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AN OPTIMAL COMMITMENT MODEL OF EXCHANGE RATE STABILIZATION

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Recently East Asian countries that have amassed large US dollar reserves face a growing threat of big losses from a sudden decline in the dollar. This threat evokes an issue of the optimal commitment of exchange rate stabilization once raised by Isard (1995) who interpreted the cost of breaking the parity as the capital gain awarded to speculators, in the event the domestic currency is devalued. The only difference in this paper is revaluation. This paper models the central bank's optimal commitment to exchange rate stabilization when it faces pressure of exchange rate revaluation which may well describe the current episode in East Asian countries. Using a simple equilibrium model optimizing speculators, market maker and the central bank are explicitly introduced and the market maker's hedging activity is highlighted. The paper considers two equilibria, classic market intervention and market intervention combined with direct regulation on the market maker's position, the latter of which believes to be commonly exercised by some East Asian governments. The paper shows that the direct regulation may incur larger expected loss on the central bank's reserves although it leaves the central bank's interest rate policy more room to maneuver.

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I. INTRODUCTION

Recently East Asian countries that have amassed large US dollar reserves face a growing threat of big losses from a sudden decline in the dollar. This threat is reflected by capital inflows which further increase reserves in these countries unless the exchange rates are fully adjusted. The capital inflows are speculative and not necessarily pro-cyclical as Kaminsky, et al. (2004) characterized. The current episode evokes an issue of the optimal commitment of exchange rate stabilization once raised by Isard (1995). He interpreted the cost of breaking the parity as the capital gain forgone by the monetary authority, or the capital gain awarded to speculators, in the event the domestic currency is devalued. Logic is the same. The only difference here is the risk of exchange rate revaluation.

In fact, many East Asian central banks holding large amount of foreign reserves have been very reluctant to revalue their currencies even though both international community and academic society often asks for more flexible exchange rates.[1] Indeed, so much have the Asian central banks intervened over the past years that their foreign reserves have risen even further. According to Geneva Report of World Economy (2005), Asian surplus countries including Japan have foreign reserves over $2.5 trillion, up two-thirds of the world total from $1 trillion in 2000.

However, the intervention has its own cost. Under dollar currency peg the East Asian economy is in a classic conflict between internal and external balance. Specifically the massive intervention creates excess liquidity. Historically low interest rates in East Asian countries may not be coincident.[2] As this paper demonstrates, the East Asian central banks may deliberately pursue low interest rate policy in order to discourage speculative attack on domestic bank reserves. The impossible trinity hypothesis says that it is impossible to achieve both exchange rate stability and ability to target interest rate when capital is freely mobile.

[1] G7 communique is one example. Frankel (2005) and Obstfeld (2006) suggested medium to long term exchange rate flexibility specifically for Chinese economy. Obstfeld and Rogoff (2005) warned eventual free fall of dollar in order to correct global imbalances at least some part of which Asian central banks are responsible for.

[2] As end of June, 2005 average short term interest rate for countries holding large foreign reserves such as China, India, Singapore, Korea and Taiwan is less than 3% per year.

The purpose of this paper is to model the central bank's policy response to speculative capital inflows and to assess the interaction between the central bank and market participants. Motivated by Isard (1995), the paper focuses on the central bank's optimal commitment to exchange rate stabilization when it faces pressure of an exchange rate revaluation, which may well describe current incidence in East Asian countries. The central bank's loss function is defined such that the choice of interest rate accompanies a trade-off between defending exchange rate and preserving the stability of macro economy. The central bank's preference over these two objectives depends on its aversion to loss from decline in the dollar which, the paper assumes, depends on the size of dollar reserves.

A simple equilibrium model characterizes the microstructure of forward exchange market through which the volume of speculative capital flows are trending upward especially in China and Korea.[3] Optimizing speculators, market maker and the central bank are explicitly considered and the market maker's hedging behavior is highlighted. The market maker who bears risks of currency and maturity mismatch after supplying forward contracts to speculators engages in 100% hedging against those risks. The hedging operation turns out to be a speculative attack on reserves of the central bank and the game-theoretical situation is expected between the market maker and the central bank.

The basic model is similar to Kim (2000) and Garber and Spencer (1995) except that this paper concerns pressure of domestic currency revaluation. Garber and Spencer first drew attention on the hedging activity of the market makers, during currency crisis, who sold currency options to speculators. Kim developed two period model of speculative attack via foreign exchange derivatives market.

Comparing literatures of interest rate defense under the pressure of exchange rate devaluation this paper shows important symmetry and asymmetry. Although the loss function certainly has a strong incentive to defend currency it may or may not be successful. It is because interest rate defense in the end creates time inconsistency problem (Kraay, 2003; Sole,

[3] Ma, Ho and McCauley (2004) made an excellent survey on the foreign exchange market for non-deliverable forwards in Asian currencies.

2004). But in currency revaluation the willingness to defend the peg depends on the size of the foreign reserves. Therefore, the greater the foreign reserves, the more likely the central bank is willing to defend.

The paper considers two equilibria, classic market intervention and market intervention combined with direct regulation on the market maker's position, the latter of which is believed to be commonly implemented by some East Asian governments. The paper shows that the direct regulation may incur even larger expected loss on the central bank's reserves although it leaves the interest rate policy more room to maneuver.

The message of this paper is twofold. First, contrary to what the impossible trinity hypothesis implies the central bank may have to engage in sterilized intervention. Otherwise, the forward exchange rate would give a strong signal such that revaluation would be imminent. Second, direct regulation on the market maker's position may result in larger expected loss on the central bank when it holds greater amount of dollar reserves.

Section II develops a theoretical model including basic microstructure of foreign exchange market. In Section III two equilibria are discussed. Section IV concludes the paper.

II. MODEL

1. Microstructure of Foreign Exchange Market

For simplicity two periods, period t and $t+1$, are assumed. It is also assumed that there exist only two types of currency, USD and domestic currency, KRW. Anticipating revaluation of KRW speculators engage in forward contract of selling dollars to a market maker at the rate of $F_{t,t+1}$ KRW/USD. The speculator's net expected profit in terms of KRW from the forward contract of supplying \$1 USD is as follows:

$$E[\pi_{t+1}^{S} \mid \Omega_t] = F_{t,t+1} - E[S_{t+1} \mid \Omega_t] \tag{1}$$

where π_{t+1}^{S} is the speculator's net profit in KRW realized in period $t+1$, and Ω_t denotes the information set in period t including all market variables in period t.

The market maker who sells KRW to speculators is subject to risk of currency mismatch and risk of maturity mismatch and, therefore, needs to hedge against these risks. Following conventional practices 100% hedging is assumed. Then, other things being constant, it is the central bank that has to purchase dollars from the market maker. Otherwise, the hedging operation will let spot exchange rate be immediately devalued. The market maker's profit π_{t+1}^{M} from hedging short sales of $1 USD is as follows:

$$\pi_{t+1}^{M} = F_{t,t+1}^{I} - F_{t,t+1} \tag{2}$$

The first term of the rhs in eq.(2) is the revenue from sales of $1 USD to the central bank and the second term represents the cost of buying $1 USD from the speculators. The market maker by selling $\frac{1}{1+i^*}$ USD spot at the rate of S_t KRW/USD and at the same time engaging foreign exchange swap with the central bank effectively exchanges $1 USD for $S_t \frac{1+i_t}{1+i^*}$ units of KRW in period t+1 and, therefore, makes synthetic forward at the implied forward exchange rate[4]

$$F_{t,t+1}^{I} = S_t \frac{1+i_t}{1+i^*} \tag{3}$$

Through 100% hedging the market maker will not be exposed to any risks.[5]

The central bank's expected loss is matched by joint profit of the market maker and the speculator shown in eqs,(1) and (2). Therefore, the central bank's expected profit is as follows:

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[4] Instead of spot and swap transactions the market maker may hedge through direct forward contract with the central bank since they are functionally equivalent.

[5] It is assumed that the counter party credit risk does not exist.

$$E[\pi_{t+1}^{C} \mid \Omega_t] = E[S_{t+1} \mid \Omega_t] - F_{t,t+1}^{I} \tag{4}$$

Throughout the paper it is assumed that there is no transactions cost. It is also assumed that speculators are unable to borrow. This assumption is crucial. Suppose, on the contrary, that a speculator borrows USD $\frac{1}{1+i^*}$, exchange for KRW at S_t in the spot market, deposit at the interest rate i_t through period t+1, and exchange for USD. In this way the speculator will draw net expected profit $S_t \frac{1+i_t}{1+i^*} - E[S_{t+1} \mid \Omega_t]$, which equals the joint profit of the speculator and the market maker shown in eqs.(1) and (2). Consequently, if speculators had access to credit they should drive the market maker out of the model and the same equilibrium would be obtained.[6]

Furthermore, the paper assumes that there are many speculators and one market maker. Consequently, the game theoretical situation between the central bank and the market maker is expected. It is also assumed that speculators are risk neutral. The assumption implies that the market maker's supply of forward contract will determine the equilibrium size of the speculative attack on bank reserves, which, of course, will depend on the profitability of the hedging operation.

2. Speculative Attack and Central Bank's Loss Function

Now consider the following money market equilibrium condition:

$$\frac{M_t}{P_t} = \alpha_0 - \alpha_1 i_t \tag{5}$$

The equality $\frac{M_0}{\overline{P}} = \alpha_0 - \alpha_1 i^*$ holds for M_0. The purchasing power parity is assumed:

[6] In fact, as one referee correctly points out specific market making role of banks is unable to be found in won-dollar exchange rate. Still, however, the model is valid as long as speculators have access to credit.

$$\overline{S} = \frac{\overline{P}}{P^*} \tag{6}$$

Without loss of generality the foreign price level is assumed to be one, $P^* = 1$ and, therefore,

$$\overline{S} = \overline{P} \tag{7}$$

It is also assumed that in period t+1 there will be a credit shock χ_{t+1} the central bank must accommodate.[7] In period t, however, only its distribution is known. The money supply contraction followed by the credit shock in period t+1 will have an effect of downward pressure on the foreign exchange market and without foreign exchange intervention it will revalue the domestic currency in period t. Therefore, in order to maintain the level of foreign exchange rate at $\overline{S}$ foreign exchange intervention must be called for in period t.

However, due to credit shock, pegging the exchange rate may not be sustainable in period t+1. The following set of equations summarizes the scenario:

$$M_{t+1} = M_t - \chi_{t+1} \tag{8}$$

$$\frac{M_{t+1}}{P_{t+1}} = \alpha_0 - \alpha_1 i_{t+1} \tag{9}$$

$$S_{t+1} = P_{t+1} \tag{10}$$

[Figure 1] summarizes how the exchange rate in t+1 is determined. If $M_{t+1} \geq M_0$ or if $\chi_{t+1} \leq \phi_t$ $(\phi_t = M_t - M_0)$ then $\tilde{S}_{t+1} \geq \overline{S}$ and $S_{t+1} = \overline{S}$ is viable. The variable ϕ_t is the size of the monetary expansion in period t followed by the foreign exchange intervention and $\tilde{S}_{t+1}$ is the shadow exchange rate. On the other hand, if $M_{t+1} < M_0$ or if $\chi_{t+1} > \phi_t$ then $S_{t+1} = \tilde{S}_{t+1} < \overline{S}$ will hold. Pegging the exchange rate will be impossible

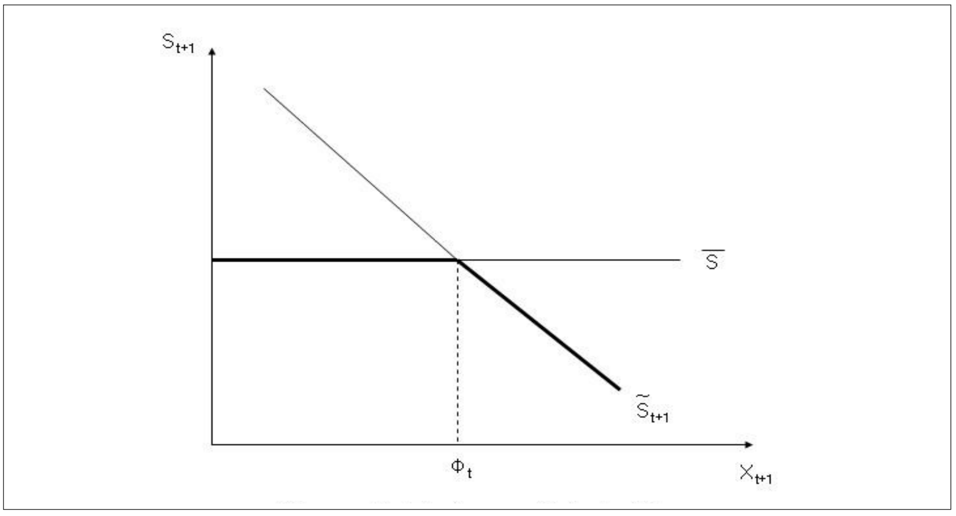
[7] Flood and Garber [1984] considered this type of credit shock. The assumption implicitly allows time inconsistency of the central bank's interest rate policy.

and the exchange rate will be revalued. Therefore, the expected exchange rate in period *t*+1 is

$$E[S_{t+1} \mid \Omega_t] = \{1 - \Pr o(\chi_{t+1} \leq \phi_t)\}\overline{S} + \Pr o(\chi_{t+1} > \phi_t)\tilde{S}_{t+1} < \overline{S} \tag{11}$$

where $\Pr o(\chi_{t+1} > \phi_t)$ denotes the probability of $\chi_{t+1} > \phi_t$. Ω_t is the information set which includes all variables in period *t* and the distribution of χ_{t+1}.

[Figure 1] Exchange Rate in *t*+1



Anticipating revaluation of KRW in period *t*+1 the speculators would like to sell dollars short through engaging forward contract with a market maker. Assuming risk neutrality they will have an infinite elastic short position in dollars as long as $E[S_{t+1} \mid \Omega_t] < F_{t,t+1}$. Therefore, the market maker's supply of forward contract will determine the equilibrium number of contract.

The market maker who promises to purchase Q_t units of the dollar would like to take a square position. This hedging operation turns out to be a speculative attack on the central bank's bank reserve, which in turn will raise the central bank's foreign exchange reserves by Q_t.

Consider the following loss function facing the central bank:

$$L_t = \beta(R_t)(i_t - i^*)^2 + Q_t(F^I_{t,t+1} - E[S_{t+1} | \Omega_t]) + R_t(\bar{S} - E[S_{t+1} | \Omega_t]),$$
$$\beta > 0, \beta' < 0 \qquad (12)$$

where R_t is the size of the foreign reserves initially held by the central bank at the beginning of period *t*. The central bank is averse to divergence from the target interest rate, which is the same as foreign interest rate i^* and the capital loss due to speculative attack on its own bank reserves. The second and third terms reflect loss in the event that the domestic currency is revalued. As explained the loss function is motivated by Isard (1995).

The loss function enables focusing the interaction between the market maker and the central bank at center stage. The parameter $\beta(R_t)$ represents the relative aversion to revaluation and it is decreasing in the size of foreign reserves, R_t. It is because as eq.(12) suggests the central bank's choice of interest rate should accompany a trade-off between defending exchange rate and preserving the stability of macro economy. The central bank's preference over these two objectives depends on its aversion to loss from decline in the dollar, which depends on the size of dollar reserves. The greater the reserves, the more averse the central bank becomes to loss from the dollar's decline and, therefore, the more the central bank is willing to defend the peg. Consequently, β is decreasing in the size of foreign reserves.

The loss function implies that in response to the speculative pressure the central bank with large foreign reserves has a strong incentive to squeeze out the market maker by lowering interest rate. It is because low interest policy should raise hedging cost of dollar long in eq.(3). However, low interest rate policy is costly. It has to sacrifice domestic economic condition.[8] On the contrary, however, if the central bank stabilizes the interest rate such that $i_t = i^*$ and lets the exchange rate float, then $S_t < \bar{S}$ with probability one. The loss in this case may be too high for sufficiently low β. Therefore, the interest rate is determined by the trade-off between the stability of exchange rates and the stability of the macro economy.

[8] Money supply increase may cause inflationary pressure which may exacerbate economic imbalance.

III. EQUILIBRIUM

The central bank's monetary policy and the market maker's hedging activity induce a game theoretical situation with strategic interaction. Here, a sequential game is assumed such that after the market maker operates hedging activity the central bank implements monetary policy. First, given the market maker's short position by Q_t the central bank chooses the interest rate i_t. Second, the market maker derives optimal short position $\hat{Q}_t$ from the central bank's interest rate policy.

Substituting $F^I_{t,t+1} = \bar{S}\frac{1+i_t}{1+i^*}$ into eq.(12) the central bank obtains the interest rate response function $\hat{i}_t$ which minimizes the loss function:

$$\hat{i}_t = i^* - \frac{Q_t(\frac{\bar{S}}{1+i^*} - \Delta)}{2\beta(R_t)} \tag{13}$$

where Δ is the amount of change in the expected exchange rate in response to monetary expansion in period t due to interest rate decrease and $\Delta = \frac{\partial E[S_{t+1} \mid \Omega_t]}{\partial \phi_t}\frac{\partial \phi_t}{\partial i_t} < 0$. The more foreign reserves the central bank has, the more aggressively the bank cuts the interest rate, and, therefore, the more divergent domestic interest rate becomes from the foreign one.

The fact that the central bank maintains the exchange rate at $\bar{S}$ and at the same time chooses loss minimizing interest rate $\hat{i}_t$ implies that the foreign exchange market intervention is sterilized.[9] Sterilized intervention is in the form of spot and swap operation through which the market maker effectively borrows dollars from the central bank and exchanges them for domestic currency at the implied rate, $\hat{F}^I_{t,t+1} = \bar{S}\frac{1+\hat{i}_t}{1+i^*}$.

The market maker's optimal forward supply is obtained from the

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[9] From eqs.(5) and (7) money supply rises by $\alpha_1\bar{S}\frac{Q_t(\frac{\bar{S}}{1+i^*} - \Delta)}{2\beta}$. However, unsterilized intervention would raise simply by Q_t.

following profit function

$$\vartheta(Q_t, i_t) = (F^I_{t,t+1} - F_{t,t+1})Q_t \tag{14}$$

Plugging the implied forward rate $\hat{F}^I_{t,t+1} = \overline{S}\frac{1+\hat{i}_t}{1+i^*}$ and the central bank's interest rate response function shown in eq.(13) into the market maker's profit function (14) the maximization problem is defined as follows.[10]

$$\underset{\hat{Q}_t}{Max}\ \pi^M_{t+1} = [\overline{S}\{1 - \frac{Q_t(\frac{\overline{S}}{1+i^*} - \Delta)}{2\beta(\cdot)(1+i^*)}\} - F_{t,t+1}]Q_t \tag{15}$$

From eq.(15) the market maker's forward supply schedule as a function of forward exchange rate $F_{t,t+1}$ is derived:

$$\hat{Q}_t = \beta(\cdot)(\frac{\overline{S} - F_{t,t+1}}{\overline{S}})(1+i^*)(\frac{\overline{S}}{1+i^*} - \Delta)^{-1} \tag{16}$$

The market maker's forward supply is decreasing in $F_{t,t+1}$. From eqs. (13) and (16) the equilibrium forward rate is

$$\hat{F}_{t,t+1} = \overline{S}\frac{1+2\hat{i}_t - i^*}{1+i^*} \tag{17}$$

Comments are in order. First, the equilibrium will be indeterminate unless Q_t were determined. It is because the market maker's optimal forward supply depends on the forward rate $\hat{F}_{t,t+1}$ as in eq.(16), which depends on the level of interest rate $\hat{i}_t$ in eq.(17), which depends on the size of the speculative attack $\hat{Q}_t$ in eq.(13), which again depends on the forward rate $\hat{F}_{t,t+1}$ in eq.(16). The indeterminacy results from the price taking risk of neutral speculators. When $\hat{F}_{t,t+1} < \overline{S}$, as eq.(17) indicates

[10] Although both Q_t and $F_{t,t+1}$ affect profits only Q_t will be considered for maximization. This problem is not uncommon in game theory.

the inequality, a speculative pressure will emerge and the speculators' demand for forward contract is infinitely elastic at $\hat{F}_{t,t+1}$ and they will accept any amounts of forward contract as long as the condition $E[S_{t+1} | \Omega_t] < \hat{F}_{t,t+1}$ holds.

Second, when equilibrium exists, the central bank *regardless* of the level of $\beta(\cdot)$ sets the interest rate at the *same* level. As eq.(13) suggests the central bank will cut the interest rate in response to the speculative pressure. The rate cut will lower the implied forward rate so that the market maker will face rising hedging cost. Now, lower β (that is, higher R_t) is associated with lower interest rate and in turn lower implied forward rate. Lower implied forward rate will reduce the optimal supply of forward contract.[11] In fact, as eq.(16) shows the optimal forward supply is homogenous of degree one in β and the equilibrium interest rate will be the same regardless of the level of β. It will only affect the size of the speculative attack $\hat{Q}_t$.

Third, when speculative pressure emerges the covered parity condition fails. Instead eq. (17) holds. As discussed earlier when speculators are unable to borrow the parity condition does not necessarily hold. Here, the sterilized intervention breaks the parity condition. The sterilized operation makes the central bank the only source of exchanging dollars for domestic currency. Through sterilized intervention the central bank is able to control interest rate and reduce the size of the attack. In equilibrium the market maker charges lower forward rate to speculators such that the return on foreign bonds is lower than domestic ones. In fact, if the parity held then the two types of bonds should be perfect substitutes.[12]

1. Regulation on Q

So far the paper considers the central bank's loss minimizing market intervention. However, direct regulation on the market maker's long position on dollars may be another viable option.[13] Suppose that the

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[11] From eq.(16) the market maker's profit from a dollar worth of KRW turns out $\bar{S}\dfrac{i^* - \hat{i}_t}{1+i^*}$.

[12] Driven by sterilized operation Flood, Garber and Kramer (1996) explicitly consider a bond-based risk premium to the spread between domestic and foreign-currency interest rates.

[13] At least some episodes of the direct regulation by the Korean government in NDF market

government imposes ceiling on the size of the market maker's position up to $\overline{Q}$ which is less than $\hat{Q}_i$.[14]

In the presence of such regulation the nature of the game is different. Given the interest rate set by the central bank, the market maker *charges* forward rate to speculators. Similar to eq.(13) the central bank sets the loss minimizing level of interest rate as

$$\bar{i}_t = i^* - \frac{\overline{Q}(\frac{\overline{S}}{1+i^*} - \Delta)}{2\beta(R_t)} \tag{18}$$

With direct regulation on Q the interest rate is positively associated with β. The more foreign reserves the central bank has, the more aggressively the central bank is willing to cut the interest rate.

Now the market maker's maximization problem is defined as looking for the optimal level of the forward rate:

$$\underset{\overline{F}_{t,t+1}}{Max} \; \pi^M_{t+1} = \{F^I_{t,t+1} - F_{t,t+1}\}\overline{Q} \tag{19}$$

where $F^I_{t,t+1} = \overline{S}\frac{1+\bar{i}_t}{1+i^*}$. Understanding that the speculators will accept the contract as long as the forward rate is greater than the expected future spot rate, the market maker will set profit maximizing level of forward exchange rate as

$$\overline{F}_{t,t+1} = E[S_{t+1} \mid \Omega_t] + \varepsilon \tag{20}$$

where ε is very small positive number.

With direct regulation (plus the condition $\overline{Q} < \hat{Q}_t$) the central bank is able to set the optimal interest rate higher

have been known.

[14] Let the equilibrium under direct regulation denote bar, "$\overline{}$".

$$\bar{i}_t > \hat{i}_t \tag{21}$$

The direct regulation has beneficial effect on pursuing stability of macro economy since it will cause home interest rate to be less divergent from the foreign rate. On the other hand, however, it may incur even larger loss on reserves. When the interest rate is set higher $\bar{i}_t > \hat{i}_t$, the implied forward rate is higher

$$\bar{F}^I_{t,t+1} > \hat{F}^I_{t,t+1} \tag{22}$$

Furthermore, the size of the monetary expansion required for exchange rate stabilization is lower such that $\bar{\phi}_t < \hat{\phi}_t$. Consequently, the future exchange rate is expected to revalue more since

$$E[S_{t+1} \mid \bar{\phi}_t \in \Omega_t] < E[S_{t+1} \mid \hat{\phi}_t \in \Omega_t] \tag{23}$$

where $E[S_{t+1} \mid \Omega_t] = \{1 - \Pr o(\chi_{t+1} \le \phi_t)\}\bar{S} + \Pr o(\chi_{t+1} > \phi_t)\bar{S}_{t+1}$. Although the direct regulation may successfully reduce the size of the speculative attack (that is, $\bar{Q} < \hat{Q}_t$) the central bank's expected loss on every dollar purchase from the market maker rises. Resultantly the capital loss on reserves may be greater.

$$\begin{aligned} &\bar{Q}_t(\bar{F}^I_{t,t+1} - E[S_{t+1} \mid \bar{\phi}_t \in \Omega_t]) + R_t(\bar{S} - E[S_{t+1} \mid \bar{\phi}_t \in \Omega_t]) > \\ &\hat{Q}_t(\hat{F}^I_{t,t+1} - E[S_{t+1} \mid \hat{\phi}_t \in \Omega_t]) + R_t(\bar{S} - E[S_{t+1} \mid \hat{\phi}_t \in \Omega_t]) \end{aligned} \tag{24}$$

As a matter of fact, the more reserves the central bank has, the more losses the central bank is likely to suffer. It is because the central bank's averseness to divergence from the target interest rate is negatively associated with the size of the reserves, $\beta'(R) < 0$.

With direct regulation the forward exchange rate will be approximately equal to the expected future spot rate as is seen in eq.(20). This may give a strong signal that the central bank would float the exchange rate in period *t*+1. Instead of the forward exchange market it will be the spot market where the speculative attack is ignited although this is beyond the scope of this paper.

The market maker's profit on every dollar purchase of forward contract $F^{I}_{t,t+1} - F_{t,t+1}$ is unambiguously greater since $\overline{F}^{I}_{t,t+1} > \hat{F}^{I}_{t,t+1}$ and $\overline{F}_{t,t+1} < \hat{F}_{t,t+1}$. On the other hand, the speculator's expected profit will squeeze to $\varepsilon(= \overline{F}_{t,t+1} - E[S_{t+1} \mid \Omega_t])$.

In this paper the forward exchange rate may be a biased predictor of the future spot rate unless direct regulation is imposed on the market maker's position. Both risk premium and Peso problem are popular explanations of the unbiasedness. However, in this model where the microstructures of foreign exchange market are emphasized none of these can justify the unbiasedness. Further explorations need to be done.

IV. CONCLUDING REMARKS

This paper develops a simple model of optimal commitment to exchange rate stabilization when domestic currency is under pressure from revaluation. A central bank having a large amount of foreign reserves may have a strong incentive to avoid revaluation because revaluation will incur capital loss to its own dollar reserves. The greater the foreign reserve, the more the central bank is willing to defend the peg. Therefore, the greater the credit shock in eq.(9) the more the central bank must accommodate, although this paper assumes credit shock at a constant. If it would be endogenized, the time inconsistency problem is less likely to emerge, of course. After all, it may be natural that the central bank aggressively intervenes in foreign exchange market in order to defend its currency as some Asian central banks have in recent years.

This paper focuses on the interaction between the market maker's hedging activities in delivering forward contracts to speculators. A game theoretical situation is expected between the profit maximizing market maker and the loss minimizing central bank. It is shown that the central bank raises the cost of hedging via sterilized intervention which in turn affects the market maker's supply of forward contracts, or the size of the speculative attack on the domestic currency. Therefore, the impossible trinity doesn't hold and the covered parity condition fails although the rate of interest remains the same regardless of the degree of aversion to revaluation which in this panes depends on the size of the foreign reserves held.

When direct regulation is imposed on the market maker's position the market maker sets the forward exchange rate at the level of the future expected spot rate. Contrary to the common belief a central bank holding large reserves may suffer even more losses.

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