Managing Currency Crises: The Case for Dual Demand Driven Monetary Policy

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Abstract

This paper develops an intertemporal optimizing model with nominal rigidities and liability dollarization that emphasizes on the periods between capital flow reversal and speculative attack, and employs a simple diagrammatic method to analyze the implications of various different interest rate policies. A financially robust economy is universally critical to the effectiveness of any policy stances.

There are sunspot equilibriums in both of the high interest rate and low interest rate cum devaluation strategies that may lead to the vicious spiral of currency crashes, credit crunch, and output collapse. The destructive high interest rate amid exchange rate overshooting is indeed the most unwise policy proposal.

Dual demand driven monetary policy has demonstrated its superiority as the first best option in this manner. Without compromising to the credibility of fixed exchange rates, and not incompatible to the banks' willingness to lend, the central bank plays the role of lender of last resort via open market forward purchase to help the banking system sail through the capital reversal. The lower yield on bank reserves bolsters the prospective output that initiates greater demand for money, and thereby enticing capital re-inflow. The resultant real depreciation helps discourage the external financing that builds a more resilient economy.

Keywords: Monetary policy; Return on bank reserves; Currency crisis; Liability dollarization; Capital flow reversal

1. Introduction

Opinions in the economics profession on the appropriateness of recession-inducing level of interest rate to defend the peg against the depreciation pressure remain divided even seven years after the Asian financial crisis started. Most of the empirical studies on the significance of high interest rate on ceasing the nominal depreciation demonstrate "no results", or at best, a mixed result (see Kraay (1999), Hubrich (2000), Flood and Rose (2001)). A widely acknowledged reason is that it is enormously difficult to empirically determine the relationship between interest rate and exchange rate, given their endogeneity to other similar fundamental determinants, i.e. the agent's expectation. Yet, control for the endogeneity factor, as done in Gould and Kamin (1999), could not establish a systematic relationship between interest rate and exchange rate.

An equally important reason contributing to the lack of consensus is the limited experience of Asian financial crisis. The sky-rocketing interest rates were coincided with the nose-diving exchange rate in all the crisis-inflicted countries (see Bacchetta 2000), which, in turn, implies that we only have the experience of increasing the interest rate *after* the currency collapse due to the speculative attack. We may not be able to redo the history, but are always entitled to ask theoretical question of "what if": what if the monetary policy is tightened *before* currency collapse *amid* the speculative attack? What if the interest rate is increased *right after* the capital flow reversal but *long before* the speculative attack? Most of the existing theoretical literatures do not explicitly and adequately address this issue (see Lahiri and Vegh (2000), Flood and Jeanne (2000), Aghion et al. (2000, 2001, 2003), Chang and Velasco (2001), Christiano et al. (2002)). Taxonomy of time warrants a serious scrutiny to extract useful policy lessons.

Recent papers by Frankel (2004, and Wei (2004)) interestingly emphasize the policy decisions during the phase "immediately after capital inflows have begun to dry up but before the speculative attack itself has hit", which, are critical to the momentum of short term borrowing and so the vulnerability of the economy. He, therefore, recommends adjustment, rather than financing, during this transient period that on average lasts 6 to 13 months. The question is: given the dollarization of liabilities and the resulting balance sheet fragility, what kind of adjustment do we need?

Before proceeding further, four points on the role of banking system are noteworthy. First, Goldfajn and Gupta (1999) find that the likelihood that high interest rate policy is effective to restore the real exchange rate equilibrium through nominal appreciation is greater in countries with strong banking sectors. Second, Singh (2002) shows that bank failure could make the BOP crises self-fulfilling. Third, Agenor et al. (2004), with Thailand as study case, reveal that the contraction in bank lending accompanied the crisis was the result of supply factor. Forth, with emphasis on the balance sheets of banks, Choi and Cook (2002) propose a case for fixed exchange rate than flexible regime to stabilize the economy. Simply, to capture a better picture about the relationship between interest rate and exchange rate particular for developing countries that heavily depend upon the banking system as source of financing the understanding on the role of banking system in this relationship seems indispensable.

This paper attempts to bridge this theoretical gap by providing a stylized multiple-equilibrium model that incorporates the nominal rigidities, endogenized balance sheet constraints of both firms and banks, and bank channel to take stock on the implications of different policy alternates, and identify the necessary conditions for those policy alternates to be effective in defending the peg during the period after the sudden stop but before the speculative attack.

Most important, this paper endeavors to propose a new approach to managing the currency crisis – dual demand driven monetary policy. Initially inspired by Hall (1997, 1999) and Goodfriend (2002), this paper, extending the works of Wong (2004a, 2004b), presents a monetary policy leveraged on *two independent* instruments, namely, the return on bank reserves and open market operations, that could respectively and simultaneously handle the jobs of real economy and financial stability to carry the burden of adjustment while preserving the fixed exchange rate regime.

The discussions are structured as follows: section 2, draws on Wong (2004b), outlines the idea of dual demand driven monetary policy; section 3 presents an intertemporal optimizing analytical framework that works on Aghion et al.'s theorizing, discusses how firms and banks optimize their decisions to invest and borrow, and how central bank strategize its monetary policy; by using diagrammatic analysis section 4 analyzes the implications of IMF-style policy stances under three different conditions: frictionless economy, liability dollarised firms with robust banking system, and full-scale liability dollarised economy; section 5 examines Stiglitz-style policy stance, and find out its conditionality; section 6 recaptures the disastrous experience of Asian financial crisis; section 7 demonstrates the usefulness of dual demand driven monetary policy; section 8 concludes.

2. Dual Demand Driven Monetary Policy[1]

The standard transmission mechanisms of monetary policy, either the "money" view or the "credit view", are all stemming from the legally required reserves. The central bank alters the base money through open market operations to impact on the market interest rate and money supply toward the desired targets.

Suppose the central bank announces to increase the market interest rate. The rate, however, will not respond simply to the "talk". Through open market sale the central bank has to absorb the liquidity with treasury bills, contracting therefore the base money. Given the reserve requirement ratio, banks with fewer reserves will have to reduce the supply of the money as loans and advances to firms and individuals. To restore their real cash balances, those agents then have to liquidate their other assets for money, which will plunge the price of assets and thus contribute to a higher interest rate.

Derived from the above observation, we could make two statements about monetary policy that the policy is *supply-driven*, and the *interest-rate determination and open market operation are interlocked*. This association makes monetary policy perform as *a* policy tool.

Once we proceed to the open-economy part of any macroeconomics textbook, we were told by the Mundell-Fleming model that supply-driven monetary policy is ineffective for a small open economy adopting fixed exchange rate regime. An economy that fixes its exchange rate with open capital account will have to surrender the say in monetary setting. The intuition is simple: if the economy runs an interest-rate policy leaning against the wind of the anchor country, the subsequent flow of interest-sensitive financial capital will impact upon the supply of the liquidity, which in turn, reverses the policy-generated monetary stance.

But what if the monetary policy is *demand driven*? Just imagine that the central bank is going to write a prescription of expansionary monetary stance. A monetary expansion implies that money supply exceeds the demand for money. To do so, at the *constant* stock of reserves, the central bank shall lower the interest rate paid on the bank reserves[2]. By doing so, it will instantaneously determine the overnight inter-bank rate (see Goodfriend (2001) for detailed descriptions)

The overnight inter-bank rate will, in turn, govern the yield on deposits, and, at the given cost of intermediation, the rate of lending. In short, the return on bank reserves has steadily established as an anchor for nominal interest rates from inter-bank rate to lending and deposit rates (simply the two most important relative prices to the firms and households in developing countries that heavily depend upon bank loans and deposits as sources of, respectively, financing and saving).

Obviously, the open market operation has ceased to support the interest-rate determination. One no longer needs open market purchase to generate a fall in interest rate and inject liquidity into the system. Open market operation is therefore *decoupled* from interest rate setting to become an independent policy instrument to undertake other macroeconomic goal. As a result, monetary policy comprises *two independent* policy tools

As more informative readers may wonder the impact on the yield on treasury bills, the most discussed market interest rate that affects the flow of financial capital. Changes in the return on bank reserves trigger assets portfolio adjustments by banks and investors to take the arbitrage advantages: for the former reserves are to be decumulated in favor of higher-yielding treasury bills; for the latter deposits will be exchanged for treasury bills. What follows on will be a higher price of, and so a lower yield on bills, which, in turn, becomes a driving factor of capital withdrawal.

The upshot of capital withdrawal is well known: it reduces the money stocks in tandem with the depletion of foreign reserves, invalidating the desired expansionary monetary stance. Be reminded, however, that this is the story of supply-driven monetary operation. Episode for demand-driven monetary operation can be different.

There is no secret that to forestall any changes in the price one needs equilibrium in supply and demand. In other words, once the central bank could increase the supply of treasury bills to equilibrate the market, the market interest rate will be stabilized, burying the reasons for capital efflux. Financial stability is therefore secured.

But we know that open market sale is restrictive; 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.

Also, note that this is how we maintain our assumption of *constant money supply*. There is no room for exogenous monetary injection through domestic credit creations, which, in other words, implies that no net flow but only compositional effect is involved. The money supply is totally a reflection of the foreign reserve account. This accommodative nature of money supply carries two implications: first, the automatic adjustment mechanism critical to the credibility and sustainability of fixed exchange rate is preserved amid the activist interest rate policy; second, the expansionary stance is achieved through the hastened velocity of circulation triggered by the lower yield on bank reserves.

Lastly, let us consider the situation of carry trade. As a matter of fact, the cheap money due to lower borrowing cost available in the money market that can be invested in higher-yielding treasury bills will induce the financial capital to flow in for lucrative arbitrage. The strategy of swap in domestic credits, nonetheless, is flexible enough to confront the hot money if it is thought to be too much: just stop the open market sale. The excess demand over the supply shall contribute to a fall in market interest rate, cooling down the speculative activities. Financial stability, again, is sheltered.

Above all, the dual demand driven monetary policy is defined as a policy that comprises two autonomous instruments to, respectively and concurrently, serve two different economic problems: real economy, and banking and financial stability.

3. The Model

Consider a small open production economy endowed with perfect foresight. The only input of production available is capital. The capital will depreciate totally at each and every period-end, which means that no capital accumulation in this model. The capital is therefore in the form of working capital. The production function with CES technology can be expressed as follows:

$$y_t = Ak_t^{\alpha} \tag{1}$$

where y_t = real output at period t

A = productivity factor

k_t = working capital at period t.

The economy comprises two representative agents: firm and bank. Firm carries the function as producer of non-storable tradable goods, bank bears the traditional roles as financial intermediaries and liquidity creator, central bank deserves the task of taking care the real sector and financial stability. The world is imperfect, as will be clear later, in the sense that firm is credit- and collateral-in-advance constrained in investing while bank is net-worth-in-advance constrained in lending.

The goods and asset markets are well integrated into the rest of the world. In this vein, the purchasing power parity should hold *ex ante*:

$$S_t = P_t \tag{2}$$

where S_t = the nominal exchange rate at period t, defined as the relative price of domestic currency

P_t = domestic price level at period t

P_t^* = foreign price level, normalized at unity.

Follow Aghion et al. (2000, 2001, 2003), the purchasing power parity won't hold *ex post* once the unanticipated shock occurs due to the price rigidities. Unlike theirs, however, where the disparity always causes nominal depreciation, in this model the yield on bank reserves – another important relative prices – will take over the burden of adjustment.

The capital moves freely across the sovereign borders, thereby validating the uncovered interest parity condition:

$$1 + i_t = (1 + i^*)\frac{S_{t+1}^e}{S_t} \tag{3}$$

where i_t = domestic nominal market interest rate (the yield on treasury bills)

i^* = time-invariant foreign interest rate

S^e_{t+1} = expected level of exchange rate at period *t+1*

$\frac{S^e_{t+1}}{S_t}$ = expected rate of depreciation.

3.1. Time Sequence of Events: from Sudden Stop to Speculative Attacks

Although the model presumes an infinite horizon, attentions are only given to two periods: *t* and *t+1*. At the beginning of period *t*, the firm sets its prices that last for the entire period while central bank fixes the level of nominal exchange rate. Only come to $t+1$ the price level will adjust to the past and the expected future. Based on the given S_t and P_t, the firm and bank decide how much to borrow and to invest. Other relative prices, specifically the policy interest rates, are free to adjust throughout the period. The sudden stop occurs at period *t* after all the price settings took place, but the outright currency speculative attack will only take place at period *t+1*. The phase between *t* and *t+1* then becomes a period of adjustment to the capital reversal that determines the likelihood of currency crash.

To explicitly measure the pressure of speculative attack on domestic currency, we have the following function:

$$X = \gamma \frac{S^e_{t+1}}{S_t} \qquad (4)$$

where $\gamma > 0$, and *X* represents the intensity of attack on the domestic currency. Clearly, the intensity of attack will build up as the expected depreciation pressure on S_{t+1} is mounting, which, in turn, will make S_t untenable. Any adjustment during *t* and *t+1*, therefore, must be able to moderate if not eliminate the condition where $S^e_{t+1} > S_t$.

3.2. Resource Constrained Firm

As in Aghion et al. (2000, 2001, 2003), the firm uses its own wealth (*w*) and funds borrowed from bank (*l*) to invest in working capital, $k_t = w_t + l_t$. The firm can borrow either in domestic currency at the prevailing domestic lending rate, or (and) in foreign currency at world rate at the beginning of each period. The total real debt in domestic goods is, therefore, $l_t = l^d_t + \frac{S_t}{P_t} l^*_t$.

Two notes are worthy to raise here: first, given the amount of foreign debt, real depreciation, either via nominal depreciation or fall in domestic price, augments the total domestic-currency value of debt, $l_t = l(s_t)$ where $l' > 0$. Since the firm is credit-constrained in production, the real depreciation that slackens the constraint increases the level of output. This is to capture the traditional effect of real depreciation on output, namely, depreciation makes the exports more competitive, stimulating an expansion in productions.

Second, the firm is often bound to borrow abroad particularly when the economy is in boom. This can be easily shown by multiplying both sides of the uncovered interest rate parity with P_t / P^e_{t+1} , the *forward-looking* domestic real interest rate will be equivalent to foreign real interest rate and the real expected depreciation:

$$1 + r_t = (1 + i^*) \times \frac{S_{t+1}^e}{S_t} \times \frac{P_t}{P_{t+1}^e} \quad (5)$$

In a booming economy with higher expected price level in the future, the relatively higher domestic real interest rate makes cost-saving foreign debt – as far the peg is expected to be sustainable in *t+1* – a more attractive option. *Put it differently, if the price level is expected to adjust downward due to greater production at t+1, the expected real depreciation that lowers the domestic cost of capital will induce the firm to tilt the composition of debt away from short term foreign debt.* In this vein, any policy – in our case the lower return on bank reserves – that could trigger this kind of positive effect is vital for adjustment to eliminate *X*.

In an imperfect capital market, the firm's ability to borrow is net-worth constrained:

$$l_t \leq \psi w_t \quad (6)$$

where ψ denotes the multiplier.

In other words, the net worth will serve as the collateral to the loans. Higher is the value of net worth, greater will be the amount of loan approved.

Putting equation (6) into (1) with the facts that $k_t = w_t + l_t$ and $l_t = l(s_t)$, the production function becomes

$$y_t(s_t) = A\left(\Phi l(s_t)\right)^\alpha \quad (7)$$

where $\Phi = \frac{1+\psi}{\psi}$.

The nominal revenue net of the burden of debt (in domestic currency value) is the profit assumed to be retained completely as collateral to the borrowing at *t+1*. Accordingly, we have the following equations:

$$\pi_t = P_t\, y_t - (1 + i_t^l) P_t\, l_t^d - (1 + i^*) S_t\, l_t^* \quad (8)$$

$$w_{t+1} = \frac{\pi_t}{P_t} \quad (9)$$

The firm maximizes (8) subject to (7). The optimal borrowing decision is given by

$$\alpha \left[\frac{1}{l_t}\right]^{1-\alpha} = \Phi^{-\alpha} \frac{1}{A}\left(1 + i_t^l + (1 + i^*)\frac{S_t}{P_t}\right) \quad (10)$$

Higher lending rate and nominal depreciation at t depress the firm's willingness and ability to demand for credit.

With equation (6)-(9), the output at $t+1$ is given by

$$y_{t+1} = A\left[\Phi\{y(s_t) - (1+i_t^l)l_t^d - (1+i^*)\frac{S_t}{P_t}l_t^*\}\right]^\alpha \tag{11}$$

Equation (11) implies that

1) History matters. Even temporary shocks on current output could have permanent effect lasting to the next period.
2) Whether devaluation is expansionary or contractionary depends on its relative impact on the output and the burden of foreign debt.
3) Return on bank reserves, and so the lending rate at current period could positively impact upon the next period production. In short, interest rate policy could have long-lasting supply effect.

3.3. Net-worth Constrained Banking System

Domestic banks are presupposed not to grant foreign currency denominated loan, but accept foreign currency denominated deposits so as to highlight the currency mismatch problem in banking system. Bank invests part and parcel of the funds in higher-yielding credits. But, at the same time, bank also acquires bank reserves and short-term treasury bills which can be converted into cash easily at no expense of its value to save on the costly disruption in lending activities that will undermine the bank's net worth once any liquidity needs arise for, among others, deposit runs. Equation (12) shows bank's net worth:

$$a_t = l_t^s + h_t + b_t - d_t^d - \frac{S_t}{P_t}d_t^* \tag{12}$$

where l_t^s = supply of credits in period t.

h_t = bank reserves in period t.

b_t = treasury bills in period t.

d_t^d = domestic deposits of the privates and central bank in period t.

d_t^* = foreign currency denominated deposits at period t.

Of bank reserves and treasury bills, which is preferable? Let γ be the proportion of liquid assets to fixed assets at each period, and assume a constant elasticity of substitution between bank reserves and treasury bills, the optimal holdings of bank reserves in the portfolio of liquid assets is determined by the its relative returns against the treasury bills

$$\max_h \left\{i_t^r h_t + i_t b_t\right\} \text{ such that } h_t^\sigma + b_t^\sigma = \gamma l_t^\sigma .$$

The optimal demand for reserves is therefore given by the first order condition:

$$h_t = \left[\frac{1}{\lambda\sigma} \times i_t^r \right]^{\frac{1}{\sigma-1}} \tag{13}$$

Equation (13) shows that the demand for reserves rises or falls with its yield.

Like firm, bank's ability to lend is conditional on its net worth, $l_t \leq a_t$ (see Stiglitz and Greenwald (2003)). Each period of net worth in turn depends on the previous net profit in real terms, $a_{t+1} = \frac{\Omega_t}{P_t}$. The bank goes bankrupt if the net worth turns negative. Given the non-trivial role of lending, we may write the bankruptcy as a function of level of lending:

$$v_t = v(l_t), \text{ where } v' < 0, v'' > 0.$$

We know that poor performance of lending may contribute to dire profits that could depress the next period's net worth and lending activities, which, in turn, contribute to more dreadful profits necessary for the successive periods' net worth and lending that unavoidably contribute to the higher probability of bankruptcy. Accordingly, there exists a critical level of lending $\hat{v}$ such that the bank goes bankrupt if $v \leq \hat{v}$.

Banks lend to firms at nominal lending interest rate, i_t^l. Banks will encounter two conditions in collecting the debt, that is, full loans with interest or default with probability ρ and $1-\rho$ respectively. For the latter, bank will sell off the collateral (debtor's current-period profit) at a discount to recover the loss. Coupled with the fact that auction is costly, the bank may only get a proportion $1-\psi$ of the firm's net profits. The expected returns on lending is given by

$$ER(i_t^l, l_t^s) = \rho(1+i_t^l)P_t\, l_t^s + (1-\rho)(1-\psi)P_t\, w_{t+1}.$$

The bank maximizes the profit by maximizing the expected returns on assets net of the costs of source of funds:

$$\max_{l} \sum_{t=1}^{2} \beta_t \Omega_t \equiv ER(i_t^l, l_t) + (1+i_t^r)h_t + (1+i_t)b_t - (1+i_t^{ad})d_t + cv(l_t) \tag{14}$$

where $\beta = \frac{1}{1+i_t}$, $d_t = d_t^d + d_t^*$. i_t^{ad} denotes the weighted average of the cost of deposits, $\phi(1+i_t^d)P_t\, d_t + (1-\phi)(1+i^*)S_t\, d_t^*$.

As mentioned that bankruptcy is costly, the last term in (14) is to capture the fact that bank internalizes the cost of bankruptcy to obtain an optimal decision of lending. Below shows the necessary and sufficient condition of optimal supply of credits:

$$i_t^l = \frac{1}{\rho P_t}(-cv') + i_t^{ad} \tag{15}$$

When $i_t^l > \frac{1}{\rho P_t}(-cv') + i_t^{ad}$, it implies that the credits are simply oversupplied, or, simply, the lending is too high, thereby put the bank at the risk of bankruptcy. To avoid so, the bank has to curb its lending to the firms. Conversely, a relative low rate of lending will prompt the bank to advance more loans into the system.

3.4. Monetary Policy

Without loss of generality, money is assumed to be in the form of interest-bearing deposit accounts. Then, the relationship between money and base money (bank reserves) is $d_t^d = \mu_t h_t$, where μ_t refers to the time-variant money multiplier.

It is widely acknowledged that external convertibility is an important backbone to the credibility and sustainability of a fixed exchange rates regime. But as Williamson (2000) has observed, "foreign reserves at least the size of base money is not sufficient to cover all potential demands in the event of a catastrophic loss of confidence that results in capital flight." Central bank in this model, therefore, has the following balance sheet to make all the deposits convertible:

$$\frac{S_t}{P_t} f_t + dc_t \equiv \mu_t h_t .$$

Quantitative policy in dual demand driven monetary strategy is completely endogenous to the flow of foreign reserves. At the *constant* stock of bank reserves, the liquidity available in the market rises with the accumulation of foreign reserves. Central bank does not exogenously inject liquidity into the market through domestic credit creation. In other words, we have gross domestic credit creation equals to unity, $\frac{dc_{t+1}}{dc_t} = 1$. For that reason we have the evolution of central bank's balance sheet over time as follows:

$$S_{t+1}^e = P_{t+1} \times \frac{\mu_{t+1}}{\mu_t} \times \frac{f_t}{f_{t+1}} \tag{16}$$

If there is a capital flight where $f_{t+1} < f_t$, to attain and strengthen the desired level of nominal exchange rates at period *t+1* such that $S_{t+1}^e = \overline{S}_t$ one needs to allow the liquidity in the banking system to contract in parallel such that $\mu_{t+1} < \mu_t$.

One has two ways for the adjustment mechanism to take place. First is the conventional adjustment mechanism where the contraction in deposits will transmit into the credit crunch, thereby leading to a *fall in demand* that push the price level downward to obtain real depreciation. But as ample evidences have shown, this approach could be very ineffective yet destructive. Real depreciation is often obtained through outright nominal depreciation that proves to be catastrophic to the liability-dollarized developing countries.

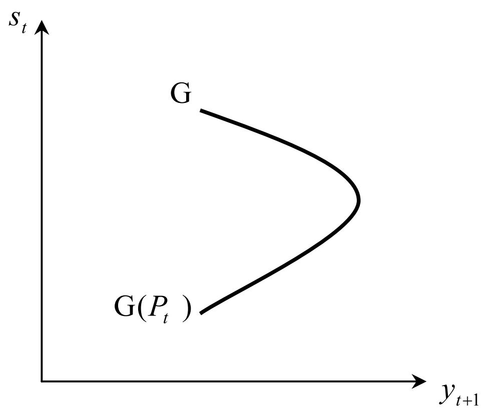
Central bank that operates dual demand driven monetary policy that owns two independent instruments will employ open market *forward* purchase to stabilize the credit markets by allowing the deposits run without interrupting banks' ability to supply the credits to firms. Instead of contracting the demand, the central bank will lower the yield on bank reserves to stimulate the production. The *increase in supply* of goods shall contribute to a decline in price, and thus the real depreciation.

Fundamentally, supply driven monetary policy works through the demand side, demand driven monetary policy, however, works through the supply side.

4. General Equilibrium in Diagrammatic Analysis

We have brought thus far three markets into the model: the goods market, the credit markets, and the asset and money markets. Equation (11) shows the goods market condition with respect to real exchange rates, as depicted in Figure I.

Figure 1: Real Sector



The slope of GG curve is given by:

$$\frac{dy_{t+1}}{ds_t} = \alpha A(\Phi l_t)^{\alpha-1}[y_s - (1+i^*)l_t^*].$$

It is obvious that in "a-original sin" economy where $l_t^* = 0$ the GG curve slopes upward from left to right as $\partial y/\partial s > 0$. A liability-dollarized private sector will have a GG curve that slopes downward from left to right since depreciation balloons the burden of foreign debt than the elasticity effect on export.

Credit market equilibrates when $l^s = l^d$. By taking the bank's net worth constraint and $a_{t+1} = \frac{\Omega_t}{P_t}$ into account, the credit market condition with respect to the future output and current real exchange rate is

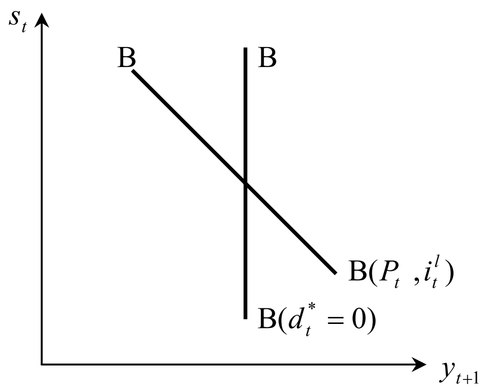
$$y_{t+1} = A\left(\Phi\left\{ER\left(i_t^l, l_t\right) + (1+i_t^r)h_t + (1+i_t)b_t - (1+i_t^d)d_t^d - (1+i^*)\frac{S_t}{P_t}d_t^* + cv\left(l_t\right)\right\}\right)^\alpha \quad (17)$$

with the slope as

$$\frac{dy_{t+1}}{ds_t} = \alpha A(\Phi l_t^s)^{\alpha-1}[-(1+i^*)d_t^*].$$

As illustrated in Figure 2, the BB curve is vertical if the banking system is robust where $d_t^* = 0$, but slopes downward from left to right if it suffers currency mismatch.

Figure 2: Banking system



The asset and money market equilibrate, respectively, when equation (3) and $M_t^s = P_t\ m_t^d$ hold. Let the linear money demand function be $m_t^d = \beta_y y_t + \beta_{i^r} i_t^r - \beta_i\ i_t$, the money market equilibrium that fulfills the uncovered interest parity condition with respect to prospective output and current real exchange rate is given by

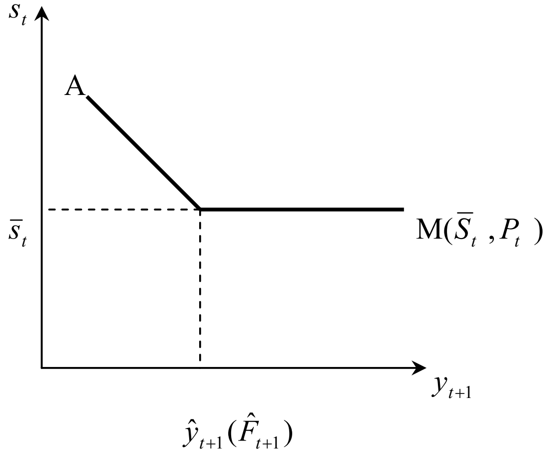
$$P_t\ s_t = \frac{1+i^*}{1+i_t} \times s_{t+1}^e \times \frac{M_{t+1}^s}{\beta_y y_{t+1} + \beta_{i^r} i_{t+1}^r - \beta_i\ i_{t+1}} \qquad (18)$$

The slope of AM curve is thus

$$\frac{dy_{t+1}}{ds_t} = -\frac{1+i^*}{1+i_t} \times \frac{s_{t+1}^e}{\bar{S}_t} \times M_{t+1}^s.$$

Depicted in Figure 3, if the foreign reserves at *t+1*, as mirrored by the corresponding money supply, are large enough, the AM curve is horizontal. But once the foreign reserves depletes approaching the critical level, $\hat{f}_{t+1}$, the peg, $\bar{S}_t$, is at risk. The AM curve will then slopes upward from right to left for any $f_{t+1} < \hat{f}_{t+1}$.

Figure 3: Asset-Money Market



General equilibrium is attained when all the markets are in equilibrium. Graphically, general equilibrium is defined as the intersections of GG, BB, and AM curves simultaneously.

5. High Interest Rate to Defend the Peg

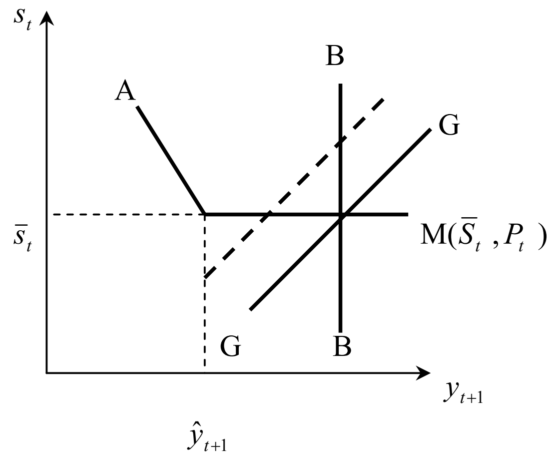
High interest rate policy to deter capital withdrawal so as to defend the peg is widely condemned. For example, the often cited Radelet and Sachs (1998) argue that "the economic fundamental weaknesses of Asian economies *per se* are not sufficient to wreak the havoc, which indeed, was the unnecessary consequence of poor policy response, particularly the high interest rate policy."

Is high interest rate necessary and sufficient to rebuild the confidence of foreign investor on domestic currency and, hence, the peg? Or, is the high interest rate simply a smoke screen behind which the fundamentals is decisive? Let us scrutinize its effectiveness under three different scenarios.

5.1 "Normal" Economy

The economy is normal when there is no currency mismatch. Firms do not borrow in foreign loans, and banks do not accept foreign currency denominated deposits. The equilibrium is then shown in Figure 4.

Figure 4: Normal Economy

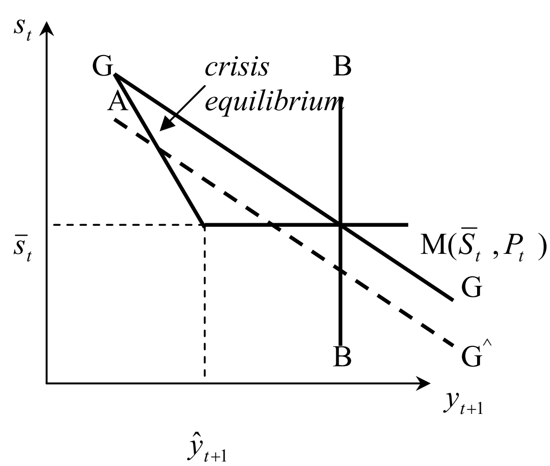


There is a *unique* equilibrium where all the curves intersect. The effect of tightened interest rate policy on output is temporary: although interest rate screws up and credits contracts initially due to capital withdrawal, the high interest rate should have deterred capital outflow, encouraged fresh inflow of capital, thereby reviving the credit availability. There is no permanent damaging effect on output in next period. The peg, of course, is credibly sustained.

5.2. Economy with Liability-dollarised Firms but Solid Banking System

Figure 5 depicted the conditions where the economy is partially dollarised. The unpleasant effect of high interest rate on output, again, is observably temporary: although high interest rate may hurt individual firms dependent upon domestic loans, solid banking system shall be able to go though the storms without cutting back loan advances. The ensuing induced capital influx that augments the market's liquidity that leads to a fall in interest rate should cease the pain on aggregate, bringing the economy back to the initial equilibrium.

Figure 5: Partially Liability-Dollarised Economy



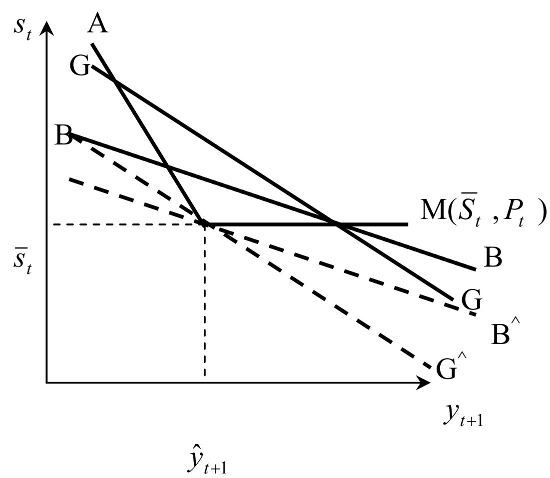
Notably, there exist *multiple* equilibriums: "crisis" and "normal" equilibriums. As long as the banking system remains robust in the sense that the banks are willing to advance loans amid high interest rate and are not dollarised such that the BB curve intersects with GG and AM curves at crisis equilibrium, the "normal" equilibrium should be attained with sustainable peg.

5.3. Full Scale Liability-Dollarised Economy

The most fragile condition is definitely attributed to full scale liability dollarised economy, that is, currency mismatch occurs in both real sector and banking system. Figure 6 demonstrates this fragility with the negatively sloped BB curve flatter than the corresponding GG curve as

$$\frac{y_s}{1+i^*} - (1+i^*)l_t^* < -(1+i^*)d_t^* .$$

Figure 6: Full Scale Currency Mismatch



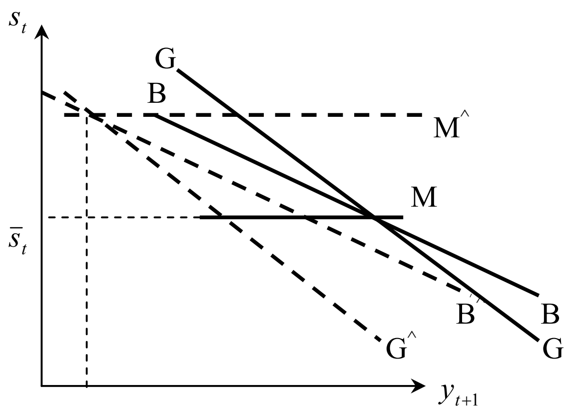
Is the effect of high interest rate still temporary? The best answer is – highly skeptical. Fragile banks are not able to extend more loans to firms given the rise in interest rate, or otherwise, will go bankrupt. Thanks to the contraction in lending coupled with high interest rate, the ensuing financial disintermediation, depicted as a shift of BB to B^B^, will no doubt derange further the domestic-financing business activity (a greater shift from GG to G^G^). In such an environment it is dubious to say that the confidence of investor over domestic currency (economy) and peg's sustainability can be easily regained through higher interest rate. Probably Kindleberger (1996) provides the best description:

"…with *elastic expectations of change* – of falling prices, bankruptcies, or depreciation – raising the discount rate may suggest to foreigners the need to take more funds out rather than bring new funds in."

Once the foreign reserves has vanished thanks to the continuous capital withdrawal to the level that $f_{t+1} < \hat{f}_{t+1}$, speculative attack will come in, guaranteeing a nominal depreciation that effortlessly drives the economy into crashes and recession.

The most disastrous policy mix is what had been done during the Asian financial crises: high interest rate amid a free fall in exchange rate. While depreciation has been destroying the external-financing firms, increasing the interest rate with the *hope not certainty* that it may increase the attractiveness of holding domestic currency is alike to putting salts on the wounds. The subsequent complete output collapse will have its long lasting effect on prospective production. Figure 7 illustrates this outcome.

Figure 7: The Worst Policy Combination



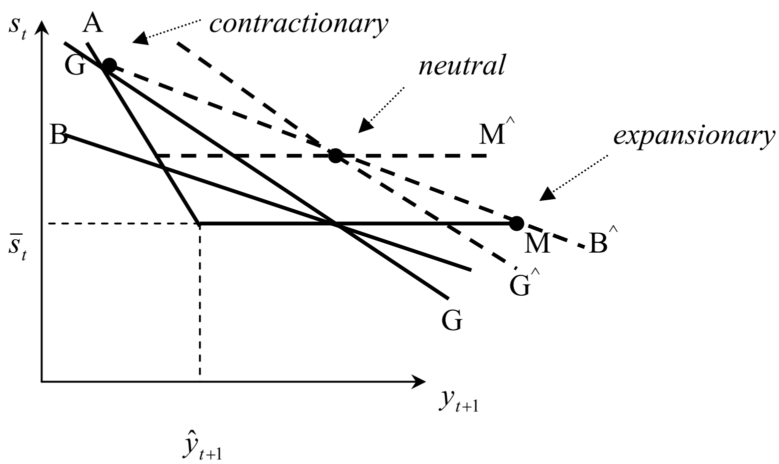
6. Low Interest Rate and Devaluation

In the line of thought of this model, Stiglitz and Greenwald (2003) correctly asserts that "…the central mistake of the IMF – beyond failing to recognize that high interest rates increase the probability of default and thereby increase the flow of capital out of the country, rather than entice a flow of capital into the country – was that their programs failed to realize the importance of trying to preserve the credit system."

Proof of one's fault, however, needs not automatically validate other's correctness. To what extent the Stiglitz-style prescription – low interest rate and devaluation – is effective not to bring about a recession?

Figure 8 exhibits the possible results of expansionary monetary policy. Obviously, there are *multiple unique* equilibriums. Even though capital reversal may cause a run on foreign deposits, the devaluation may stabilize the flow of capital out of the countries, not to speak that devaluation increases the domestic currency value of the foreign deposits. Combined with the fact that lower lending rate moderates the probability of default, banks are, therefore, more willing to lend in order to maintain a positive net worth. Accordingly, the BB curve moves outward to G^G^.

Figure 8: Low Interest Rate and Devaluation



Conditional on the relative impact of devaluation on the real sector, the outcomes of expansionary monetary policy are far from certain. At best, the elasticity effect of devaluation and lower rate of lending, together, perform a good show such that current production is significantly bolstered with a stabilized exchange rate, which, in turn, leads to brighter prospective output performance. At worst, the balance sheet effect could dominate all other expansionary effect of the policy, resulting in overshooting exchange rates and severe recession. In between, the policy causes depreciation at no impact on the prospective output.

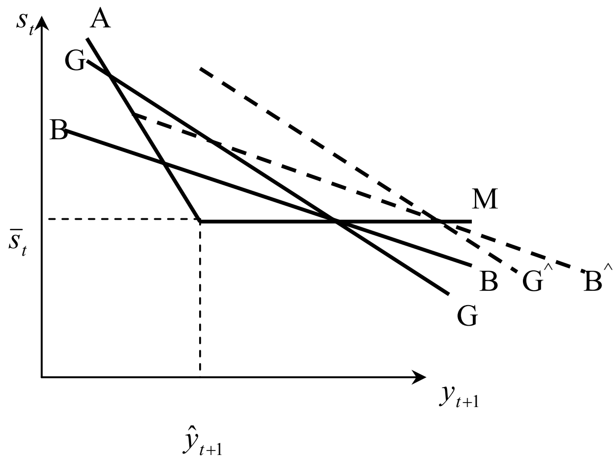
Undoubtedly, Stiglitz-style prescription of lower interest rate and devaluation seems preferable to other strong medicines, particularly the one that requires high interest rate during currency crashes, despite the fact that the outcome could turn out to be as disastrous as the others. It is easy to show that the policy can produce positive effect to the prospective output with *certainty* if and only if the banking system is *robust* since a more resilient banking system is in better position to absorb new liabilities, to advance more credits, and to enhance the investors' confidence on domestic currency. In retrospect to those Asian economies that heavily incurred in foreign debts with weak banking systems that had bundles of bad loans, not to speak the J-curve effect of devaluation on export, this prescription is at most the second best solution.

7. Lower Return on Bank Reserves and Open Market Forward Purchase

The natural question to ask, then, is: what is the first best solution?

The first best solution must be able to firmly uphold the external convertibility so as to credibly fix the peg while, at the same time, stimulating the economy between the period *t* and *t+1* such that S^e_{t+1} is low enough for any profitable speculative attack. In this vein, this paper proposes a monetary strategy that simultaneously lowers the return on bank reserves for the sake of real economy, and mounts the open market *forward* purchase, a role similar to the lender of last resort, to stabilize the financial markets, as depicted in Figure 9.

Figure 9: Lower Yield on Bank Reserves and Open Market Forward Purchase



As we know that an initial reduction in foreign reserves due to capital flow reversal will impact correspondingly upon the money supply in the markets. To prevent the costly interruptions in lending, banks will cash in the liquid assets to compensate for the run in deposits. But the stocks of liquid assets owned are always limited. At the end the banks will have no options but to cutback the lending.

Central bank could help avoid this sad story with interventions in the money market. The central bank could forward purchase its reserves that match the forward sales of the banks. By entering such a forward contract, the central bank implicitly supplies domestic currency credit to the banks that helps to cushion the impact of deposits run.

The advantages of open market forward purchase are obvious:

1) Since both parties could enter a forward contract repeatedly, the money supply could then always correspond to the flow of foreign capital without interrupting the banks' lending.

2) Providing that the banks as short seller at t are obligated to purchase and deliver the reserves to the central bank on the value date of the forward contract at $t+1$, h_{t+1} remains equal to h_t. In other words, the central bank still commit to the rule of no exogenous liquidity injection via domestic credit creation.

With the rigid P_t and so s_t, the return on bank reserves will bear the burden of adjustment. A lower i_t^r that leads to an equivalent decline in i_t^l contributes to a greater discount value of prospective revenue. Reduction in the burden of debt service improves current profits, and, hence, enhances the value of collateral for production in next period. A buoyant prospect of y_{t+1} increases m_{t+1}^d, which, in turn, thanks to the arbitrage, should have stimulated m_t^d. This force is strongly believed to be able to forestall if not reverse the outflow of capital.

More important, strong demand for domestic currency at $t+1$ due to greater y_{t+1} signals a fall in the price level at $t+1$. Lower P_{t+1}^e implies real depreciation. Besides encouraging exports, both of lower lending rate and expected real depreciation facilitate the necessary adjustment toward a more resilient economy by tilting the composition of debts away from the foreign financing. Graphically, both of the GG and BB curves will move outward to $G^{\wedge}G^{\wedge}$ and $B^{\wedge}B^{\wedge}$ along the AM curve. $\overline{S}_t$ is sustained with greater y_{t+1}.

8. Conclusion

This paper develops a simple intertemporal optimizing model with focus on the periods between capital flow reversal and speculative attack, and employs diagrammatic methods to analyze the implications of various different interest rate policies. We find a financially robust economy is universally critical to the effectiveness of any policy stances. There are sunspot equilibriums in both of the contractionary and expansionary interest rate policy that may lead to the vicious spiral of currency crashes, credit crunch, and output collapse. Worst, high interest rate amid exchange rate overshooting that surely destroys the whole system is indeed an unwise policy proposal. Dual demand driven monetary policy has demonstrated its superiority in this manner. Without compromising to the credibility of fixed exchange rates, and not incompatible to the banks' willingness to lend, the central bank plays the role of lender of last resort via open market forward purchase to help the banking system sail through the sudden stop of capital flow. The lower yield on bank reserves bolsters the prospective output that initiates greater demand for money, and thereby enticing the flow of capital into the countries. The resultant real depreciation should do the adjustment that builds a stronger economy.

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Endnotes

[1] Formerly dubbed as "two-stage demand driven monetary policy" in Wong (2004b).

[2] Up to date, the legally required bank reserves in most of the countries are non-interest bearing. To implement the suggested monetary operation, the prerequisite is, of course, to compensate the holding of bank reserves so that it becomes an asset rather than opportunity cost. The demand for reserves is, hence, policy induced instead of legally enforced. The yield could then be used as policy instrument