# Why is Managed Floating Adopted as a *De Facto* Exchange Rate Regime?

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ABSTRACT

This paper examines the welfare implications of the managed floating as an intermediate regime. Modifying and generalizing the Hamada's model (2002) to accommodate intervention policy, we compare the expected losses under three alternative regimes; freely floating, pegged exchange rate, and managed floating. We show that, with some restrictive conditions, the welfare level of a small country under the managed floating regime is possibly higher than that under other regimes. This is because the private sector misconceives the exchange rate regime that the central bank actually selects. This partly explains why managed floating is widely adopted as a *de facto* regime.

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2001; Fischer, 2001).[3]

These historical and practical developments and concurrent theoretical examinations of the appropriate exchange rate regime motivate us to investigate which exchange rate regime should characterize the global economy of the new millennium. The number of countries under the pegged exchange rate regime had been decreasing since the collapse of the Bretton Woods system, but has been increasing since 2000.[4] However, many other countries still select the exchange rate regime in various other forms, such as a currency union with Euro, currency board, dollarization, a single currency peg, or a basket peg.[5] Nevertheless, the number of countries under the freely floating exchange rate has sharply been increasing since 1980's. According to Rajan (2002), while about 8.3% of the whole sample of 154 countries adopts freely floating in 1980, however, it went up to 45% in 1999. The rate went down to 26% in 2002.

Because of this growing transition from peg to freely floating, Calvo and Reinhart (2002) analyzed the behavior of exchange rate, international reserves, and nominal interest rate volatility. They concluded that emerging markets usually considered to be floaters are subject to the "Fear of Floating" syndrome. According to their examination, most countries that officially claim to have a freely floating domestic exchange rate should not have their words taken at face value. In other words, managed floating is adopted as a *de facto* regime. This allows the monetary authority to intervene in some way in the foreign exchange market, and is therefore likely to be selected in many countries.[6] While the variance of exchange rates tends to be relatively small, that of the foreign exchange reserve is theoretically shown to be relatively large under a pegged exchange rate. In comparison, while the variance of exchange rates has been relatively large, that of reserve should be zero if there is no intervention as in the case of freely floating regime. As a result, the probability of the variance of reserves going beyond the 2.5% band is the highest in officially freely floating regimes. That is, the variability of

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[3] This hypothesis has also been called the "hypothesis of the vanishing intermediate regime" (Frankel, 1999, 2003), the "missing middle" (Frankel, Fajnzylber, Schmukler, and Serven, 2001), and the "bipolar view" (Fischer, 2001).

[4] According to Rajan (2002), while about 39% of 154 sample countries adopted a pegged exchange rate in 1980, about 11% adopted the system in 1999.The figure rises to 48% of 187 countries in 2002.

[5] The data from IMF (2003) shows that the number of countries that adopt "hard pegs", such as a currency union, currency board, and dollarization is 48 and the number of a single peg and a basket peg is 42 (IMF, 2003, pp.118-9).

[6] There are numerous literature on central bank intervention. For recent theoretical and empirical contributions, see the special issue of *Journal of International Financial Market, Institutions & Money*, Vol. 10 (2000), containing 11 articles that consider various aspects of central bank intervention.

shock or a monetary shock. Bird and Rajan (2002) cast doubt on the policy recommendation of corner solutions and conclude that a currency basket is the optimal prescription for Southeast Asian countries. Goldfajn and Silveira (2002) developed a general equilibrium model where debtors and creditors have heterogeneous beliefs. They showed that, if debtors are more pessimistic than creditors (foreign investors), the private sector tends to under-hedge its foreign currency exposure. The authors then showed that, in this case, intervention may be Pareto improving. Bofinger and Wollmershäuser (2003), focusing on monetary policy strategies on the basis of the so-called policy frontiers, showed that the strategy of managed floating provides a better outcome than that of pure floating in the sense the former has a smaller social cost in terms of output and inflation volatility.

As far as the authors know, the welfare analysis of a managed floating regime has been scanty, but Goldfajn and Silveira (2002) and Bofinger and Wollmershäuser (2003) are notable exceptions. We will pursue this issue by emphasizing a different informational friction from the previous authors. It should be mentioned that, while Goldfajn and Silveira (2002) examine under what conditions intervention is Pareto improving, they do not directly address the optimal exchange rate regime. In section 4 we will show that the expected loss of the manage floating regime with appropriate intervention by the central bank is smallest among the three possible regimes (clean floating, managed floating, and pegging) when there is informational friction in a small country, in the sense that the private sector *misconceives* managed floating as a clean float regime.[9] This suggests that secret (or hidden) intervention by deceiving the private sector is welfare improving, at least temporarily. We believe that, by modeling this deception of the private sector, we successfully incorporate the central bank's sentiment of "Fear of Floating" (Calvo and Reinhart, 2002) and thus provide theoretical foundation for secret (or hidden) intervention within an optimization model.

The rest of this paper is organized as follows: Section 2 describes the private sector for each country of a three-country model, and focuses on a small country. The loss function of the government to be minimized is considered for both of a large and a small country. Section 3 modifies and generalizes the Hamada's model to be able to deal with the managed floating by including possible intervention operation. Section 4 examines the effects of intervention in the foreign exchange market and some comparative statics results are presented. Section 5 compares the expected losses of the three exchange rate regimes to determine which of them is optimal for a small country. Section 6 concludes

[9] Thus, our model is close in spirit to Goldfajn and Silveira (2002), but significantly different from theirs in the source of informational friction.

changed if country A is large and country B is small.

In the first step, we assume that a growth rate of a nominal wage $w_k$ is determined by the private sector so as to minimize the following objective function.

$$L_K = E\left[\left(w_K - p_K - \alpha_K\right)^2\right],\ K = A, B, C, \qquad (1)$$

where $\alpha_K \geq 0$ is the target rate of increase in the real wage that public regards desirable; $E$ is the expectation operator. This loss function is minimized by a dominance of a growth rate of a nominal wage $w_K$ over an inflation rate $p_K$. However, if the nominal wage is set too high for the inflation rate, the loss becomes larger since a rise of the real wage reduces demand for labor and leads to increases in unemployment.

The distinction of a large and a small country is crucial in the analysis to follow. Remember that we have assumed country B is large and country C is small.[12] In addition, we assume that the former adopts freely floating and the latter the managed floating. The central bank of country B observes the behavior of the private sector described in (1) and uses monetary policy to minimize their loss function (2).

$$V_B = p_B^2 + \gamma(p_B - w_B + \theta_B)^2 \qquad (2)$$

where the first term of the right-hand side indicates a loss from the rate of inflation and the second term the cost of unemployment. A higher growth rate of real wage ($w_B - p_B$) does not generate unemployment if it is caused by a positive supply shock $\theta_B$. Thus, the effect of the higher rate on unemployment is represented by $w_B - p_B - \theta_B$, and the loss is denoted by a quadratic form in the second term on the right-hand side. The parameter $\gamma$ indicates the degree that the central bank is concerned about the employment policy relative to the inflation. The higher the $\gamma$, the higher the degree the central bank dislikes unemployment.

On the other hand, the objective function of the central bank of country C is defined by the following loss function.

$$U_C = \left[p_C^2 + \gamma\left[p_C - w_C + \theta_C\right]^2 + \beta\left[x_B - x_C - R_C\right]^2\right] \qquad (3)$$

where we assume that the large country B is the reserve country and the small country C, who adopts managed floating, is subject to the balance of payments constraint by the need of holding the stock of foreign exchange reserves. The third term of the right-hand side in equation (3) denotes the constraints. The parameter $\beta$ indicates the degree

[12] A small country implies that domestic policy is independent of foreign policy. Domestic policy in a large country could affect the policy decision by a small foreign country.

and a sum of the domestic credit and the foreign exchange reserves.

$$M_C = D_C + R_C \tag{5}$$

The asset side in the balance sheet is affected by exchange rates and other factors (cf. Kouri and Porter, 1974).

$$M_C = D_C\left(V, \frac{E_C}{\overline{E}_C}\right) + R_C\left(W, \frac{E_C}{\overline{E}_C}\right) \tag{6}$$

where $E_C$ is the nominal exchange rate (defined as units of country C's currency per unit of country B's currency) and $\overline{E}_C$ is the central bank's target for the nominal exchange rate. In equation (6), the domestic credit and the foreign exchange reserves are represented by a function of an exchange rate. We assume that changes in the domestic credit and reserves are caused by intervention when the exchange rate deviates from the target rate set exogenously by the central bank. $V$ and $W$ are other exogenous factors that affect the domestic credit and reserves. We assume that both terms in the right-hand side of equation (6) are multiplicatively separable between the parts in exchange rates and parts in other factors, and that the former has the same functional form, g.[13] Thus, factoring out the g function implies:

$$M_C = [\widetilde{D}_C(V) + \widetilde{R}_C(W)] \cdot g\left(\frac{E_C}{\overline{E}_C}\right) \tag{7}$$

where the inside of the first square bracket term is exogenously given, because $V$ and $W$ are exogenous factors by assumption. Thus, money supply is a function of exchange rates. For the functional form of $g(\cdot)$, we specify it as equation (8) following Marston (1985) and Da Silva (2000).

$$g\left(\frac{E_C}{\overline{E}_C}\right) = \left(\frac{E_C}{\overline{E}_C}\right)^{\phi} \tag{8}$$

where $\phi$ is a parameter of the degree that the central bank intervenes in the foreign exchange market. The polar cases of fixed and freely flexible exchange rates correspond to infinity and zero values, respectively, of the intervention parameter $\phi$. Leaning-against-the-wind intervention is represented by $\phi \in (-\infty, 0)$, whereas leaning-into-the-wind intervention is given by $\phi \in (0, \infty)$ (see Da Silva, 2000,2002).

[13] Marston (1985) analyzes the effects of intervention policy by parametrizing sterilized intervention. Natividad and Stone (1990) use the model in which the policy reaction functions are different between domestic credit and foreign exchange reserves to examine the effects of sterilized intervention.

If the purchasing power parity holds, then $P_C = P_B E_C$, and $z_B = 0$ *and* $\phi = 0$, since country B adopts freely floating without intervention. Thus, the following relationships hold.

$$p_B = x_B \tag{13}$$

$$p_C - q_C = p_B \tag{14}$$

where lowercase variables denote the rate of changes, e.g. $\dot{P}_B / P_B = p_B$. If country C adopts either a pegged exchange rate or freely floating, the corresponding equations are respectively represented as follows.

$$q_C = 0, \beta \neq 0, p_C = p_B, z_C = x_B - x_C \quad \text{(pegged)} \tag{15}$$

$$z_C = 0, \phi = 0, \beta = 0, p_C = x_C, q_C = x_C - x_B \quad \text{(floating)} \tag{16}$$

Since the central bank of country C, who adopts managed floating, decides excess credit expansion $x_C^*$ to minimize the loss in equation (3), the optimal strategy is given by the following equation.

$$x_C^* = \frac{1}{1+\beta+\gamma}\left\{\beta\left(x_B - R_C\right) + \gamma\left(w_C - \theta_C\right) - \left(1+\gamma\right)\left(z_C + \phi q_C\right)\right\} \tag{17}$$

As equation (17) demonstrates, the optimal excess credit expansion for country C is affected by the monetary policy in country B ($x_B$), the required increase of reserves ($R_C$), the rate of wage inflation ($w_C$), the domestic supply shock ($\theta_C$), the actual growth rate of reserves ($z_C$), and the effect of intervention ($\phi q_C$).

When the central bank of country C adopts managed floating, it is subject to the balance of payments constraint. Because of the selected exchange rate regime, $R_C = z_C$ must hold. In other words, the actual increase in reserves (*zc*) has to be equal to the level of reserves to balance the payments (*Rc*). Keeping this constraint in mind, from equations (12) and (17), the optimal inflation rate for country C is given by equation (18).

$$p_C = \frac{1}{1+\beta+\gamma}\left\{\beta\left(x_B + z_C + \phi q_C - R_C\right) + \gamma\left(w_C - \theta_C\right)\right\} \tag{18}$$

Substituting equations (17) and (18) for equation (3), we rewrite the loss function as in the following expression.

$$U_C = \frac{1}{1+\beta+\gamma}\left\{\beta\left(1+\gamma\right)\left(x_B + \phi q_C\right)^2 - 2\beta\gamma\left(x_B + \phi q_C\right)\left(w_C - \theta_C\right) + \gamma\left(1+\beta\right)\left(w_C - \theta_C\right)^2\right\} \tag{19}$$

It should be emphasized that the both effects of monetary policy in country B ($x_B$) and intervention policy by country C ($\phi q_C$) are not only included as the variables in the loss

Assuming that the both variances of the supply shock in countries B and C, and also the covariance term are normalized to one, the expected loss of the central bank of country C reduces to:[15]

$$E[U_C]=\frac{\gamma}{1+\gamma}(w_C^2+1)+\frac{\beta(1+\gamma)}{1+\beta+\gamma}[(\frac{\gamma}{1+\gamma})(w_B-w_C)+\phi q_C]^2 \tag{22}$$

Comparison of (22) with (20) implies the following Proposition 1:

*Proposition 1: Freely floating is better than managed floating, if monetary policy is credible for the private sector.*[16]

Since the expected loss for equation (20) is $\gamma\left(w_C^2+1\right)/\left(1+\gamma\right)$ (for a unitary variance of the supply shock for country C), freely floating is unambiguously superior to managed floating. However, for the equal nominal rates of wage growth in countries B and C ($w_B = w_C$), managed floating has the same level of the expected loss as freely floating when there is no intervention ($\phi = 0$) or a negligible deviation from the equilibrium exchange rate ($q_C = 0$).[17] Although freely floating is shown to be better than managed floating if the monetary policy announced by the central bank is credible for the private sector, we are interested if Proposition 1 is turned over when the central bank announces that they adopt freely floating but deceive the private sector through hidden or secret intervention. We now turn to pursue such a more complex situation by examining the effects of intervention.

## 4. Effects of Intervention

We are now ready to focus on the main purpose of this paper and examine the relationships between the parameter of the degree of the intervention $\phi$ and the loss of the central bank under managed floating. We will also consider the loss arising from the

[15] These assumptions are imposed only to emphasize the effects of the parameters $\phi$, and $q_C$.

[16] This proposition is similar to Goldfajn and Silveira (2002). There is, however, a basic difference between their model and ours in informational friction. While they focus on the informational friction between debtors and creditors (foreign investors), our focus is on the friction between the central bank and the private sector.

[17] In principle, the managed floating regime is characterized by two distinct features. First, if there is no intervention, it is similar to a freely floating regime. Second, for deviations from the equilibrium exchange rate being negligible in size, it is similar to a pegged regime.

$w_C = (1+\gamma)\alpha_C$ (Hamada, 2002, p.23).[20] If the central bank observes the wage negotiating process under the misconception by the private sector, the expected value of equation (23) is:[21]

$$E[U_C] = \frac{\beta(1+\gamma)}{1+\beta+\gamma}\left\{\gamma^2\alpha_B^2 + \frac{\gamma^2}{(1+\gamma)^2}\sigma_B^2 + 1\right\}\phi^2 q_C^2 + \frac{2\beta\gamma(1+\gamma)}{1+\beta+\gamma}(\alpha_B - \alpha_C)\phi q_C$$
$$+\frac{\gamma(1+\beta)}{1+\beta+\gamma}\left\{(1+\gamma)^2\alpha_C^2 + \sigma_C^2\right\} - \frac{2\beta^2\gamma^2}{1+\beta+\gamma}\left\{(1+\gamma)^2\alpha_B\alpha_C + \mathrm{cov}(\theta_B, \theta_C)\right\} \quad (25)$$

From equation (25) it is straightforward to derive the important characteristics of the loss function, $\partial E[U_C]/\partial(\phi^2) > 0$, and $\partial E[U_C]/\partial(q_C^2) > 0$. That is, the larger the degree of intervention denoted by $\phi^2$ is, or the larger the deviation from the equilibrium exchange rate $q_C$ is, the greater the loss of the central bank. Dominguez and Frankel (1993) show that intervention policy increases uncertainty in the foreign exchange market and hence exchange rate volatilities. Our result is similar to theirs in the sense that it implies from equation (25) that intervention makes the degree of market uncertainty higher and thus increases the loss of the central bank.[22] However, the sources of market uncertainty identified in our model are wage negotiating processes in the labor markets and productivity shocks. In contrast, the loss decreases as the positive correlation between supply shocks in country B and C becomes higher.

On the other hand, if the central bank adopts a freely floating regime as the private sector expects ($\beta = 0$, and $\phi = 0$), the expected value should be slightly different from equation (25)(Hamada, 2002, equation (36)).

$$E[U_C] = \frac{\gamma}{1+\gamma}\left\{(1+\gamma)^2\alpha_C^2 + \sigma_C^2\right\} \quad (26)$$

A quick glance at equations (25) and (26) makes it clear that the loss under managed floating is larger than under freely floating. While the monetary authority needs to care

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20 The nominal wage set by the private sector in country B is $w_B = (1+\gamma)\alpha_B$.

21 If the private sector does not misconceive and regards the actual regime as the managed floating, the nominal wage is set as follows.

$$w_C = \frac{\beta\gamma}{1+\beta}\alpha_B + \frac{\beta}{1+\beta}\phi q_C + \frac{1+\beta+\gamma}{1+\beta}\alpha_C$$

While the expected loss in this case becomes more complex than in equation (25), the conclusion that the expected loss decreases for a positive covariance of supply shocks is invariant.

22 From the first term on the right-hand side in equation (25), intervention increases the expected loss whether the intervention is leaning against the wind or not.

$q_C = (\alpha_C - \alpha_B)/2\theta\phi$, and the vertex of $[(\alpha_C - \alpha_B)/2\theta\phi, -(\alpha_B - \alpha_C)^2/4\theta\phi]$. We are interested in the leaning-against-the-wind intervention, $\phi < 0$, and hence the parabola is convex to the above (see Figures 1 and 2). Since the effects of intervention on the expected losses for the government of country C depend on the parabola depicted in the $(q_C, \frac{1}{\delta}\frac{\partial E[U]}{\partial \phi})$ -plane, it is convenient to examine the effects by classifying the possible combinations of $q_C$ and $(\alpha_B - \alpha_C)$. Equation (28') makes clear that the effects of intervention $(\phi)$ on the expected loss are the sum of two terms in the brace of the right-hand side. The first term $(\theta\phi q_C^2)$ is unambiguously negative for leaning-against-the-wind intervention, $\phi<0$, implying that intervention always has a tendency of increasing the expected loss. However, the sign of (28') is undetermined, but ambiguous because of the second term which implies that intervention affects the expected loss through the cost difference and deviation from the equilibrium exchange rate. Below, we will explore the implications behind the second term and consider if the overall effects of intervention lead to a reduction of the expected loss and thus are beneficial for a small country C.[24]

First suppose a combination of $q_C>0$ and $\alpha_C < \alpha_B$, which is depicted in Figure 1. The relevant region is the first and the fourth quadrants. In the first quadrant where the deviation of exchange rate from its equilibrium level, $q_C$, is restricted in an interval (0, $(\alpha_B - \alpha_C)/\theta\phi$), it is observed that $\partial E[U_C]/\partial\phi > 0$. This implies that the expected loss is decreased by the leaning-against-the-wind intervention, $\phi<0$. However, if the deviation $q_C$ is large and lies outside of the interval, $\partial E[U_C]/\partial\phi < 0$, it implies that intervention increases the expected loss. This is obvious from the right-hand side of (28'), as the first term in the brace dominated the second term for the area outside the

[24] Invoking a theorem on the quadratic form, equation (25) is discriminated as a parabola with respect to $\phi$. Thus, differentiating (28') once more with respect to $\phi$ yields $\partial^2 E[U_C]/\partial\phi^2 = \delta\theta q_C^2 > 0$. The last expression implies that intervention $(\phi)$ maximizes the expected loss function $(E[U_C])$ if the level of intervention happen to be $\phi^* = (\alpha_C - \alpha_B)/\theta q_C$. We assume in the following that the central bank intervenes in the foreign exchange market by deliberately avoiding the level of intervention at $\phi = \phi^*$.

(imports), and thus country C benefits under managed floating when the gains from exports (imports, respectively) outweigh (or more than offset) the welfare cost of intervention. In contrast, in the case of (b) ((c), respectively), there are contradicting forces in the expected loss, because the cost disadvantage (advantage) indicates imports (exports), while exchange rate depreciation (appreciation) dictates an increase (a decrease) in exports (imports). Thus, country C incurs an additional loss from trade on top of the loss from intervention. We will investigate below how intervention affects the expected loss, using Figures 1 and 2 for each of the four possible cases.

Consider first the case (a), which is depicted in Figure 1. Since $q_C$>0, the relevant region is the first and fourth quadrants. Since the required intervention in the case of depreciating exchange rate ($q_C$>0) is selling the foreign exchanges and withdrawing the corresponding money supply, the intervention operation has a deflationary impact. As long as the deviation $q_C$ is small in the sense that it is restricted in the interval (0, $(\alpha_B - \alpha_C)/\theta\phi$), the deflationary impact of the intervention operation offsets the inflationary effects of depreciation. Then, the cost advantage measured by $(\alpha_B - \alpha_C)\, q_C$ in (a) above remains, and thus the intervention is beneficial to the government of country C in the sense that it removes the inflationary pressure of $q_C$. However, if the deviation $q_C$ is large, intervention simply cannot offset the inflationary pressure. It is observed that the larger the benefits, the larger the difference in the target wage increase.[25]

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Insert Figure 1 around here

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Secondly, consider the case (b) above, a combination of $q_C$>0 and $\alpha_C > \alpha_B$, which is depicted in Figure 2. Since $q_C$>0, the relevant region is the fourth quadrant. As observed in the Figure, $\partial E[U_C]/\partial\phi$ is always negative, implying that the expected loss increased as a result of intervention. Intervention in this case is also selling the foreign exchanges and thus deflationary. If the depreciation deviation is offset as a result of the

[25] Even if $\phi$ (<0) is large in absolute value, it is possible that the expected loss decreases in the case of a large difference in the target wages.

beneficial in the sense that it enhances the benefits by reducing the expected loss of government of country C. If appreciation deviation is large, intervention simply cannot offset the deflationary pressure. The benefit is largest when the cost disadvantage is largest.

Our finding up to here is summarized in Table 1 and in the following Proposition 2.

<u>Proposition 2</u>: *When the private sector misconceives the actual exchange rate regime, the changes in the expected loss by central bank intervention are subject to the classical theory of Comparative Advantage: Intervention decreases the expected loss for cost advantage cum depreciation, or cost disadvantage cum appreciation.*

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Insert Table 1 around here

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Next, we consider another interesting question to ask if further, *stronger* intervention could change the results summarized in Table 1. As shown in Figures 1 and 2, the thick curves represent the shifted curves after the stronger leaning-against-the-wind operation, i.e. a larger $\phi$ (<0) in absolute value.[26]

As observed from Figure 1, for $q_c > 0$ and $\alpha_B > \alpha_C$, the parabola shrinks inward but passes through the origin after a stronger intervention. The axis shifts leftward and the vertex goes down. Thus, for a small deviation, it is obvious that, although intervention reduces the expected loss, the degree of the reduction is smaller. This indicates that stronger intervention soon becomes ineffective, simply because the cost advantage realized through depreciation deviation fades away. It is also obvious from Figure 1 that, for large deviation $q_c>0$ ($q_C > (\alpha_C - \alpha_B)/\theta\phi$), if the degree of intervention is high ($\phi <<0$), it is possible that the expected change in loss is negative, i.e., stronger intervention actually increases the expected government losses.

However, for $\alpha_B < \alpha_C$ and $q_c < 0$, the axis of the parabola is located in the negative region of $q_c$. In this case, the parabola curve (28') shifts downward by intervention, as in the above case. However, it is obvious, as observed from the third quadrant of Figure 2, that the change in the expected losses is negative and the loss with further, stronger

[26] It can easily be verified that the parabola passes the origin and shifts downward as a result of the leaning-against-the-wind intervention. The original and the shifted parabola curves are tangential each other only at the origin with the common slope of $(\alpha_B - \alpha_C)$. Thus the shifted curve is always located below the original one for all domain of $q_c$.

$$-\frac{2\beta\gamma(1+\gamma)}{(1+\beta+\gamma)^2}\{\gamma(2\gamma+\beta+2)\alpha_B\alpha_C+(\beta+\gamma)\text{cov}(\theta_B,\theta_C)\} \qquad (29)$$

Although the sign of $\partial E[U_C]/\partial\beta|_{\phi=0}$ is generally ambiguous, we can derive the following Proposition from equation (29):

<u>*Proposition 4*</u>: *When the private sector misconceives the actual exchange rate regime, stronger concern about the balance of payments constraint eventually decreases the expected loss if the supply shocks are positively correlated.*

When the parameter $\beta$ becomes relatively high, i.e. when the concern of the central bank is higher about the balance of payments, there is a range in that the higher concern decreases the expected loss. As $\beta$ is larger, the first term on the right-hand side decreases, while the second term increases if the covariance term is positive. We suppose that the positive covariance between supply shocks of open countries B and C is plausible because of the link through international trade. As the result, as $\beta$ is larger, the positive first term is eventually dominated by the negative value of the expected loss, and the whole expression turns out to be negative.[28] Thus, it is inferred that an increase in the degree of the concern about the balance of payments eventually decreases the expected loss.

## 5. Welfare Comparison under Three Regimes

This section compares the expected losses under three regimes, pegged exchange rate, freely floating, and managed floating, in order to investigate which of them is the most desirable in our model. The expected losses under the three regimes (pegged, freely floating, and managed floating) are already examined in the last section as summarized

[28] It is straightforward to rearrange (29) as:

$$\frac{\partial E[U_C]}{\partial\beta}|_{\phi=0}=\frac{\gamma\beta^2}{(1+\beta+\gamma)^2}\{\frac{\gamma}{\beta}[(1+\gamma)^2\alpha_C^2+\sigma_C^2]-\frac{2(1+\gamma)\gamma}{\beta}[2(1+\gamma)\alpha_B\alpha_C+\text{cov}(\theta_B,\theta_C)]-2(1+\gamma)[\gamma\alpha_B\alpha_C+\text{cov}(\theta_B,\theta_C)]$$

Thus, the limit value is:

$$\lim_{\beta\to\infty}\frac{\partial E[U_C]}{\partial\beta}|_{\phi=0}\to -2(1+\gamma)\gamma[\gamma\alpha_B\alpha_C+\text{cov}(\theta_B,\theta_C)]<0$$

When country C adopts the managed floating regime, while it leaves a determination of exchange rates to the market to some extent, it has to control the money supply to satisfy the balance of payments constraint. Since the money supply control plays a role of a nominal anchor for inflation, the balance of payments constraint enhances credibility for monetary policy. Thus, the higher credibility makes the maintenance of purchasing power parity by exchange rate policies ($q_C = 0$) easier and has a deterrent effect on a rise in the nominal wage in the wage bargaining process in the private sector.

Thus, we have the following Proposition 6:

<u>Proposition 6</u>: *For sufficiently small deviations of the exchange rate from the equilibrium rate, the expected loss under managed floating is likely to be lower than that under freely floating if the private sector misconceives the actual exchange rate regime and if the supply shocks are positively correlated.*

This Proposition also seems to appeal to our understanding of managed floating, under which the balance of payments constraint serves as the nominal anchor for inflation to the extent that the exchange rate is kept stable around the equilibrium level (Calvo and Reinhart, 2002; Rajan, 2002).

Finally, for the pegged and the freely floating regimes, our result is consistent with that of Hamada (2002) who shows that the freely floating is better (i.e. the loss is lower) than pegged (and basket peg), and the difference between the losses under pegged and freely floating depends on the covariance of productivity shocks between countries B and C. The larger a positive value of the covariance, the smaller the difference is. This is because the cost that the monetary policy in country C is subject to that in country B is smaller as the similarity of economic structures in the two countries increases.[32]

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which could be positive, even for $\operatorname{cov}(\theta_B, \theta_C) = 0$ and $\alpha_B = \alpha_C$, if $\beta > 1/2(1+\gamma)$ as a necessary (but not sufficient) condition. K is a positive constant, $K \equiv 1/(1+\beta+\gamma)$.

[32] Hamada's proposition is translated into our model as, with $q_C = 0$ :

$$E[U_C]_{(27)} - E[U_C]_{(26)} = K\{\gamma^2(\beta+\gamma)\alpha_B^2 + \frac{\beta\gamma^2}{1+\gamma}\sigma_B^2 + 2\gamma^2\alpha_B\alpha_C - \gamma^2(\beta+\gamma+2)\alpha_C^2$$

$$+\frac{\beta\gamma^2}{1+\gamma}\sigma_C^2 - \frac{2\beta\gamma^2}{1+\gamma}\operatorname{cov}(\theta_B, \theta_C)\}$$

where K is a positive constant, $K \equiv 1/(1+\beta+\gamma)$. This expression is positive if $\alpha_B = \alpha_C$

belief that the exchange rate determination is left to the market. Even if the central bank intervenes publicly ($\phi \neq 0$ in equation (25)), the high credibility generated by the balance of payments constraint allows the central bank to maintain the equilibrium exchange rate level ($q_C = 0$). The managed floating regime has characteristics of both the freely floating and a pegged exchange rate regimes.

Under managed floating, while characteristics of the pegged remain, more flexibility of the monetary policy than the pegged is provided and as a result, the balance of payments constraint plays the role of the nominal anchor to the money supply and thus the price level is more likely to be stable than under freely floating. Thus, our general conclusion is that managed floating is likely to be chosen as the most desirable exchange rate regime under certain circumstances. From Figure 3, we find that the possible welfare gains accrue from the covariation of productivity shocks between a large (the key currency) country and a small country, given other parameter values. Thus, the policy implication is that a small country should adopt managed floating when her productivity is positively synchronized with that of the large country. This implication seems to have empirical relevance for many countries, e.g. most of the Asian small countries that coordinate and manage their exchange rates with the US dollar. We believe that, taken together, our examination and the complementary Figure 3 may partly explain why managed floating has been widely adopted as a *de facto* regime (Calvo and Reinhart, 2002).

## 6. Conclusion

This paper has examined managed floating from the point of view of economic welfare using a model modified from Hamada (2002). Hamada's model (2002) compares a single peg and a basket peg with freely floating, but neglects intermediate regimes. Thus, we have attempted to compare managed floating, one of intermediate regimes, with a pegged exchange rate and the freely floating regimes.

Several interesting conclusions emerge from this investigation. These are summarized in *Propositions 1* to *7*. With some restrictive conditions on deviations of the exchange rate from its equilibrium level and the difference in the target rate of increase in real wages, we found that the welfare level of the central bank of the small country under the managed floating is possibly higher than that under other regimes. It was shown that this possible superiority of managed floating accrues from secret (or hidden) intervention which deceives the private sector. We interpret that, by modeling this deception of the private sector, we have successfully incorporated the central bank's regime has a distinct advantage of *independence* of the monetary policies. The intermediate regime considered in this paper inherits those advantages concurrently.

In concluding the paper, we must mention several drawbacks in the present investigation. First, it may not be appropriate to assume the costs of deviation from the equilibrium exchange rate symmetrically in welfare consideration à la Barro and Gordon. Looking at the actual intervention operation, we have frequently observed asymmetric behavior by the central banks. We also implicitly assumed that a small country's government has the same loss as a large country's with regard to employment relative to inflation. This may not be the case, as each government may have different preferences to the trade-off curve of inflation and unemployment. Second, our investigation assumes that the exchange rate is not far deviated from the equilibrium exchange rate. In this sense, our investigation and conclusions are valid only locally. Furthermore the deviation is assumed to be given exogenously in our model and intervention to have no explicit effect. Third, throughout the paper it is implicitly assumed that intervention is unsterilized, which may not truly reflect the actual intervention operation. All of these issues are on our future research agenda.

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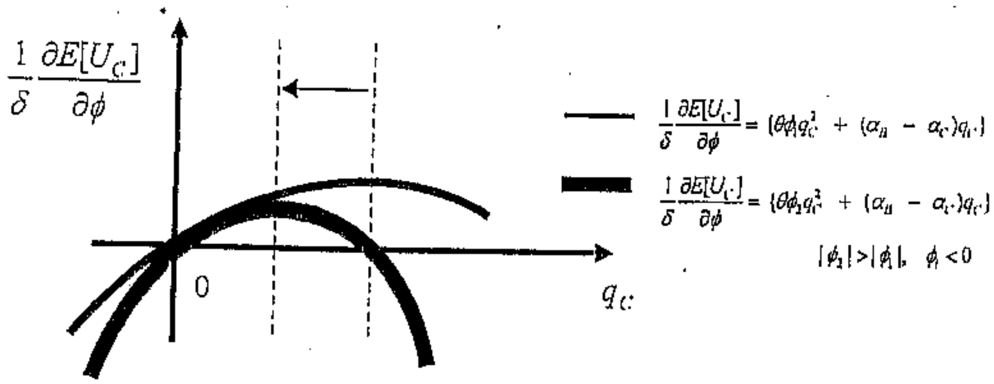
Figure 1 The Effects of Intervention

$q_C > 0$ *and* $\alpha_B > \alpha_C$ *(The 1st and 4th quadrants)*

$q_C < 0$ *and* $\alpha_B > \alpha_C$ *(The 3rd quadrant))*

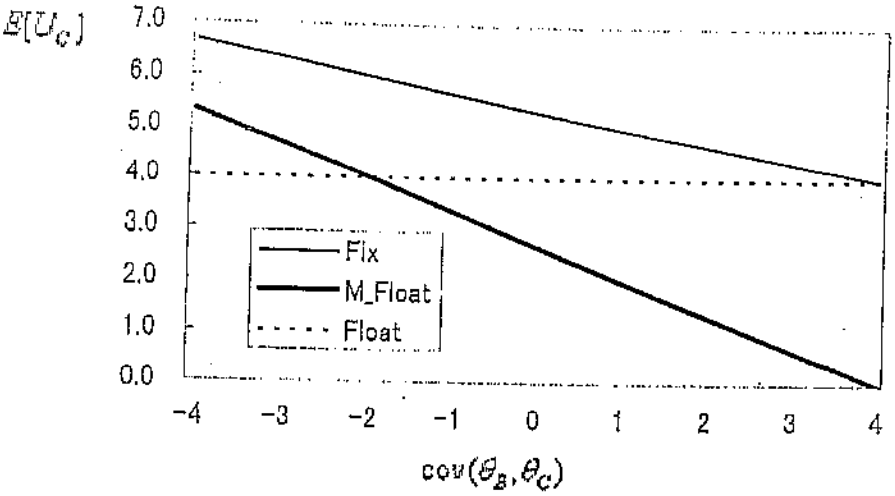



Remarks: Parabola: Equation (28')

The axis: $q_C = (\alpha_B - \alpha_C)/2\theta\phi$

The vertex: $(\frac{(\alpha_C - \alpha_B)}{2\theta\phi}, -\frac{(\alpha_B - \alpha_C)}{4\theta\phi})$

Figure 3 Relationship between the expected loss and the covariance




Remarks: Fix = Fixed (or Pegged) Exchange Rate regime

M_Float = Managed Floating regime

Float = Freely Floating regime

Three curves are drawn with:

$q_C = 0$, $\beta=1$, $\gamma=1$, $\alpha_B=1$, $\alpha_C=1$, *and therefore* $\sigma_B^2=4$ *and* $\sigma_C^2=4$.

Table 2 The Effects of Stronger Intervention on the Expected Loss

| deviations from the equilibrium rate | Target rate of increase in real wage | Changes in the expected loss by leaning-against-the-wind intervention | Remarks |
|---|---|---|---|
| $q_e > 0$ | $\alpha_B > \alpha_C$ | decrease (smaller)<br>increase (larger) | Figure 1, 1st and 4th quadrants |
| | $\alpha_B < \alpha_C$ | increase (larger) | Figure 2, 4th quadrant |
| $q_e < 0$ | $\alpha_B > \alpha_C$ | increase (larger) | Figure 1, 3rd quadrant |
| | $\alpha_B < \alpha_C$ | decrease (smaller)<br>increase (larger) | Figure 2, 2nd and 3rd quadrants |