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Time Consistency of Monetary Policy in Separating Exchange Markets

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Though a dual exchange rate system might be a preferable intermediate step from a fixed to a flexible rate, the efficiency of such a regime depends on the complete separation between two markets. When government reneges on its announcement and changes the commercial rate, the time inconsistency of monetary policy arises. This event might result in incomplete separation, the instability of spread and hence the erosion of this management. This paper attempts to investigate the role of credibility in such a regime. It concludes that, for successfully separating exchange markets, government should fix the commercial exchange rate rather than change it.

I. Introduction

Various international monetary regimes organizing international currency transactions have emerged since the breakdown of the Bretton Woods System in the early 1970s. In particular, since May 1997, monetary crisis has hit hard most South and East Asian countries, in addition to the standard exchange rate regimes, fixed and flexible, other intermediate forms of exchange rate management need to be re-investigated. The question that naturally arises among these alternatives, what is the best exchange rate system? Obviously, if there were an exact answer to this question, all nations would adopt the same exchange rate regime. Unfortunately, there is no simple answer.

The greater the international crisis, like Asian financial crisis, the stronger the need for action. But since that is complicated, it is far easier for the experts to get together and discuss. In many ways, the crisis erupted because countries that suddenly opened up to foreign capital were not prepared to handle these new flows. A consequence of the greatly increased exchange rate volatility has been a parallel increase in policy discussions for exchange controls. Among Asia turmoil, People's Republic of China is the least affected one. Experts attributed it to the success of adopting two-tier exchange markets. Malaysia thus separated exchange markets to avoid transitory shocks in the financial exchange market affecting the current account, and hence the real economy. It allowed flexibility in setting domestic monetary targets.

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The potentially harmful effects of volatile capital movements provide a strong argument for conducting transactions of current account and capital accounts at different exchange rates; that is, for conducting a two-tier or dual exchange rate system. The central purpose of this paper is to consider analytically such a regime which has been used by many countries in the last two and half decades. It is expected to combine some of the advantages of both fixed exchange rate (generally for the current account) and flexible exchange rate (for the capital account) and to reduce somewhat the harmful impact of the two polar alternatives. By fixing the exchange rate for the current account, the impact of volatility and uncertainty for the domestic real economy and the trade balance is sought to be reduced or eliminated. Having flexible exchange rates for the capital account, some independence of monetary policy can be preserved with the domestic interest rate (and the inflation rate) having the ability to diverge from world rates. Hence, the monetary authorities can pursue a 'relatively' independent monetary policy in response to shocks and attempt to stabilize the economy when there are business cycles.

Though a dual exchange rate system might be a preferable intermediate step from a fixed exchange rate to a flexible rate, the efficiency of such a regime depends on the complete separation between two markets (as represented by the current and capital accounts), the stability of the spread between two rates (commercial and financial rates) and the credibility of the government. When government breaks its announcement and changes the commercial rate, the time inconsistency of monetary policy arises. These events might result in incomplete separation, the instability of the spread and hence the erosion of this management.

The concepts of credibility and the particular example known as the "time-consistency problem" in macroeconomics has been addressed over the last two decades. This problem was first noted by Kydland and Prescott (1977) who showed that optimal macroeconomic policies could well be time inconsistent and argued for rules rather than discretion. The model of reputation was applied to monetary policy for the first time by Barro and Gorden (1983). Grossman and van Huyck (1986) and Barro (1983) applied it to the decision about inflation tax. The majority of studies - see Persson (1988) for a survey - have focused on the trade off between the rate of inflation and the level of employment or output in a closed economy because there are a number of conflicts in decisions between the government and economic agents. However, previous studies paid little attention to the role of credibility for the effects of a change in the exchange rate policy. Horn and Persson (1985) examined the interplay between wage setting and the exchange rate policy and found that a change in the exchange rate system is probably made to eliminate inflation in the beginning of an election period.

Among the demonstrations for the effects of reputation on the exchange rate policies, none of them has looked at the time consistency consideration of dual exchange rate management. This paper attempts to investigate the role of credibility in such a regime. It focuses on time-consistency issues rather than on characterizing the optimal policy. We shall show that, with successfully separating exchange markets, government should fix the commercial exchange rate rather than change it.

According to annual International Financial Statistics, there are not only developing but also developed countries engaging in two-tier exchange rate practice. Most of them (for example, Latin American countries) have inflationary pressure. Given a need for disinflation, exchange rate policies should be designed across all phases of the disinflation experience. On the other hand, de Haan, Knot and Sturm (1993) found that a credible exchange rate policy could reduce the costs of disinflation policies. Razin, Yuen, and Prakash (1997) also demonstrated that some of the disinflation episodes in developing countries were associated with relatively small output losses. Especially, capital controls significantly improve the sacrifice ratio of the output-inflation tradeoff. We then assume that governments have incentives to appreciate the commercial rate for remedying inflation during a period of turbulence under a two-tier exchange rate system. However, our analytical results could be applied to commercial depreciation cases.

The discussion is organized as follows. Section II describes the nature of the dual exchange rate regime. Section III deals with the credibility of monetary policy. Section IV draws some conclusions.

II. The Nature of the Dual Exchange Rate System

The general assumptions about the domestic economy, a small open economy, adopting separate exchange markets will be given as follows. The government operates a dual exchange rate system by fixing the foreign bonds held by the private sector at a particular volume. There exist two exchange rates: a market-determined rate for capital account transactions called a financial exchange rate and an official rate for current account transactions called a commercial exchange rate. Both rates are expressed as the price of foreign currency in terms of home currency.

The home price level equals the domestic currency value of the foreign price level which is assumed constant and is equal to one, implying that the commercial exchange rate, E, is also a measure of home price. In other words, domestic inflation (disinflation) is equivalent to commercial exchange rate depreciation (appreciation). Here we assume that the unpredictable change of spread stems from unexpected commercial depreciation (appreciation) conducted by the government.[1] The small open economy has two sectors: one is the private sector and the other is consolidated public sector. We shall use the terms 'government' and 'monetary authority' interchangeably to present the public sector. There is a large, but fixed, number of identical consumers. We normalize the mass of these consumers to unity.

The time-consistency problem of separating exchange market arrangement arises from the following source. When government sets the commercial exchange rate, consumers trust that the monetary authority will maintain it. The single agent then chooses the financial exchange rate, which in turn determines both the price of foreign bonds and the spread between two rates. Once government breaks its announcement, however, actual spread above the anticipated level by appreciating commercial rate will erode the balance of trade. The

1. We shall show below that government's policy switches of officially appreciating will success only once. The financial exchange rate will adjust downward when time inconsistency occurs and the spread will return to be a constant. Precisely, it is regarded as revaluating rather than appreciating.

monetary authority trades the unfavorable balance of trade against the benefit of exchange revenue that results from bigger spread.

To understand the nature of dual exchange markets, we describe the timing of setting up for two rates as follows:

(1) the monetary authority sets commercial exchange rate at E_t;

(2) consumers observe E_t and then choose financial exchange rate, X_{t+1}, which in turn determines the spread, $X_{t+1} - E_t$, say, x_{t+1}.

Where the subscripts, t and $t+1$ represent the current period and the next period, respectively. Because of the assumption that the change of spread only results from unpredictable appreciation or depreciation of commercial exchange rate, the single agent will fix the financial exchange after government sets the commercial exchange rate. For fixed financial exchange rate, the government could gain by choosing a bigger value of spread; that is, it could gain by choosing a smaller value of commercial exchange rate by deviating from a commercial rate target once announced.[2] In other words, with promise where the government chooses commercial exchange rate and fixes it, a single agent trust the government and chooses the financial exchange rate. The spread is $x_{t+1} = x^*$. However, this is not a credible decision in that the government could gain by choosing a bigger value of x_{t+2}, the spread of next two periods, being carried out by appreciating commercial exchange rate. The variable of interest is thus the rate of unexpected appreciation of commercial exchange rate.

The working of dual exchange markets is that only unpredictable appreciation (depreciation) of commercial rate, which is presented by g, changes the spread between financial and commercial exchange rates:[3]

$$
\begin{aligned}
x &= x^* + (E^e - E_{t+1}) \\
&= x^* + g_{t+1}, \qquad (1)
\end{aligned}
$$

where $E^e = E_t$ is the expected commercial exchange rate at current period t, and g_{t+1} is the unpredicted appreciation (depreciation) rate of commercial rate at next period $t+1$,

2. The volume of foreign bonds in the private sector under the dual exchange rate system is lower than that under the flexible exchange rate system. The price of foreign bonds in the former system is higher than that of the latter regime. From the authority point of view, this difference is a gain from adopting different exchange rate regimes. The bigger this difference, the larger this exchange revenue.

3. We assume that the initial value of commercial rate equals one and hence the appreciation rate of the commercial exchange rate is equal to g.

when it is positive (negative). When actual and expected commercial exchange rates are the same, unpredictable appreciation rate does not exist. Two situations thus can be found:

(1) If $E^e = E_{t+1}$ then $g_{t+1} = 0$.

(2) Otherwise $g_{t+1} \neq 0$.

The policy maker derives a disutility or bears costs from the deterioration of the balance of trade resuling from commercial appreciation but it is concerned about exchange revenue and derives positive utility or gains when the spread rises above the initial value due to surprise appreciation. Based on this concept, we then introduce a finitely-lived monetary authority and a finitely-lived single agent who has perfect foresight on commercial and financial exchange rates to illustrate the time consistency of monetary policy under such a regime within a finite time horizon.

III. Time Consistency of Monetary Policy

A commercial exchange rate policy could regard as a monetary policy since domestic inflation (disinflation) is equivalent to commercial exchange rate depreciation (appreciation). There are many factors affecting the expectations of the financial exchange rate. We assume that the change of expectation of financial exchange rate only results from the appreciation (depreciation) shock of the commercial exchange rate. Given a need for disinflation during a period of turbulence, as mentioned previously, we focus on the case that the government has incentives to appreciate commercial rate for remedying inflation.

1. Discretion with Finitely-lived Players

Initially, with promise, the announced rate of commercial appreciation is zero. The single agent believes the government pledge and will maintain a financial exchange rate at its initial level, say, $E^e + x^*$. For simplicity, the time subscripts have been scrapped. We guess that there is an initial period, $0 \leq t \leq t^*$ (for some t^* to be determined), with no commercial appreciation. After t^*, government intends to improve its payoff by reneging on its prior announcement to zero commercial appreciation and appreciating at a rate of g.[4] The rational agent expects commercial appreciation rate at γ and chooses financial exchange rate at $E^e - g + x^*$. Thus, the spread between two rates still be constant. In the context of dual exchange markets it serves to emphasise the phenomenon, a steady, narrow or zero spread can persist under rational expectation. This implication is also demonstrated by the experiences of some European countries which adopt two-tier markets and sustain a steady spread.[5]

4. See Note 3.

5. See Flood and Marion (1988, p. 5). Their conclusion is:

For constant spread, the adjustment path of the financial exchange rate will coincide with that of the commercial exchange rate after t^*; that is

$$\dot{X} = \dot{E}$$

$$= -g. \quad (2)$$

When government appreciates the commercial exchange rate, it means that both commercial and financial exchange rates will exhibit jump discontinuities at t^* along the horizon. The government' s one period- cost function of policy switches is:

$$cost = g^2 - (X + g - 1). \quad (3)$$

The government bears costs of the unfavorable balance of trade resulting from surprise commercial appreciation, indicated by the first term, and gains from exploiting exchange revenue due to a bigger value of spread, indicated by the second term.[6] Using a quadratic form means that the cost rises at an increasing rate with the appreciation rate. Government preference is characterized by a positive discount factor d. We assume that the commercial exchange rate must be returned to its initial value at the end of the horizon, which in turn means that the financial exchange rate should also be returned to its initial value. Any other fixed time horizon would result in similar policy effects. The policy- planning problem of government can be stated formally as finding $g(t)$ that minimizes

$$\int_0^T [g^2 - (X + g - 1)] \exp(-dt) dt, \quad (4)$$

subject to

$$\begin{cases} \dot{X} = -g, \\ X(0) = X(T) = 1 + x^*, \\ g(t) \geq 0. \end{cases} \quad (5)$$

Through the techniques of bounded controls, the more definite form of $g(t)$ is expressed as:

Contrary to popular belief, a narrow spread between the commercial and financial exchange rate doesn't necessarily imply that the authorities have been unsuccessful in partitioning the foreign exchange market. *Indeed, a narrow or zero spread can persist even when there are no leakages across markets*

To us, a narrow spread is in line with some country experiences especially European country practice.

6. As mentioned, we have assumed that the initial value of commercial rate is unity. After commercial appreciating, the spread between these two rates becomes the second term of Equation (3).

$$g(t) = 0\,, \qquad 0 \le t < t^*.$$

$$\boldsymbol{g}(t) = \frac{1}{2}\{1 - \frac{1}{\boldsymbol{d}} + (\frac{1}{\boldsymbol{d}} - 1)\exp[(\boldsymbol{d}(t - t^*)]\ \}, \qquad t^* \le t \le T. \tag{6}$$

Integrating Equation (5) and employing Equation (6), the value of the financial exchange rate is:

$$X(t) = 1 + \boldsymbol{x}^*, \qquad 0 \le t < t^*.$$

$$X(t) = -\frac{1}{2}\{t - \frac{1}{\boldsymbol{d}}t + (\frac{1}{\boldsymbol{d}} - 1)\frac{1}{\boldsymbol{d}}\exp[(\boldsymbol{d}(t - t^*)]\ \}, \quad t^* \le t \le T. \tag{7}$$

Using the terminal condition of financial exchange rate in Equation (5), t^* can be solved as

$$t^* = T - \frac{1}{\boldsymbol{d}}\ln[-2(1 + \boldsymbol{x}^*) - T + \frac{1}{\boldsymbol{d}}]. \tag{8}$$

Given a finite time horizon T, from Equation (8), we predict that government might break its promise at time t^*. When government appreciates commercial exchange rate at a rate $\boldsymbol{g}$, time-inconsistency of monetary policy with two-tier exchange markets occurs. Furthermore, we also predict that t^* will increase with the discounting factor, $\boldsymbol{d}$. The higher the time preference of government, the less likely of time inconsistency occurrence. In other words, the appreciation rate, $\boldsymbol{g}$, is decreasing with $\boldsymbol{d}$. When the government is perfectly patient, the government does not appreciate the commercial rate to exploit the exchange revenue, that is, $\boldsymbol{d} = 1$ and $g = 0$.

2. The Credibility Problem

We shall be interested in an equilibrium concept in which the private sector at time 0 are able to predict the optimal government policy in succeeding periods (i.e., the optimal government decision about E and $\boldsymbol{g}$ at time t $(0 < t < T)$ as discussed above) with perfect certainty. Under these circumstances, Equation (5) holds, and hence, by Equation (3), the value of the financial exchange rate at time t is

$$X(t) = 1 - \boldsymbol{g}_t + \boldsymbol{x}^*. \tag{9}$$

The latter would remove some incentives from government at time t^* to set $g > 0$, because it would involve financial exchange rate appreciation. It in turn eliminates the benefit but generates the cost from surprise commercial appreciation. Therefore, in Figure 1(a), t^* is expected to be within finite horizon (0~T_2) or out of it (0~T_1).

Equation (9) is a reaction function of the private sector and is required to be non-negative. It implies that Equation (9) is only relevant over the range where $g \le 1+x^*$ and over the period when $t^* \le t \le T$. This relevance is depicted in Figures 1(a) and 1(b), indicating that in the period $0 \le t < t^*$, time-consistency condition holds and γ equals zero. The initial value of financial exchange rate, $1+x^*$ stands. However, we guess that the government will conduct commercial appreciation shock at time t^*. In other words, g function jumps and is discontinuous at t^*. For rational expectations, the financial exchange rate also jumps at t^*. We exclude the possibility that either the commercial or financial exchange rate is negative. For the sake of non-negative values of commercial and financial exchange rates, the conditions, either $g > 1$ or $g > 1+x^*$ are ruled out, as the dotted lines in Figures 1(a) and 1(b) indicate.

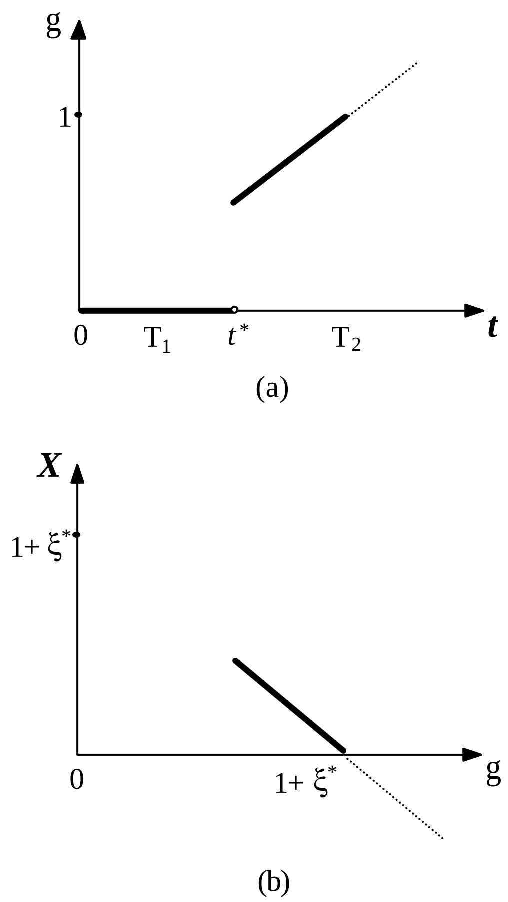

Figure 1 Time Inconsistency of Monetary Policy with Dual Exchange Markets

The following proposition summarizes our discussions:

Proposition 1: *Given a finite horizon T, for* $0 \le t < t^*$, *government keeps to its promise;* $g_t = 0$, $X = 1 + x^*$. *On the other hand, for* $t^* \le t \le T$, *time-inconsistency occurs, then* $g_t > 0$. *For the sake of ruling out non-positive values of commercial and financial exchange rates, γ must be within the range* $0 < g < 1$. *Should* $g \ge 1$ *hold, there is no equilibrium.*

We proceed to make the numerical examples for credibility examinations in a finitely-lived economy with the government and the single agent. These examples investigate whether time t^* is realizable within a finite horizon or precisely whether commercial exchange rate policy is credible under a dual exchange rate system. Three cases are presented. First, the spread is a fixed value of 0.25.[7] Given a finite horizon *T*=100, the discounting factor is changed from 0.05 to 1 in steps of 0.05. The timing on time-inconsistency is given in Table 1.

Table 1 Dependence of t^* on ä in Monetary Inconsistency

$T = 100$	d									
	0.05	0.10	0.15	0.20	0.25	……	0.80	0.85	0.90	0.95	1.00
t^*	68	77	82	86	88	……	95	95	96	96	100
g_{t*}	0.487	0.473	0.459	0.443	0.426	……	0.153	0.118	0.081	0.042	0
X_{t*}	0.763	0.777	0.791	0.807	0.824	……	1.097	1.132	1.169	1.208	1.25
t^*+1	69	78	83	87	89	……	96	96	97	97	100
$g_{t*}+1$	0.999	0.996	0.991	0.984	0.973	……	0.494	0.395	0.281	0.15	0
$X_{t*}+1$	0.251	0.254	0.259	0.266	0.277	……	0.756	0.855	0.969	1.1	1.25

From Table 1, it indicates that t^* increases with the discounting rate d. Nonetheless, the appreciation rate decreases with further increases in t^*. It implies that, with rational expectation, financial exchange rate X_t increases with further increases in t^*.

Second, we examine the dependence of t^* on x^* in the monetary inconsistency. The terminal condition of financial exchange rate is relaxed and changed from 0.05 to 2.00 in steps of 0.05 while the discounting factor d is set at a common value of 0.25 and the length of finite horizon is still given at *T*=100. Then commercial appreciation shock occurs at $t^* = 88$. The commercial appreciation and the financial exchange rates at t^* are 0.426 and 0.824, respectively. This is always the story, whatever the terminal condition of financial exchange rate is, and hence the relevant table is not provided here. The result of this examination indicates that the time-inconsistency occurs within a finite horizon, no matter

7. Though we do not discuss the utility of the private sector previously, the agents only bear costs in the policy switches from bigger spread or higher price of foreign bonds. The agents' one-period reaction function is to solve the response: minimizing $[(X - E^e + g)^2]$. We find that g equals 0.25and X equals 1.25 by the assumption of unity commercial exchange rate.

what the spread and terminal condition of financial exchange rate are. However, by ***Proposition 1***, we exclude the non-positive value of commercial and financial exchange rates.

Third, given $d = x^* = 0.25$, the length of the finite horizon is changed from 10 to 200 in steps of 10. The inconsistency always occurs at the point of roughly 88 per cent within the horizon. We might predict that there is no dependence of t^* on T. The finite horizon T does not affect the occurrence of time-inconsistency in a two-tier exchange rate system. The relevant table is hence not provided here.

Above all, the major factor affecting the credibility of commercial exchange rate policy is the discounting rate, d, the time preferences of government. The appreciation rate, g, is decreasing with d. The more patient the government, the less likely the occurrence of commercial appreciation.

To illustrate ***temptation*** in government and ***enforcement***, we assume that the government can move one step before the single agent at t^*. At time t^*, government not only bears costs of the deterioration of the balance of trade from commercial appreciation but also benefits from bigger spread by deviating from the appreciation rate target once announced. The increase in benefit thus tempts government to conduct commercial appreciation. Following the definition of temptation[8] in Gärtner (1993) who defines temptation as: an increase in utility, resulting from cheating rather than playing honestly, from Equation (3), the government's temptation to break its promise then is expressed as:

$$temptation = -[cost(g^e \neq g, g^e = 0) - cost(g^e = g = 0)]$$

$$= -(g_{t^*}^2 - g_{t^*}). \qquad (10)$$

where g^e is the expected commercial appreciation rate which is also the announced rate of commercial appreciation and equals zero. According to ***proposition 1***, γ should be within the range, $0 < g < 1$, and hence, the cost (dis-utility) of commercial exchange policy of reneging on announcement for government will be less than that of the policy of sticking to its promise. In other words, the government's utility in the former is higher than that in the latter. From Equation (10), it thus implies that government's temptation to cheat is positive.

However, from time $t^* + 1$, government will only bear the cost of commercial appreciation since the single agent can expect both rates, commercial and financial exchange rates, rationally and the spread will return to be a constant. This cost might reduce some government incentives to break its promise and might be regarded as a mechanism to enforce government to keep to its announcement. Following again the definition of enforcement in Gärtner (1993)[9] who defines enforcement as: the present value of all future losses by deviating from some announced policy today, enforcement could be expressed as

8. See Gärtner (1993, p. 239).

9. See Gärtner (1993, p. 242).

$$enforcement = \int_{t^*+1}^{T} [g_{t^*+1}^2 - x^*] \exp(-dt)\,dt - \int_{t^*+1}^{T} (-x^*) \exp(-dt)\,dt$$

$$= -\frac{1}{d} g_{t^*+1}^2 [\exp(-\frac{T}{d}) - \exp(-\frac{t^*+1}{d})] \tag{11}$$

From Equation (11), since t^*+1 is within the finite horizon *T*, the difference in square brackets is negative. Combining this condition with the assumption of a positive value for the discounting factor, the value of enforcement should also be positive.

To examine the terms, temptation and enforcement, more clearly, we pick the simulated value of actual appreciation rate from Table 1 for calculation. Meanwhile, we set both discounting factor and spread at 0.25 as they are in case 3. The length of finite horizon, *T*, is fixed at 100 since the result of examination in case 3 indicates that the length of the finite horizon is not a factor on which t^* depends. As we know, the shock of commercial appreciation will occur at 88, that is, $t^* = 88$. The value of appreciation rate and financial exchange rate at time 88 are 0.426 and 0.824 respectively.

From Equation (10), when government reneges on its announcement, its cost will be less than that of sticking to its promise by 0.244524. In other words, the temptation is 0.244524. The temptation to cheat is positive since its utility increases. On the other hand, employing Table 1, we find $g_{89} = 0.973$. Substituting it into Equation (11), the present value of loss, the enforcement, is $4.813076738 \times 10^{-11}$.

Obviously the value of temptation is much higher than that of enforcement. It then suggests that an optimal commercial exchange rate policy $(g = 0)$ is not a time-consistent decision in that the single agent has perfect foresight for both exchange rates and the government has temptation to deviate from its announced rate.

3. Optimal Policy and the Best Enforceable Rule

Although $g^e = g = 0$ is an optimal policy, it is not a time-consistent decision in that the temptation is still higher than the enforcement as previously pointed out. We intend to search the optimal appreciation rate by minimizing government's temptation. Equation (10) becomes

$$temptation = -[cost(g_{t^*} \neq g^a) - cost(g_{t^*} = g^a)]$$

$$= -[(g_{t^*})^2 - (x^* + g_{t^*} - g^a) - (g^a)^2 + x^*]\,. \tag{12}$$

where g^a is the announced rate of commercial appreciation. The necessary condition for g^a to minimise temptation is

$$\frac{dT}{dg^a} = 2g^a - 1 = 0 . \tag{13}$$

Solving Equation (13), the optimal announced rate of commercial appreciation is 1/2.

Using second-derivative test, it gives

$$\frac{d^2T}{d(g^a)^2} = 2 > 0 . \tag{14}$$

provided $g^a = 1/2$ is precisely a minimum. On the other hand, the enforcement in Equation (11) becomes

$$enforcement = \int_{t^*+1}^{T} [g_{t^*+1}^2 - x^*]\exp(-dt)dt - \int_{t^*+1}^{T} [(g^a)^2 - x^*]\exp(-dt)dt$$

$$= -\frac{1}{d} g_{t^*+1}^2 [\exp(-\frac{T}{d}) - \exp(-\frac{t^*+1}{d})]$$

$$+ \frac{1}{d}(g^a)^2[\exp(-\frac{T}{d}) - \exp(-\frac{t^*+1}{d})] . \tag{15}$$

Following the mechanism used in Barro and Gorden (1983), we try to define ***the best enforceable rule*** as minimizing

$$enforcement = \int_{t^*+1}^{T} [g_{t^*+1}^2 - x^*]\exp(-dt)dt - \int_{t^*+1}^{T} [(g^a)^2 - x^*]\exp(-dt)dt ,$$

subject to

$$\int_{t^*+1}^{T} [g_{t^*+1}^2 - x^*]\exp(-dt)dt - \int_{t^*+1}^{T} [(g^a)^2 - x^*]\exp(-dt)dt$$

$$\geq [(g^a)^2 - g^a - (g_{t^*})^2 + g_{t^*}] . \tag{16}$$

By Kuhn-Tucker theorems and Lagrangian techniques, it yields

$$g^a = \frac{l}{\{[\exp(-\frac{T}{d}) - \exp(-\frac{t^*+1}{d})](\frac{2}{d} - \frac{2l}{d}) + 2l\}} , \tag{17}$$

where l is Lagrangian multiplier.

From Equation (15), using the second-derivative test of enforcement curve, we find

$$\frac{d^2N(enforcement)}{d(g^a)^2} = \frac{1}{d}[\exp(-\frac{T}{d}) - \exp(-\frac{t^*+1}{d})] < 0\,.$$

It provides that the appreciation rate under enforcement is precisely a maximum. Our discussion is summarized in Figure 2, where $n = \dfrac{l}{\{[\exp(-\frac{T}{d}) - \exp(-\frac{t^*+1}{d})](\frac{2}{d} - \frac{2l}{d}) + 2l\}}$ is the announced appreciation rate for the best enforcement rule.[10]

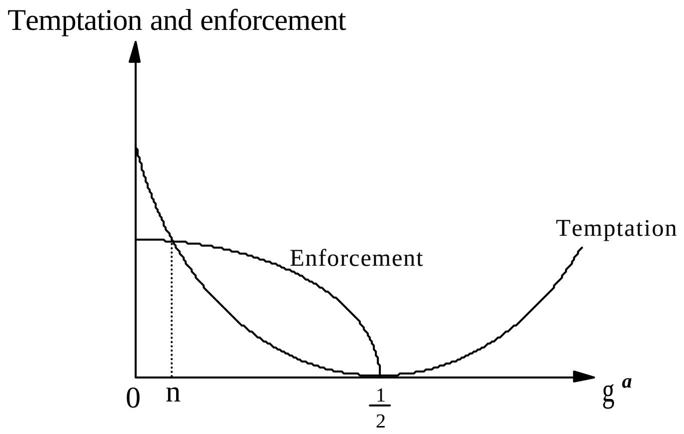

Figure 2 Temptation and Enforcement under Dual Exchange Markets

From Figure 2, although, at period 0, $g^a = 0$ is the perfect possible announcement rate for commercial appreciation, according to ***Proposition 1***, we guess that the time-inconsistency will occur within a finite horizon. In other words, $g^a = 0$ is not credible in that temp tation is much higher than enforcement.

Should $g^a = 1/2$ hold, it is an optimal and credible choice. Nevertheless, viewed through the payoff to government, it is not able to minimise the cost function in Equation (13). It implies that $g^a = n$ is the best enforcement rule where not only enforcement equals temptation but also the payoff (cost) to government is a maximum (minimum). Any announcement rates lying between *n* and 1/2 are credible policies because the enforcement is higher than the temptation and there is no incentive for government to deviate from its announcement. Furthermore, the payoffs to government of these rates are preferable to that of $g^a = 1/2$, which can be proved by Equation (13).

10. Barro and Gordon (1983), called it the best enforcement rule and Gätner (1993) called it the best credible rule.

This implication is in line with Barro and Gorden (1983) and Gätner (1993) in macroeconomics. Nonetheless it is the first step to the road of designing a commercial exchange rate policy under two-tier exchange markets.

IV. Conclusions

Economists continue to seek a better understanding of the nature of exchange rate systems. The dual exchange rate system that we investigate in this paper is a mechanism by which some of the costs of fixed and flexible exchange rate systems are sought to be minimized. Alternatively, the gains from having one or other of the two polar alternatives can be increased by having a 'hybrid' system. Our analysis provides an illustration of the nature of dual exchange markets and the clarification of time consistency of monetary policy for this exchange rate arrangement. It focuses on the credibility issues rather than on characterizing the optimal policy.

Although the announcement of zero commercial appreciation rate is an optimal decision, it is not a credible policy. Given a finite time horizon, when government announces zero appreciation rate at initial period, it is predicted to renege on its announcement within the finite horizon in that, under such an announcement, temptation is higher than enforcement. When announced rates are between the rates under the best credible rule and discretionary policy, they will be time consistent. As mentioned in the context, the efficiency of such a regime depends on the complete separation between two markets, the stability of the spread between commercial and financial exchange rates and the credibility of the government. When government breaks its promise and changes the commercial rate, the time inconsistency of monetary policy arises. This event might result in incomplete separation, the instability of the spread and hence the erosion of this management.

A dual exchange rate system is an intermediate exchange rate regime. Clearly, such a regime is not expected to be permanent but is to be used as an intermediate step for an economy abandoning its commitment to maintaining international parity in its exchange rates but unable to withstand the shocks and volatility emanating from a floating exchange rate which has adverse implications for the domestic macroeconomy.

Fixed exchange rates allow the current account to be protected from the uncertainty caused by fluctuating exchange rates. Where export promotion is a policy strategy under export promoting industrialization, export volatility due to exchange fluctuations can have serious impact on a country's long term growth rates. Countries might also wish to import capital goods which are essential intermediates in long term growth and may also contribute to research and development and technical progress through learning by doing. In addition, the existence of exchange rate uncertainty *per se* reduces the volume of international trade, discourages inward investment and generally increases the problems that are faced (for example by migrants) in insuring human capital in incomplete asset markets. These features are common to developing countries, hence, the impetus towards keeping exchange rates fixed for the determinants (exports and imports) of the current account.

However, the exchange rate is difficult to peg in the face of large and increasing financial capital mobility. In recent years, developing countries have witnessed large capital flows, particularly for emerging stock markets. Often, the reserves of the domestic Central

Bank is not large enough to withstand speculative pressures unless there are stringent capital controls. It is becoming increasingly difficult, within a framework of integrating capital markets and factor mobility, to maintain artificially pegged exchange rates and prevent black markets from operating and swamping the ability of the authorities to stop illegal transactions in the foreign exchange markets. The share of capital flows in GDP is high for many developing countries and shows an increasing trend for most developing countries.

The most important problem and difficulty for fixed exchange rate are the impotence of domestic monetary policy. Stabilization policy via monetary means becomes difficult and even impossible and over reliance on fiscal policy creates difficulties at a microeconomic level (such as setting suitable targets for health, education, defence and the structure of taxation). With a fixed exchange rate, and sticky domestic prices, a foreign shock can change the terms of trade and the real exchange rate. This in turn will have adverse impact on either export or import, creating similar problems as when nominal rates were volatile. If purchasing power parity always held there would be fewer problems but most empirical and policy oriented analysis shows that such parity conditions rarely hold except in the very long run. Clearly, a system which attempts to combine the better features of both exchange rates is the most optimum exchange rate regime that developing countries would like to have. The dual exchange rate system contains these attractive features. The commercial rate is fixed so that the current account is insulated and protected. The financial rate is allowed to be flexible to act as a shock absorber to capital flows and to allow limited autonomy in monetary policy. The capital account transactions then obey the laws of demand and supply with flexible prices while rigid prices for the current account gives insulation and protection to vital components of the GDP.

Clearly, such a regime is not costless and effective implementation is very important. The major issues debated in the existing literature were asked: How can we successfully separate commercial and financial exchange markets? In the previous context we have tackled this question from theoretical and simulation study perspectives. This paper has carried us beyond orthodox analyses of open economies under dual exchange markets.

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