balance-of-payment deficits, as in conventional model, whereas demand-driven expansionary policy stance leads to balance-of-payment surplus, as in this reserve-interest-cum-treasury-bond-deposit-swap regime.

5. FINAL REMARKS

The model, however, is by no means comprehensive, not to say conclusive. Extensive researches are required to assure the feasibility and effectiveness of the return on bank reserves as a policy tool. Among others, the effects on capital accumulation and growth seem warranted. In this paper the fiscal policy is implicitly assumed to accommodate the monetary policy. What will be the consequence if it is the monetary policy to accommodate the fiscal policy? What are the advantages of reserve interest rate regime vis-à-vis the orthodox approaches, i.e. inflation-targeting, interest rate targeting, Friedman's k percent money targeting, and real exchange rate targeting? Should reserve interest rate regime be a targeting or instrument rule?

Most stimulating, if there is no tradeoff among open capital markets, fixed exchange rates, and autonomous once the monetary operation is revised by adjusting the return on bank reserves to control the liquidity stance and price level, would it mean that some forms of monetary union different to the EU is possible? That comes into the imagination will be a currency area without the core country to sail the one-size-fit-all monetary policy, a currency union that simultaneously allows the automatic balance-of-payment adjustment mechanism to take place and the monetary stance sized for domestic economic conditions (see Wong (2004)).

REFERENCES

[1] Agenor, Pierre-Richard, Aizenman, Joshua, and Hoffmaister, Alexander W. (2004) "The Credit Crunch in East Asia: What Can Bank Excess Liquid Assets Tell Us?" *Journal of International Money and Finance* 23, pp. 27-49.

[2] Bordo, M.D. and Schwartz, A.J. (1996) "Why Clashes between Internal and External Stability Goals End in Currency Crises, 1797 – 1994?" *Open Economies Review*, Vol. 7 pp. 437-468.

[3] Caballero, Ricardo J., and Krishnamurthy, Arvind (2000), *International Liquidity Management: Sterilization Policy in Illiquid Financial Markets*, NBER Working Paper No. 7740.

[4] Calvo, Guillermo A. (1991), "The Perils of Sterilization" *IMF Staff Papers*, Vol. 38, No. 4 (Dec), pp. 921-926.

[5] Cook, David, and Devereux, Michael B. (2001), *Capital Controls in Malaysia: Effectiveness and Side Effects*, mimeograph.

[6] Dooley, Michael (1995), *A Survey of Academic Literature on Controls over International Capital Transactions*, NBER Working Paper No. 5352.

[7] Eichengreen, B. (1999), *Globalizing Capital: a History of International Monetary System*, Princeton: Princeton University Press.

[8] Freeman, Scott, and Haslag, Joseph H. (1995), "Should Bank Reserves Earn Interest?" Federal Reserve Bank of Dallas *Economic Review* (Forth Quarter).

[9] Goodfriend, Marvin (2000), "Overcoming the Zero Bound on Interest Rate Policy", *Journal of Money, Credit and banking* 4, No. 32, part 2 (Nov), pp. 1007-1035.

[10] _______________ (2002), "Interest on Reserves and Monetary Policy", Federal Reserve Bank of New York *Economic Policy Review* (May), pp. 77-84.

[11] Hall, Robert E. (1999), *Controlling the Price Level*, NBER Working Paper No. 6914.

[12] Kaplan, Ethan, and Rodrik, Dani (2001), *Did Malaysia Capital Control Work*, NBER Working Paper No. 8142.

[13] Jomo, K.S. (2002), *Malaysian Eclipse*, London: Zed.

[14] Mckinnon, Ronald I. (2000), *After the Crisis, the East Asian Dollar Standard Resurrected: an Interpretation of High-Frequency Exchange Rate Pegging*, mimeograph, Stanford University.

[15] Obstfeld, M., Shambaugh J.C. and Taylor, A.M. (2004a) *Monetary Sovereignty, Exchange Rates and Capital Controls: the Trilemma in the Interwar Period*, NBER Working Paper No. 10393.

[16] ____ (2004b) *The Trilemma in History: Tradeoffs among Exchange Rates, Monetary Policies, and Capital Mobility*, NBER Working Paper No. 10396.

[17] Reinhart Carmen, and Smith R.T. (1998), "Too Much of a Good Thing: the Macroeconomic Effects of Taxing Capital Inflows" in Glick R. (ed.), *Managing Capital Flows and Exchange Rates: Perspective from the Pacific Basin*, Cambridge: Cambridge University Press.

[18] Riasco, Alvaro and Vegh, Carlos A. (2004), "Procyclical Government Spending in Developing Countries: The Role of Capital Market Imperfection", *IMF Staff Papers*, Vol. 51, Special Issue 2004.

[19] Wong Chin-Yoong (2004), *Towards a New Paradigm in Theory of Currency Areas*, in progress, New Era College.

7. APPENDIX

A.1. Comparative Static Effects

Total differentiating the dynamic equations [25] – [27] against the reserve interest rate in matrix form, we obtain the followings:

$$\begin{bmatrix} r - r^R - u_{mc^N} / u_{c^N c^N} & 0 & 0 \\ -\varphi & -\varphi y^T & 0 \\ -1 & -c^T & r \end{bmatrix} \begin{bmatrix} \partial c^N / \partial r^R \\ \partial e / \partial r^R \\ \partial k / \partial r^R \end{bmatrix} = \begin{bmatrix} u_{c^N} / u_{c^N c^N} \\ -\varphi f_{r^R} \\ -f_{r^R} \end{bmatrix} \qquad \text{[A1]}$$

Apparently, we will obtain the following partial differentials of choice variables to the return on bank reserves:

$$\frac{\partial c^N}{\partial r^R} = \frac{1}{\varphi(r - r^R - u_{mc^N} / u_{c^N c^N})} \frac{u_{c^N}}{u_{c^N c^N}} < 0$$

$$\frac{\partial e}{\partial r^R} = \frac{f_{r^R}}{y^T} - \frac{\varphi}{y^T} \frac{\partial c^N}{dr^R} < 0$$

$$\frac{\partial k}{\partial r^R} = \frac{\varphi c^T - y^T}{\varphi r} \frac{\partial e}{\partial r^R} < 0, \qquad \text{[A2]}$$

Figure 1a: The dynamic stability adjustment in (c^N,m) space

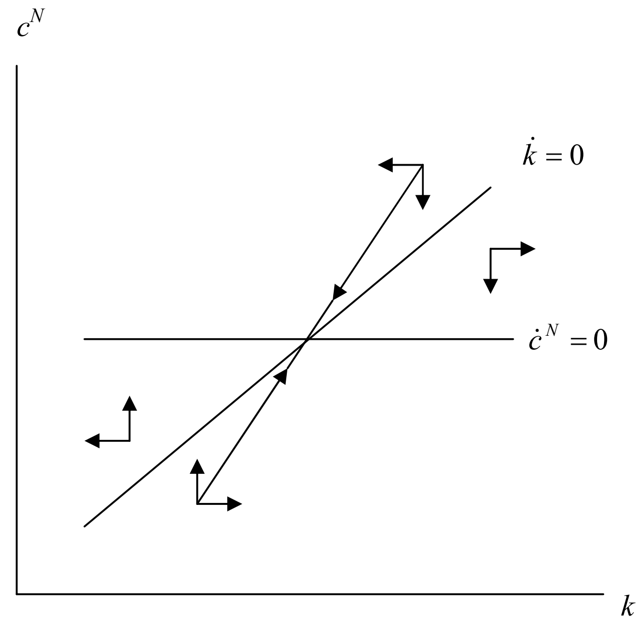


Figure 1b: The dynamic stability adjustment in (e, c^N) space

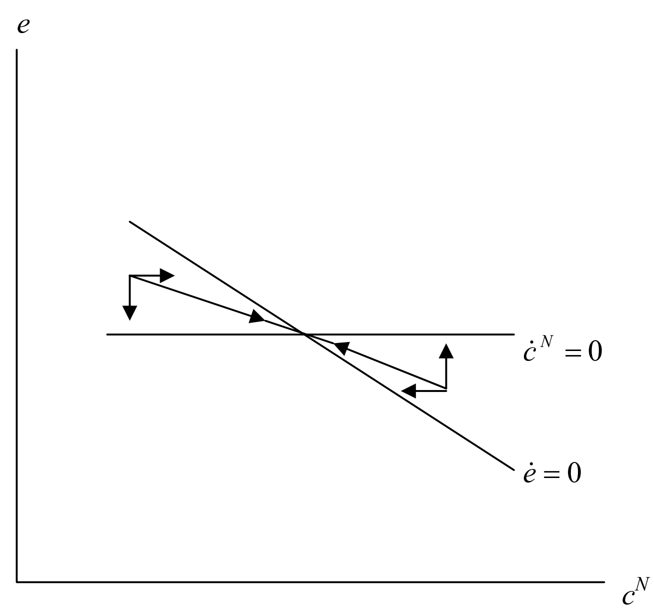
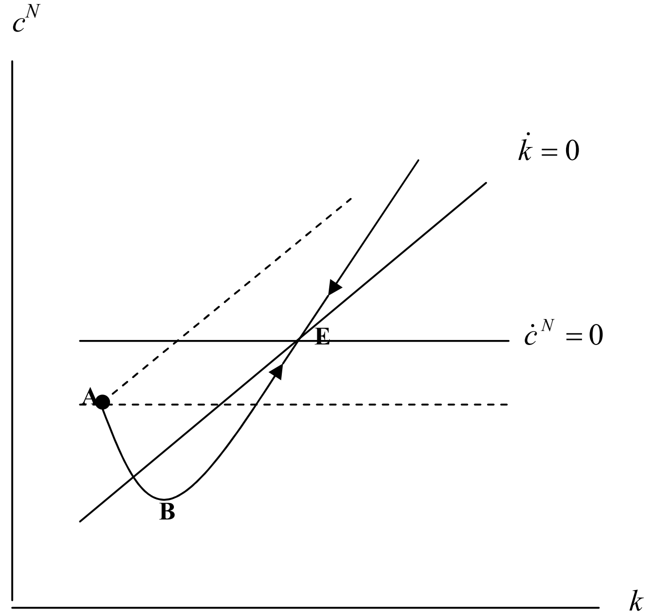
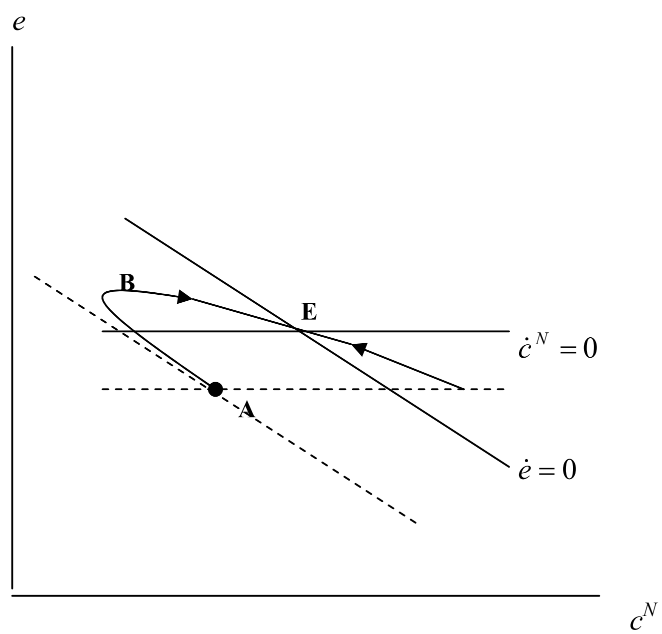


Figure 2: Permanent reduction in return on bank reserves

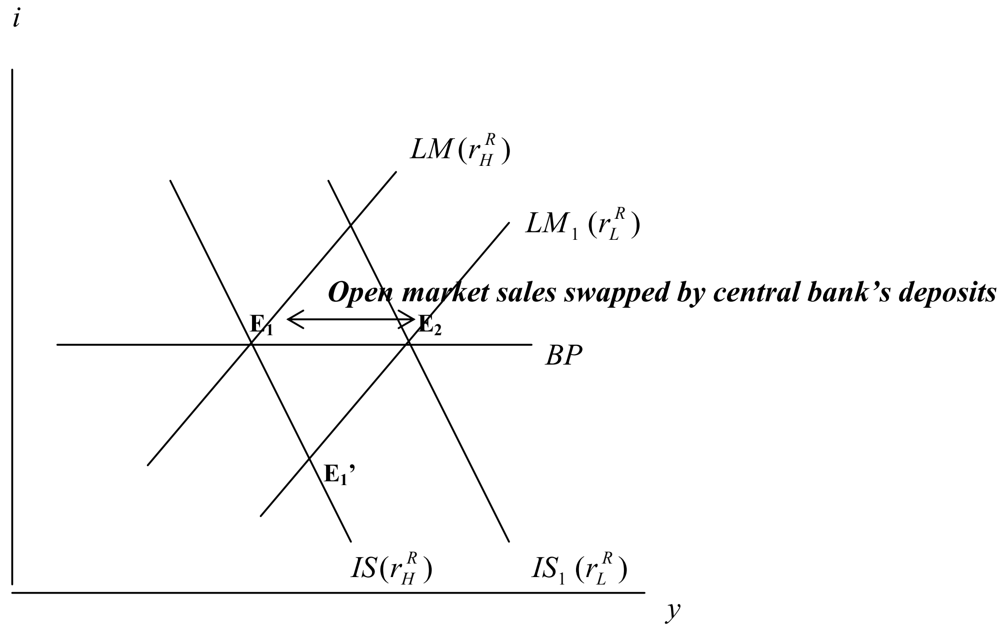


(a)



(b)

Figure 3: Reserve-interest-cum-domestic-credit-swap regime in IS-LM-BP



[1] Any attempt to reduce the opportunity cost of holding money will induce capital outflow and a loss in foreign exchange reserves. Central bank's contracting assets should then be reflected in its liabilities: reduction in base money, and the opportunity cost of holding money increases subsequently.

[2] Caballero and Krishnamurthy (2000) offer an interesting illustration on how sterilization may lead to "liquidity illusion" that unnecessarily feeds the boom, which acts to drain the system's liquidity, in the unsustainable unproductive non-tradable investment, which, once burst, brings about an external crisis.

[3] See Reinhart and Smith (1998), Cook and Devereux (2001), Kaplan and Rodrik (2001), and Jomo (2002). For the extensive survey of literatures on capital controls before Malaysia's controls, see Dooley (1995).

[4] See Hall (1983, 1999) for further details about this alternative monetary system for a closed economy. Freeman and Haslag (1995) and Goodfriend (2000, 2002) have discussions on other benefits and applications of paying interest on bank reserves.

[5] With the constant market interest rate, the widened interest-rate differentials between treasury bonds and bank reserves, and hence greater opportunity cost of holding money, will keep inducing the monetary dishoarding, thereby require a continuous swap between treasury bonds and deposits at banking system.

[6] For analytical convenience, the production structure is transformed into logarithmic form, implying a perfect substitutability between non-tradable and tradable goods.

[7] Throughout the paper, money is assumed to comprise only interest-bearing deposits, which, implies equality between base money and bank reserves. The terms, therefore, are used interchangeably.

[8] $\dot{x} \equiv dx/dt$

[9] Consumption and real balances are assumed to be Edgeworth complement.

[10] Time preference (β) is assumed to be equal to the world real interest rate.

[11] Recall that $y^N = y - y^T$. From equation [1] and [12g], the production is the function of return on bank reserves, $y = f(r^R)$, where $f_r^R < 0$.

[12] See appendix for the formal derivation of comparative static effects of r^R on c^N, e, and k in which $\partial c^N/\partial r^R < 0$, $\partial e/\partial r^R < 0$, and $\partial k/\partial r^R < 0$.