COORDCAB3.DOC
11/20/98

Economic Consequences of Pegging to the Dollar In a Multicurrency World

Koichi Hamada*
(Yale University)

ABSTRACT

This paper studies the monetary mechanism of a three country world where two large countries are engaged in floating exchange rates and a small country is pegged to one of these large countries. Three countries possess the wage negotiating process (Barro and Gordon, 1983) and price rigidities that trigger overshooting of exchange rates (Dornbusch, 1976).

A simple monetary approach to the balance of payments indicates that this arrangement can create serious difficulties for the small country. Monetary or exchange rate coordination between the large countries hardly helps the small country. Complete float of the small country and the currency basket pegging are promising alternatives. Unless complete float increases the militancy of the labor union, the complete float seems to be a better choice between these two alternatives.

* I am much indebted to Debbie Rueb for her meticulous typing and assistance.

Economic Consequences of Pegging to the Dollar
In a Multicurrency World

Koichi Hamada

Financial crises are caused by the combination of various unfortunate factors as the derailment of a train by concurrence of reasons. In this paper, I will concentrate on one factor among them, that is, the misalignment of exchange rates. I will study the effect of pegging to the dollar in the world where major currencies are in float, and the emergence of financial crises. I also explore the question how the pegging system can be improved. Discussions are conducted in the context of the incentive structure that lies behind a country's choice for a certain exchange rate regime.

While dominant players in the world financial market, such as the United States and Japan, are under flexible exchange rates, smaller countries such as Thailand and Indonesia used to peg their currencies to the dollar. When adverse shocks hit Japan, in the decade of 1990s, Japan adopted the easy money policy that depreciated the yen with respect to the dollar. In the short run,when the wage-price rigidity prevails, the Dornbusch type of overshooting of the exchange rate was ignited. The jumps in the dollar exchange rate had negative spill-over effect, that is, the "beggar my neighbor" effect on other countries outside Japan. The United States was in a boom, however, so that it did not react with expansionary monetary policy until very recently in 1998.

Naturally, as a result, developing countries in Asia experienced difficulty as the overshooting depreciation of the yen directly affected their economies directly. Their policy reactions to sustain the fixed exchange rate with the US dollar eventually failed As soon as the danger of their failure was foreseen, their currencies were subject to severe speculative attacks. This is the scenario of financial crises from the perspective of the exchange rate misalignment. As already mentioned, this may be a highly simplified, picture that focuses only on the factor among others. But, I regard this explanation as important, and as worth examining. The nature of the process in the light of the degree of flexibility of the economies depend on the nature of macoreconomic interdependence, and the incentive for a country to defect from the fixed peg

system to the flexible exchange rate. I illustrate in this paper this mechanism with a prototype model of macroeconomic interdependence, and describe strategic interactions for cooperation and conflicts in the context of the Asian scene. I plan to assess the effect of policy coordination among large countries on a small Asian country.

We use the familiar framework of Barro and Gordon (1983) with slight modifications. In each country first the public proposes wage, and then the monetary authority conducts monetary policy. The monetary authority decides on monetary policy after knowing the wage level set by the public, or the price expectations formed by the public in alternative interpretation. As the alternative environment for this two-stage process, we have to distinguish the following features of the economy.

First, the distinction of the exchange rate regimes. Under the flexible exchange rate a monetary authority can directly decide its money supply and essentially decides its price level. Under the fixed exchange rate the money supply becomes a dependent variable jointly determined by credit expansions of the participating countries. The price levels will be aligned among countries and equal to the weighted average of the excess credit expansions in those countries. The balance of payments of a country is determined by the difference between the weighted average of excess monetary expansion and the rate of excess credit expansion of the country. Here, the excess credit expansion is defined as the increase in the liability (normalized by the money supply outstanding) of a central bank in excess of the credit expansion needed to keep the domestic price level constant. In this paper, we analyze a system that incorporates both mechanisms, the flexible exchange rate and the fixed exchange rate.

Second, we have to distinguish between, the flex-price world in the Hicksian sense and the "inertia world," that is, the fix-price world. Needless to say, in a genuinely classical world where both wages and prices are flexible, the neutrality of money prevails and, accordingly, the exchange rate regime hardly matters. Only exceptional factors are the effects of the requirement of international reserves on monetary policy under the fixed-exchange rate and the freedom of choosing the rate of inflation under flexible exchange rates (Helpman, 1981). After the advent of the rational expectations revolution and the dominance of the real business cycles approach, the economic profession strongly favors the analysis of the classical system where wages as well as prices are flexible and the flex-price system defined above. On the other hand, actual course of

events like the Asian financial turmoil seems to indicate that price inertia still plays a significant role in the real world.

In this paper, we utilize a simplified, discrete version of the eclectic world analyzed by Dornbusch (1976) in his well-known exchange rate determination model.

In the world economy we call "the inertia world," below prices adjust only partially in the first period, but completely adjust only in the second period. Between the first and the second period, the exchange rate overshooting is assumed essentially in the way as Dornbusch (1976) formulated. Thus the effects of the monetary policy and the policy coordination appear differently in the two different periods. Under the flexible exchange rate, in the first period, non-traded goods prices stay constant but trade goods prices jumps in a manner consistent with overshooting exchange rate process. In the first period, the policy prescription by Mundell (1963) applies with the link to the second period by rational expectation. The structure of monetary interdependence is similar to Canzoneri and Gray (1985) and Cooper (1984). In the second period, the economy will return to the flexible price equilibrium. The structure of this process has the nature of strategic complements.

Of course, the Dornbusch type of adjustment may be only one of the alternative descriptions of the real world. It is, however an alternative, to be used as an experimental ground. We do not provide a microeconomic foundation to the Dornbusch type of adjustment, but possible explanation could be found in terms of quadratic adjustment costs of prices or monopolistic competition (Corsetti and Pesenti, 1997).

We consider a three country economy with the inertia structure in each country. (See Figure 1) Country A and country B, like Japan and the United States, are large countries, and they engage in the flexible exchange rate. with respect to each other. Country C, like Thailand, is a relatively small country, and its currency, say Baht, is linked by the fixed exchange rate with the currency of B, say dollar. In this framework, we ask the following questions: (I) What happens to Country C if Country A is hit by an adverse supply shock and starts to devaluate its currency with respect to B's currency? (II) Is the exchange rate coordination between Country A and Country B beneficial or detrimental to Country C? (III) Does the floating of currency C help the economic situation of Country IV? And, (IV) does it help Country C if it fixes its currency to a basket of currencies consisting of the currency of A and that of B?

The Basic Framework

The macroeconomic framework, similar to that of Barro and Gordon (1983), consists of the following process. Within each country, the public, which you may think as the labor union or the negotiation between the labor union and the management, sets the nominal wage. Then the central bank conducts monetary policy aiming to stabilize the price level and the employment. The linkage of price levels and employment as well as the interactive effects of monetary policy depends on the exchange rate regimes and on the presence or absence of monetary policy coordination.

I consider a three country version of the model. Three countries are under macroeconomic disturbances but under no technological progress. All variables are written in terms of the rate of increase except the domestic credit expansion and the balance of payments that are normalized by the existing stock of money.. In country K, first, the public proposes a rate of increase in the nominal wage, w_K, (K = A, B, C) Next, the exogenous supply shock θ_K (K = A. B. C) is observed. If θ_K is positive (negative), the shock is favorable (unfavorable). Then, after observing the wage, the central bank determines the domestic credit expansion normalized by the money stock, which is denoted by x_K . x_K is defined as $x_K = \Delta D_K/M_K$, where ΔD_K indicates the excess domestic credit expansion, and M_K indicates the money stock in Country K. x_K will be equal to the rate of increase in money supply m_K under the flexible exchange rate. Let $\bullet_K$ be the relative size of countries so that $\sum_{K=1}^{3} \omega_K = 1$. But, $\bullet_C$ is small such that $\bullet_C \cong 0$ and $\bullet_C + \bullet_B \cong 1$.

The objective function of the public that moves first is:

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

where α_K is nonnegative ($\alpha_K \geq 0$) and indicates the desirable rates in increase in the real wage. E[ ] is the operator for taking mathematical expectation. The values parameter α_K can vary across country, reflecting the military of the labor union, for example. The public or the labor behaves to minimize the loss function L_K . The rationale for the objective function is that the labor seeks wage higher than the rate of inflation but that wages too much higher than the rate of inflation hurts the labor by reducing the level of unemployment. The underlying structure of the

economy is that the employment is determined by $w_K - p_K = f'(y_K)$, where y_K is the level of employment and f is the production function ($f' > 0$, and $f'' < 0$). In the two period setting to be dealt in this paper, the objective become

$$(1) \qquad L_K = E\{\frac{1}{2}[(w_K - p_{KI} - \alpha_K)^2 + (w_K - p_{KII} - \alpha_K)^2]\}.$$

Before the next (human) player, the central bank, moves, nature sends an exogenous disturbance to each economy, θ_K, such that $E[\theta_K] = 0$, $E[\theta_K^2] = \sigma^2$, (for K = A, B and C) and that θ_K is independent across country so that $E[\theta_J\theta_K] = 0$ for J • K. A higher realization of θ_K implies a favorable condition for the macroeconomy like a positive supply shock, and a lower one is like a negative supply shock. Those shocks affect directly the unemployment so that the rate of employment becomes $p_K - w_K +$ • $_K$. The central bank of each country attempts to minimize the loss function that depends, in addition to the foreign reserve objectives under the fixed rate, the rate of inflation p and the level of unemployment ($p_K - w_K +$ • $_K$). That is, the central bank of a major country under flexible rates, would minimize in a single period analysis $V_K = p_K^2 + \gamma(p_K - w_K + \theta_K)^2$, where γ is the strength of concern about the employment level by the central bank, and $1/\gamma$ is the degree of commitment to the price stability by the central bank.[1] It is assumed that the central bank of country K knows at the time of decision about the current value of θ_K of its own country. Whether or not it knows è$_J\gamma$ of the other countries depend on the state of communication and policy coordination. This point will be a topic in another paper.

Under the two period setting below, the objective of A and B's central bank becomes

$$(2) \qquad U_K = \frac{1}{2}\{[p_{KI}^2 + \alpha(p_{KI} - \omega_K + \theta_K)^2] + [p_{KII}^2 + \gamma(p_{KII} - \omega_K + \theta_K)^2]\}. \quad K = A \text{ and } B.$$

U_C depends on the regime Country C is under, and will be explained later.

For the monetary authority, the strategic instrument depends on the exchange rate regime. Under the flexible rates, money supply can be directly controlled. Under the fixed rate, the rate

[1] In the original version by Barro and Gordon (1983), the employment loss (gain) was incorporated in a linear form. We use the quadratic loss form because it allows monetary policy to respond to the wage demand. For a similar formulation to ours see Vickers (1986).

of domestic credit expansion, x_K, is no longer equals a country's money supply and money supply becomes endogenous.

After the monetary policy is conducted, its effect will be realized in the two periods. In the first period, the price does not move or sticky in each country. Interest rates change and exchange rates are adjusted in the Dornbusch fashion. The economy that takes relatively more aggressive monetary expansion experiences a overshooting currency devaluation and its stimulating effect on output. In the second period, the world economy in either exchange-rate regime returns to the classical world with price flexibility.

The different exchange rate regimes, flexible exchange rates and fixed exchange rates, affect the monetary mechanism in our model in the following way.

Under the flexible exchange rate, accordingly for Country A and Country B, each monetary authority has the autonomy of monetary policy so that $m_K = x_K$, K = A and B, where m_K is the rate of money supply increase in country K. Since there is no constraint from the level of international reserves, monetary authority is chiefly concerned with the domestic economic conditions. Rigorously speaking, Country B should be affected by the monetary policy of Country C because it is linked with Country C by the fixed exchange rate. Nevertheless, since we have assumed that the size of Country C is relatively very small to Countries A and B, we can neglect the effect of policies taken by Country C.

Country B and Country C are connected under the fixed rate, in our prototype model. Thus, the price levels of the two countries are mutually aligned. Later, I relate the assumption of fixed exchange rates and compare its economic performance with those under floating and basket float models. In the second period when prices fully adjust, the common rate of inflation will equal $(\omega_B x_B + \omega_C x_C)/(\omega_B + \omega_C) = \bar{x}$ which is almost equal to x_B since $\bullet_C$ is very small. Under the fixed rates, a country other than the reserve currency country is constrained to attain a desired increase in foreign reserves. In our setting, Country B is the reserve currency country, so B is free of this requirement, But Country C will be penalized to achieve the increase of reserves less than R_C, which is measured as the desired increase in foreign reserves normalized by the money stock M_C. The balance of payments of Country C is written as $(\bar{x} - x_C) = x_B - x_C$, where $\bar{x}$ is the weighted average of monetary expansion. Therefore, the objective function of the central bank of C is

(2C) $$U_C = \frac{1}{2}\{[p_{CI}^2 + \gamma[p_{CI} - \omega_C + \theta_C]^2 + [p_{CII}^2 + \gamma(p_{CII} - \omega_C + \theta_C]^2\} + \beta[x_B - x_C - R_C]^2.$$

Thus, the requirement of R_C puts an additional constraint for the monetary authority. The fixed exchange rate regime is still a rational choice when the economy cannot sustain price stability either because the labor union is militant so that the higher value of $\bullet_K$ will result in an inflationary choice for the society, or because the central bank or the government has a weak preference for price stability so that the nation cannot attain its nationally desirable state of inflation.[2]

The Snap-Shot Dornbusch Model

Let us recall the mechanic of the Dornbusch model, which in my opinion, still captures realistically the exchange rate dynamics of the price-inertia world. In presence of external shock like monetary expansion, first, the price level stays the same, the interest rate goes down and triggers the overshooting of the exchange rate. Eventually, economic variables move to a long-run (flex-price) equilibrium where interest rates return to the initial level and money becomes neutral. Instead of assessing all the welfare effects associated with the total course of the dynamic paths by integrating all the instantaneous benefit, I will simplify the model into two "snap-shot" pictures of the process. First, the initial point which I call period I, and next the long-run equilibrium point which I call period II. I will solve backward, the exchange rate of period I from period II. Let us make Country B as the numeraire country of currency and e_A as the value of currency B in terms of currency A (yen/dollar rate for example) and e_C as the value of currency B in terms of currency C (baht/dollar rate, for example).[3] In period II, where the effect of interest rate can be neglected, applying the monetary approach we obtain

(3) $$p_{KII} = x_K + z_{KII}, \qquad K = A, B, C$$

where p_K , x_K and z_K are respectively the rate of increase in price level excess credit expansion and increases in reserves, both normalized by existing money stock.

---

[2] Of course, the fixed exchange rate delivers an additional benefit from exchange rate stability, predictability and the saving of transaction cost, which is certainly relevant in the case of European Union. The last element will be outside the scope of this paper.

[3] An increase in e_A, for example, implies the devaluation of currency of Currency A with respect to Currency B.

The relationship can be derived from the monetary approach to the balance of payments in the following fashion (Johnson, 1972; Hamada, 1976). If money supply, international reserves and domestic credit creation by M, R and D, the money supply equation is $M_K = R_K + D_K$, accordingly,

(4) $$\frac{\dot{M}_K}{M_K} = \frac{\dot{R}_K}{M_K} + \frac{\dot{D}_K}{M_K}, \qquad K = A, B, C.$$

If we neglect the effect of interest rates and writing the income elasticity of money demand as • , money demand equation is

(5) $$\frac{\dot{M}_K}{M_K} = \frac{\dot{P}_K}{P_K} + ç\frac{\dot{Y}_K}{Y_K}, \qquad K = A, B, C.$$

From (4) and (5)

$$\frac{\dot{P}_K}{P_K} = \frac{\dot{R}_K}{M_K} + \left(\frac{\dot{D}_K}{M_K} - ç\frac{\dot{Y}_K}{Y_K}\right), \qquad K = A, B, C.$$

Considering the good arbitrage

and writing $\frac{\dot{P}_K}{P_K} = p_K$, excess credit expansion $\left(\frac{\dot{D}_K}{M_K} - ç\frac{\dot{Y}_K}{Y_K}\right) = x_K$, and normalized increase in reserves as z_K, one obtains the above equations (3).

(6) $\frac{\dot{P}_K}{P_K} - e_K = \frac{\dot{P}_B}{P_B}$, in period II, (3) becomes,

(3A) $p_{BII} + e_{AII} = x_A$,

(3B) $p_{BII} = x_B$,

(3C) $p_{BII} + e_{CII} = x_C + z_{CII}$.

Here we assume $z_{KII} = 0$ for K=A and B because Country A and Country B are under flexible rates. By taking the weighted average by monetary weight (assume that it is identical to GDP weight) $\omega_K = \frac{M_K}{(M_A + M_B + M_C)}$, K = A, B and C, and $\omega_C \cong 0$, one obtains

$$p_K + (\omega_A e_A + \omega_C e_C) = \sum \omega_K z_K + \sum \omega_K x_K$$

or

(7) $p_K + (\omega_A e_A + \omega_C e_C) = G_R + \bar{x}$,

Here G_R is the rate of growth of reserves for the world which can be regarded as constant, and we take this to be zero now. $\bar{x}$ is the (money) weighted average of credit expansion. Now we can distinguish three cases: IIP) Currency C is pegged to Currency B, IIF) Currency C is under float and IICB) Currency C is pegged to a currency basket.

IIp) Country C pegs its currency to the currency of B. Then, $e_{CII} = 0$. Then,

(8) $e_{AII} = x_A - x_B$

(9) $p_{BII} \cong (\omega_A x_A + \omega_B x_B) - \omega_A e_{AII} = \bar{x} - \omega_A e_{AII}$

(10) $z_{CII} = x_B - x_C$

(11) $p_{CII} = p_{BII}$

because $\omega_A + \omega_B \cong 1$.

IIF) Country C floats its currency. Then,

(12) $z_{CII} = 0$

(13) $e_{AII} = x_A - x_B$

(14) $e_{CII} = x_C - x_B$

(15) $p_K = x_K$ (K = A, B, and C)

IIB) Country C pegs its currency to a weighted currency basket. Weight being the relative size of the trading partner: then, since (8) is still valid, $e_{CII} = \omega_A e_{AII} = \omega_A (x_A - x_B)$ and z_{CII} becomes again the endogenous variable

(16) $p_{BII} \cong (\omega_A x_A + \omega_B x_B) - \omega_A e_A = x_B$

(17) $z_{CII} \cong (\omega_A x_A + \omega_B x_B) - x_C = \bar{x} - x_C$

again using $\omega_C \cong 0$.

Now we can go back to the earlier stage, period I. It is assumed that price does not move at this stage, but interest rates will decrease by monetary expansion by the liquidity preference schedule. Let us assume the sensibility of money demand to interest rate is common in all countries and denote it by $\bullet$. Then in each country

(20) $-\eta i_{KI} + p_{KI} = x_K + z_{KI}$ K = A, B, C.

However, since $p_{KI} = 0$

(21) $-\eta i_{KI} = x_K + z_{KI}$ K = A, B, C

Considering the fact that $z_{KI} = 0$ for K = A and B, we obtain

(21A) $-\bullet\ i_{AI} = x_A$

(21B) $-\bullet\ i_{BI} = x_B$

(21C) $-\bullet\ i_{CI} = x_C + z_{KI}$

We have interest parity conditions from period II.

(22A) $i_{AI} = i_{BI} + (e_{AII} - e_{AI})$

(22B) $i_{CI} = i_{BI} + (e_{CII} - e_{CI})$

By the interest arbitrage, one has

(23A) $e_{AI} = e_{AII} + (i_{BI} - i_{AI}) = (1 + 1/\bullet\ )(x_A - x_B)$,

where $1/\bullet$ shows the degree of overshooting.

Again consider the alternative sub-regimes, Currency C is either pegged to B or under float, or pegged to a currency basket.

Ia) Country C pegs it currency to Currency B.

$e_{CII} = e_{CI} = 0,\ i_{CI} = i_{BI}$

And,

$i_{AI} = -x_A/\bullet\ ,\ i_{BI} = i_{CI} = -x_B/\bullet$

$z_{KI} = x_B - x_C$

IF) Currency C is on float. Then, obviously,

(24) $e_{AI} = (1+\frac{1}{\eta})(x_A - x_B)$,

and

(24C) $e_{CI} = (1+\frac{1}{\eta})(x_C - x_B)$.

ICB) Currency is pegged to a currency basket

Since $e_{AI} = (1+\frac{1}{\eta})(x_A - x_B)$,

(25C) $e_{CI} = \omega_A(1+\frac{1}{\eta})(x_A - x_B)$.

In this case i_{CI} is determined from e_{CI} in the interest parity relationship.

(26) $i_{CI} = i_{CI} - \omega_A \cdot \frac{1}{\eta}(x_A - x_B)$

$$= -\frac{x_B}{\eta} - \omega_A \frac{1}{\eta}(x_A - x_B)$$

$$= -\frac{1}{\eta}(\omega_A x_A + \omega_B x_B) = -\frac{\overline{x}}{\eta}$$

The interest rate of a pegging country depends on the weighted average of excess monetary expansion of Country A and Country B.

Central Bank Objectives and Strategic Interaction of Monetary Policy

Let us now posit the following objective function for the monetary authorities with:

(27) $U_K = \frac{1}{2}[(-\varepsilon i_{KI} + \sum_J h\omega_J e_{(KJ)I} - \omega_K + \theta_K)^2 + p_{KII}^2]$, K = A, B, and C.

In the second period, no real effects remain and the objective function is straightforward on price that depends on monetary policy. In the first period, the objective function depends on the positive effect of lower interest rate on economic activities, the export drive effect through depreciated exchange rates and the effect of the wage and supply shock. e_{KJ} is the exchange rate of currency J expressed in terms of currency K, so that a higher value of e_{KJ} corresponds to the depreciation of K's currency. The effects from exchange rates are assumed to depend on the degree of openness and the relative share of the trade partner in the world economy. Let • be the sensitivity of economic activity with respect to a lower interest rate, and h is the sensitivity of economic activity with respect to a unit depreciation of exchange rates $e_{(KJ)}$ in the first period.

Thus,

(27A)

$$U_A = \frac{1}{2}[(-\varepsilon i_{AI} + he_{AI} - w_A + \theta_A)^2 + p_{AII}^2] = \frac{1}{2}\{[(h + \frac{h+\varepsilon}{\eta})x_A - h(1+\frac{1}{\eta})x_B - (w_A - \theta_A)]^2 + x_A^2\}$$

$$= \frac{1}{2}\{[(bx_A - ax_B - (w_A - \theta_A)]^2 + x_A^2\}$$

(27B)

$$U_B = \frac{1}{2}[(-\varepsilon i_{BI} - he_{AI} - w_B + \grave{e}_B)^2 + p_{BII}^2] = \frac{1}{2}\{[-h(1+\frac{1}{\eta})x_A + (h + \frac{h+\varepsilon}{\eta})x_B - (w_B - \theta_B)]^2 + x_B^2\}$$

$$= \frac{1}{2}\{[-ax_A + bx_Y - (w_B - \grave{e}_B)]^2 + x_B^2\},$$

Where we write $h(1+\frac{1}{\eta}) = a$, $h + \frac{h+\varepsilon}{\eta} = a + \frac{\varepsilon}{\eta} = b$, where $b - a = \frac{\varepsilon}{\eta} > 0$. For Country C, one has

(27C)

$$U_C = \frac{1}{2}[(-\varepsilon i_{CI} + h(e_{CI} - e_{AI}) - \omega_C + \grave{e}_C)^2 + p_{CII}^2] = \frac{1}{2}\{[-\frac{\varepsilon}{\eta}x_C + h(e_{CI} - e_{AI}) + (w_C - \theta_C)]^2 + p_{CII}^2\}$$

Whatever the exchange rate regime of Country C, may be it does not affect the optimal decisions of monetary policy (accordingly the wage formation) of Country A and B. Therefore, we can solve the system with respect to x_A and x_B independently of x_C. The optimizing conditions for x_A and x_B are

(28A) $b(bx_A - ax_B) - (w_A - \theta_A) + x_A = 0$

(28B) $b[-ax_A + bx_B] - (w_B - \theta_A) + x_B = 0$

These equations will give the solutions

(29A) $x_A = \frac{b}{D}[(1+b^2)(w_A - \theta_A) + \dot{a}b(w_B - \theta_B)]$,

(29B) $x_B = \frac{b}{D}[ab(w_A - \theta_A) + (1+b^2)(w_B - \theta_B)]$,

where $D = [1+b^2]^2 - a^2b^2 > 0$ because b > a.

We note at the Nash equilibrium and given the militancy of the union and disturbances, ($w_A - \bullet_A$) and ($w_B - \bullet_B$), the following difference between the monetary policies of A and B indicates the degree of cost to be borne by Country C. The difference enters into the cost of Country 3.

(30) $x_A - x_B = b(1+b^2+ab)^{-1}[(w_A - \theta_A) - (w_B - \theta_B)]$

The policy coordination solution is illustrated by the solution maximizing, for example, $\frac{1}{2}(U_A + U_B)$ such that,

(31A) $(1+a^2+b^2)x_A - 2abx_B = b(w_A - \theta_A) - a(w_B - \theta_B)$

(31B) $-2abx_A + (1+a^2+b^2)x_B = -a(w_A - \theta_A) + b(w_B - \theta_B)$

(32A) $x_A = \frac{1}{D'}\{(1-a^2+b^2)b(w_A - \theta_A) - (1+a^2-b^2)a(w_B - \theta_B)\}$

(32B) $x_B = \frac{1}{D'}\{-(1+a^2-b^2)a(w_A - \theta_A) + (1-a^2+b^2)a(w_B - \theta_B)\}$

where $D' = (1+a^2+b^2)^2 - 4a^2b^2 > 0$

Second, we may note first that *the proper monetary coordination under the flexible exchange rate requires a country to react negatively to the shock in the other country.* If Japan is hit by a negative shock, the way the United States cooperates is to adopt or at least keep a tight stance in its monetary policy. This is in contrast to the popular notion that monetary coordination is to conduct monetary policy in the same direction.

(33) $x_A - x_B = \frac{1}{D'}\{[(1-a^2+b^2)b + (1+a^2-b^2)a][(w_A - \theta_A) - (w_B - \theta_B)]$

which is not necessarily smaller than $x_A - x_B$ in a non-coordination case. In fact, when the effect though interest is negligible so that $\bullet = 0$ and a = b, it is easy to show from (30) and (34).

(35) $-|x_A - x_B|_{\text{COORDINATED}} = 0.$

Even though the coefficient on $|x_A - x_B|$ is slightly magnified in the coordination case,[4] $|x_A - x_B|$ itself vanishes under the coordination.

Thus we have found the following: *If two larger countries are playing the Nash monetary game in the inertia world, the small country that pegs its currency to the currency of one of the larger countries will have hardship, torn between the objective of keeping reserves and the objective of coping with recession resulting from the depreciation of the other large country. This effect is generally offset by the presence of policy coordination between the two large countries. Policy coordination may intensify the hardship of a small country.*

As is illustrated in Figure 2, the strategic structure of this monetary policy game is that of strategic complements. When Country A is attached by an adverse shock ($(\theta_A < 0)$, then the reaction curve of A will shift to the right. The Nash equilibrium moves from P to Q. The severity of spillover effect depends on the distance between 45 degree sloped line like that through P and that through Q. The coordination shifts the equilibrium to R instead of Q. The distance between the 45 degree line through P and that through R depends on the position of R in the contract curve, which in turn the relative bargaining power. At least the above example indicates that cooperation between Country A and Country B may not be a blessing to Country C.

The Choice for a Small Country

Let us now return to the state of the small country, Country C. We have to distinguish three cases as already explained.

(P) Currency C is pegged to Currency B, $e_{CI} = 0$, $p_{CII} = x_B$.

$$(36) \qquad U_C = \frac{1}{2}\{[\frac{\varepsilon}{\eta}x_C - h(1+\frac{1}{\eta})(x_A - x_B) - (w_C - \theta_C)]^2 + x_B^2\} + \beta(x_B - x_C - R_C)^2$$

What Country C can do is to minimize the last square expression, so that

$$\left[\frac{\varepsilon^2}{\eta^2} + 1 + 2\beta\right]x_C - a(x_A - x_B) - (\omega_C - \theta_C) + 2\beta(x_B - R_C) = 0$$

[4] The following inequality holds

$$\frac{a}{D} - \frac{2a}{D'} = \frac{a}{(1+2a^2)} - \frac{2a}{(1+4a^2)} < 0.$$

(37P) $x_C = \left[\left(\frac{\varepsilon}{\eta}\right)^2 + 1 + 2\beta\right]^{-1}\{a(x_A - x_B) + (w_C - \theta_C) + 2\beta(x_B - R_C)\}$,

where $a = h(1+\frac{1}{\eta})$.

The first term in the last brace is the dead weight loss to the country whatever the conduct of C's monetary policy x_C. In particular, the term $(x_A - x_B)$ becomes a heavy burden if $(x_A - x_B)$ is positive. If Country A triggers expansionary monetary policy, then the utility loss for the small country can be great. *The burden can be eliminated if Country A and Country B engage in monetary policy coordination as is seen from the discussion of equation (35) above. The single currency peg is harmful to the small country*.

(F) Currency C is in float. Then the last square of U_C is neglected.

(38F)
$$U_C = \frac{1}{2}\{[\frac{\varepsilon}{\eta}x_C + h(1+\frac{1}{\eta})w_A(x_C - x_A) + w_B(x_C - x_B) - (w_C - \theta_C)]^2 + x_C^2\}$$
$$= \frac{1}{2}\{(h + \frac{h+\varepsilon}{\eta})x_C - h(1+\frac{1}{\eta})\bar{x} - (x_C - \theta_C)]^2 + x_C^2\}$$
$$= \frac{1}{2}\{(bx_C - a\bar{x} - (w_C - \theta_C)]^2 + x_C^2\}$$

Optimal condition is

$(1+b^2)x_C = ab\bar{x} + b(\omega_C - \theta_C)$

and thus

(39F) $x_C = [ab\bar{x} + b(\omega_C - \theta_C)]/(1+b^2)$

(CB) The case when exchange rate is pegged to the market basket. Accordingly,

$e_{CI} - \omega_A e_{AI} = 0$,

(40) $U_C = \frac{1}{2}\{[\frac{\varepsilon}{\eta}x_C - (w_C - \theta_C)]^2 + \bar{x}^2\} + \beta[(\bar{x} - x_C) - R_C]^2\}$

which gives us the optimal condition

(41BC) $x_C = \left[\frac{\varepsilon}{\eta}(w_C - \theta_C) + 2\beta(\bar{x} - R_C)\right]/\left[\left(\frac{\varepsilon}{\eta}\right)^2 + 2\beta\right]$.

Let us compare the minimum values of loss for each other and Country C in these three different sub-regimes. Under the single country peg (regime-P):

$$\text{(42P)}\quad \min U_{C'} = \frac{1}{2}[\frac{\varepsilon}{\eta}(\bar{x}_B - R_C) + a(x_A - x_B) + (w_C - \theta_C)]^2 / \left[\left(\frac{\varepsilon}{\eta}\right)^2 + 2\beta\right] + \frac{x_B^2}{2}$$

Under the complete float (regime-F)

$$\text{(42F)}\quad \min U_{C'} = \frac{1}{2}[ax + (w_C - \theta_C)]^2 / (b^2 + 1).$$

Under the basket float (regime-CB)

$$\text{(42CB)}\quad \min U_{C'} = [\frac{\varepsilon}{\eta}(\bar{x} - R_C) + (w_C - \theta_C)]^2 / \left[\left(\frac{\varepsilon}{\eta}\right)^2 + 2\beta\right] + \frac{\bar{x}^2}{2}.$$

One can make the following observations: In the regime of single currency peg, a country relies on the policy preference of Country B to whose currency it is pegged. Also, the discrepancy between the world money supply and the reserve requirement, $(\bar{x} - R_C)$, internal wage and real shocks $(\omega_C - \theta_C)$ affect the objective of Country BC. Most importantly the discrepancy of monetary policy between Country A and B, in particular, the devaluation of Country A affects unfavorably to the objective of U_C.

Under the complete float system, $(w_C - \theta_C)$ affects the welfare of Country C, so does the average money supply. But the discrepancy of monetary policy between A and B, $(x_A - x_B)$ creates no difficult problem for Country C.

Under the market basket float, the average money supply of the world plays an important role, but the effect of the discrepancy between monetary policy of A and that of B will also disappear. Here what matters is the weighted average of the world monetary policy $\bar{x}$ and not $(x_A - x_B)$.

Endogenous Wages

The next task is to go back to the wage negotiating process. The total comparison can be made after the wage responses in each regime is taken into account. The minimization of the labor's utility at the wage setting process is by equation (1)

(43) $w_K = \frac{E(p_{KI}) + E(p_{KII})}{2} + \alpha_K$, K = A, B, and C

Since, $E(p_{KI}) = 0$, and $E(p_{KII}) = E(p_K)$, (46) becomes

(44) $w_K = \frac{E(x_K)}{2} + \alpha_K$, K = A, B and C.

or $E(x_K) = 2(w_K - \alpha_K)$

Let us start from Country C and pegging case P. Taking the expectation of (37P), on obtains

$2(w_C - \alpha_C) = g\{aE(x_A - x_B) + w_C + 2\beta(E(x_B) - R_C)\}$ where $g = \left[\frac{\varepsilon}{\eta}\right]^2 + 1 + 2 + \beta$.

Accordingly, it follows

(45P) $w_C = \{2\alpha_C + ga[E(x_A) - E(x_B)] + 2g\beta(E(x_B) - R_C)]\}/(2 - g)$

Here w_C depends on the discrepancy between the monetary policy between A and B. Also w_C is strongly suppressed by the reserve requirement. The morale of having a fixed rate system is that it may dampen the wage demand. These two effects should be compared.

Next consider the case of float. From equation (39), one obtains

$2(w_C - \alpha_C) = [abE(\bar{x}) + bw_C]/(1 + b^2)$

or

(46F) $w_C = [2\alpha_C + abE[\bar{x}]/(2 - \frac{b}{1 + b^2})$.

The wage process is encouraged by the inflationary tendency of the major countries.

Finally, in the currency basket case, (Case of CB), from (41CB) one obtains

$2(w_C - a_C) = [\frac{e}{h}w_C + 2ba(E(\bar{x}) - R_C)\}/f$, where — .

Thus,

(47CB) — –

I would not over-crowd the attention of the reader by working out a similar exercise for the time consistent wages for A and B in the symmetric case. The results are as follows. By noting $w_A = w_B$, assuming and a = b, one obtains in the Nash case

(48) — .

For the coordination case

(49) .

The comparison between (48) and (49) shows that coordination dampens the wage behavior. The merit of coordination was recognized not only in the harmonious conduct of monetary policies, but also in the less militant attitude of the labor unions. Despite the intellectually stimulating counter example of Rogoff (1985) that cooperation can be unproductive, this setting provides the example where its normal benefit prevails. Thus, under the basket float, wages tend to respond to the overall monetary policy $\bar{\ }$ in the world.

In short, the peg to the dollar and the peg to the currency basket have the deterrence effect on wage through credibility of the monetary authority under international reserve constraints. The float system does not have this merit, but instead can get rid of the loss due to the discrepancy of monetary policy A and B. The peg to a single country suffers from this discrepancy through the policy stabilization effect as well as wage pressure that anticipates the devaluation of Country A. Only when the labor demand is very strong, a reasonable case for the currency basket peg can be made, in place of a clean float.

Tentative Conclusions

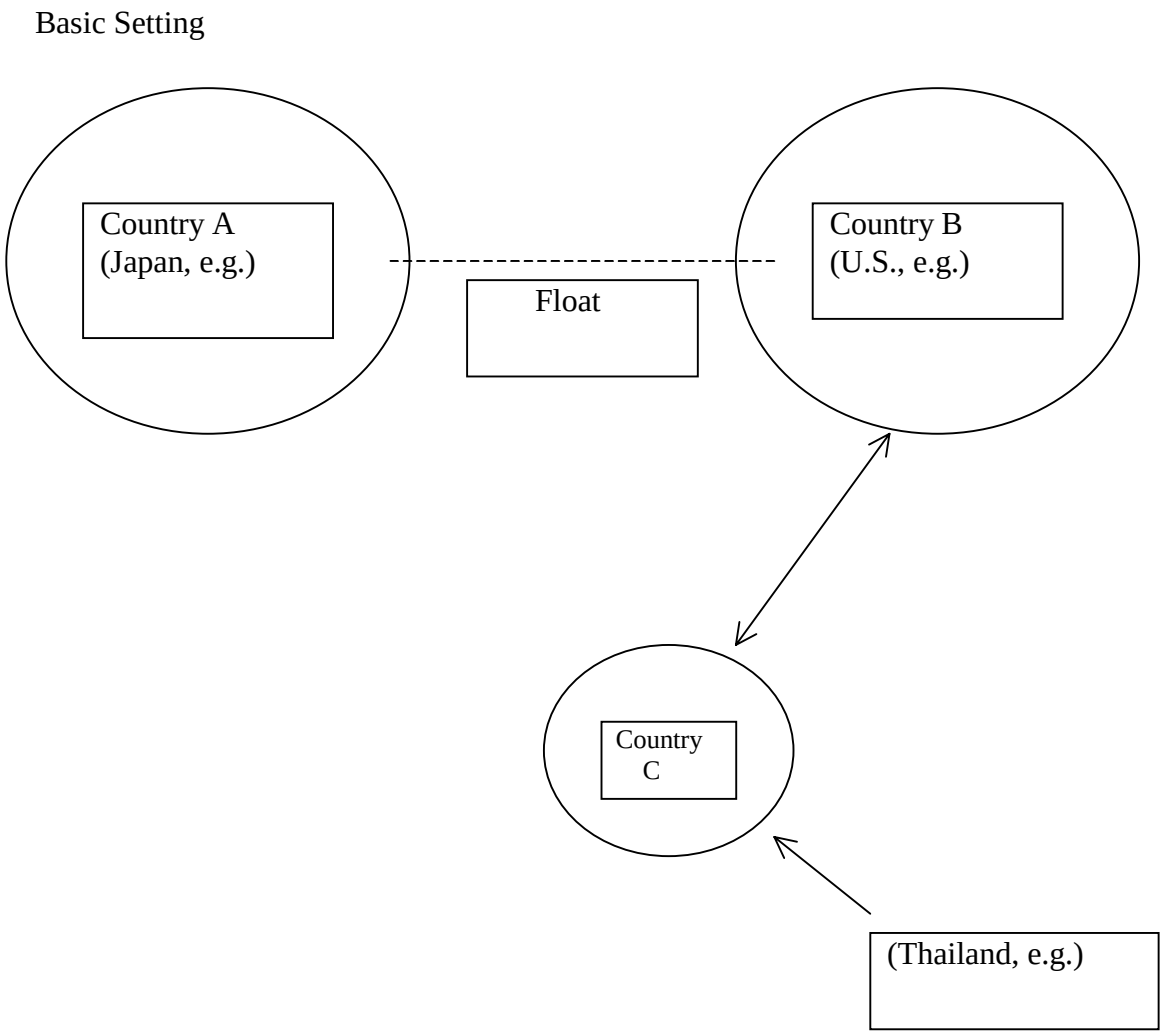
This paper has studied the monetary mechanism of a three country world where two large countries are engaged in floating exchange rates and a small country is pegged to one of these large countries. Three countries possess the wage negotiating process and price rigidities that trigger overshooting of exchange rates.

A simple monetary approach to the balance of payments indicates that this arrangement can create serious difficulties for the small country. Monetary or exchange rate coordination between the large countries may help the small country. Complete float of the small country currency and the currency basket pegging are promising alternatives. Unless complete float increases the militancy of the labor union, the complete float seems to be a better choice between these two alternatives.

In sum, the analysis in this paper confirmed the converse of Milton Friedman's dictum that you trust your central bank, then you adopt the flexible rate. That is, if you do not trust your central bank, or the social process of wage determination in your country, you may well adopt the fixed rate. The adoption of the fixed rate works well if the exchange rate is pegged to the currency whose central bank has a stable monetary policy. This paper has analyzed this problem in a coherent world economy framework which shares such realistic features as jumping exchange rates and employment fluctuations.

This paper has shown the danger of fixing to a single major currency when the exchange rates among major currencies are changing dramatically. Pegging to a currency basket resolves some of the difficulties provided that the average money supply of major countries is not superfluous.

FIGURE 1



Sequences

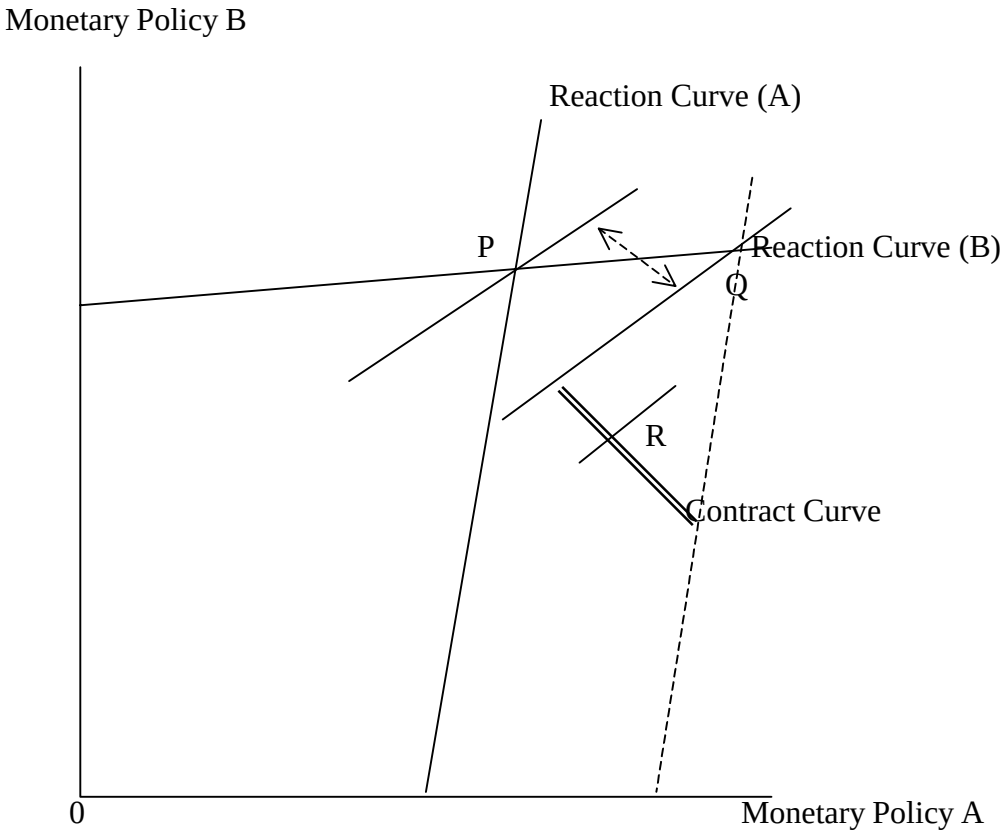
w_A . . . . . Q_A . . . . . x_A

w_B . . . . . Q_B . . . . . x_B

w_C . . . . . Q_C . . . . . x_C

The Public Nature Central Bank

FIGURE 2


Monetary Policy B
Reaction Curve (A)
P
Reaction Curve (B)
Q
R
Contract Curve
0
Monetary Policy A

REFERENCES

Barro, R. and D. Gordon. 1983. "Rules, Discretion, and Reputation in a Model of Monetary Policy." *Journal of Monetary Economics*. 12: 101-21.

Canzoneri, M., and J. A. Gray. 1985. "Two Essays on Monetary Policy in an Interdependent World." *International Economic Review*.

Cooper, Richard N. 1984. "Economic Interdependence and Coordination of Economic Policies." In R. Jones and P. B. Kenen, eds., *Handbook of International Economics.* Amsterdam: North-Holland.

Corsetti, G. and P. Pesenti. 1997. "Imperfect Competition and Policy Interdependence: Equilibrium and Welfare Analysis." Mimeo (August).

Dornbusch, R. 1976. "Expectations and Exchange Rate Dynamics" *Journal of Political Economy* 84 (December): 1161-1176. A Theoretical Analysis of Exchange Rate Overshooting.

Gibbons, R. 1992. *Game Theory for Applied Economists,* Princeton, NJ: Princeton University Press.

Hamada, K. 1976. "A Stratgic Analysis of Monetary Interdependence." *Journal of Political Economy*. (August): 677-700.

Hamada, K. 1985. *The Political Economy of International Monetary Interdependence*. Cambridge: MIT Press.

Helpman, E. 1981. "An Exploration of the Theory of Exchange Rate Regimes." *Journal of Political Economy* 89 (October): 865-90.

Johnson, H. G. 1972. "The Monetary Approach to Balance-of-Payments Theory." *Journal of Financial and Quantitative Analysis* (March): 1555-1572.

Mundell, R. 1963. "Capital Mobility and Stabilization Policy Under Fixed and Flexible Exchange Rates." *Canadian Journal of Economics and Political Science* 29 (November): 475-85.

Rogoff, K. 1985. "Can International Monetary Policy be Counterproductive?" *Journal of International Economics* 18 (May): 199-217.

Vickers, J. 1986. "Signalling in a Model of Monetary Policy with Incomplete Information."*Oxford Economic Papers* 38: 443-55.