The Danger of Hard Pegs: Monetary and Fiscal Policy Coordination in Emerging Market Economies*

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Abstract

The paper develops a model in which excessive capital inflows are associated with fixed exchange rates. The key components of the model are a) endogenous fiscal subsidies to international borrowing, b) an exchange rate rule followed by the central bank, and c) ex-ante wage setting with market power by wage setters. In this environment, a fiscal authority that lacks pre-commitment may distort international capital flows. But this depends critically upon the exchange rate rule. When the central bank follows a pegged exchange rate, then the fiscal authority will always subsidize capital inflows. The economy will engage in `over-borrowing', and in welfare terms may end up worse off than under capital market autarky. There is an optimal exchange rate rule however, whereby if the central bank allows the exchange rate to depreciate in response to an increase in domestic interest rates, it can sustain the full pre-commitment fiscal policy, without excessive capital inflows. Finally, we show that if fiscal policy must be financed by money creation rather than lump-sum taxes, then a fixed exchange rate rule may cause both over-borrowing and a subsequent exchange rate crisis. In this fiscal-driven currency crisis, the exchange rate collapses at the same time that capital inflows are reversed.

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Since the financial crises of the 1990's, there has been a considerable debate regarding the desirability of fixed exchange rates in emerging market economies. All the crisis countries at this time were initially attempting to peg their exchange rates. A common view among recent studies of crises is that fixed exchange rates increases the vulnerability of an economy to currency and financial crises. In fact, most of the significant capital inflows into emerging market countries took place under fixed exchange rates. This is true of both the Latin American and East Asian economies. From a statistical perspective, there is a tendency for emerging economies with fixed exchange rates to be experiencing large current account deficits.

This paper explores the linkage between the exchange rate regime and capital flows in a theoretical model of a small economy. The particular feature we address is the interaction between the exchange rate regime and government subsidies to capital inflows. We show that fixed exchange rates lead to government subsidies to encourage international borrowing. As a result, fixed exchange rates tend to be associated with excessively high current account deficits.

The role of government subsidies, capital inflows, and fixed exchange rates has been stressed as an important part of the Asian crisis by Krugman (1998) and Corsetti et al (1999). They argue that fiscal authorities in Asian countries tended to subsidize borrowing, and the fiscal burden of these subsidies eventually led to the collapse of the exchange rate regime. Mckinnon and Pill (1998) argue that fixed exchange rates encourage excessively risky, unhedged borrowing in foreign currency. Similarly Burnside, Eichenbaum, and Rebelo (1999) develop a model in which implicit government guarantees against investment losses remove the incentive to hedge exchange rate risk. While our model also stresses the linkage between the

exchange rate regime and borrowing subsidies, the mechanism is very different from the above papers. In our framework, it is the fixed exchange rate itself that encourages the fiscal authority to implement capital subsidies. It does this in order to stimulate the economy, as a substitute for exchange rate movement. The economy borrows excessively simply because the government subsidies reduce the cost of borrowing below the world opportunity cost of capital.

The key feature of the model is that the degree to which governments intervene in capital markets is endogenous. We allow a fiscal authority, by imposing capital controls, to tax or subsidize foreign borrowing. Whether the authority wishes to do this depends critically upon its commitment ability. If the authority can perfectly pre-commit to a rule, it will never wish to interfere with international capital flows, no matter what the exchange rate policy followed by the central bank. But if the authority lacks pre-commitment ability, then in general, it will wish to intervene in capital markets to drive a wedge between domestic and world rates of returns. The underlying distortion pushing the fiscal authority to intervene in capital markets is in the labor market. Wages are set by monopoly suppliers of labor so that employment is inefficiently low. By subsidizing capital inflow after wages are set, the fiscal authority attempts to ameliorate this distortion.

But the manner in which the fiscal authority which lacks pre-commitment will intervene in capital markets depends critically upon the exchange rate rule followed by the central bank. With a fixed exchange rate, the fiscal authority will always wish to subsidize foreign borrowing. As a result the country will have an excessive level of debt, potentially leaving itself open to crises. In fact, in our model, a fixed exchange rate leads the economy to end up in a worse welfare position than if it was under complete capital market autarky.

Hence, a fixed exchange rate policy is decidedly undesirable, in an environment where fiscal authorities cannot pre-commit to a policy rule. But there is an optimal exchange rate rule, which exactly nullifies the lack of fiscal pre-commitment. If this rule is followed by a central bank, it offsets the incentive for the fiscal authority to intervene in capital markets, allowing the economy to fully exploit the benefit from international capital flows. The key ingredient behind the policy rule is that the nominal exchange rate should be increasing in the domestic real interest rate. Thus, a rising interest rate should automatically generate a nominal exchange rate depreciation.

We then extend the model to show that the combination of fixed exchange rates, absence of pre-commitment in fiscal policy, and a requirement that government needs to finance its activity with money creation can generate a joint capital-market-currency crisis. This version of the model has all the hallmarks of an emerging market crisis. The economy initially pegs the exchange rate. Through the mechanism already described, the peg encourages the fiscal authority to subsidize capital inflow, leading to an over-borrowing episode. But the financing requirements of the capital inflow subsidies mean that the exchange rate peg must collapse in the future. Moreover, this collapse takes place jointly with the turnaround in the current account. Thus, we have an over-borrowing episode which subsequently causes a currency collapse – in a sense, a joint currency and capital market crisis. The key insight is that this joint crisis is caused solely by the initial imposition of a fixed exchange rate regime. Without an initial peg, there is no over-borrowing, and no subsequent currency collapse. In fact, without the peg, the exchange rate can be kept stable throughout. Thus, in a sense, the initial fixed exchange rate regime sows the seeds of its own demise.

The paper is organized as follows. The next section develops the basic model. Section 2 shows the results with pre-commitment. Section 3 deals with the no commitment case. Section 4 extends the analysis to show that excessive capital inflows may generate subsequent currency crises. Some conclusions are then offered.

1. The Model

We take a simple model of a small open economy. There are two periods, period 0 and 1. In each period there is a single good produced by competitive firms. Consumer-workers supply labor to the firms, and set their wage monopolistically.

Firms

Each firm has a production function given by

$Y_t = F(H_t)$,

where $F(H_t)$ is increasing, concave, and satisfies Inada conditions. We define the labor composite as $H = \left(\int_0^1 H(i)^{1-\frac{1}{\lambda}} di \right)^{\frac{1}{1-\frac{1}{\lambda}}}$, so that the firm uses differentiated labor in production, and the elasticity of substitution between types of labor is λ. For the firm, the profit maximizing rule is:

$$(1.1) \quad S_t F'(H_t) \left[\frac{H_t(i)}{H_t} \right]^{-\frac{1}{\lambda}} = W_t(i)$$

so that the wage elasticity of demand for each type of labor is equal to λ.

Consumer-Workers

Consumers have utility given by:

$$(1.2) \quad E_{-1} U_i = E_{-1} \sum_{t=0}^{1} \beta^t (U(C_t(i)) - V(H_t(i)))$$

where $C_t(i)$ ($H_t(i)$) is consumption (employment) of household i in period t. The functions $U(.)$ and $V(.)$ are increasing, concave, and continuously differentiable.

The household can lend or borrow (if negative) amount $B_1(i)$ at rate *r*, receives wage income where the nominal wage is W_t, and receives profits $\Pi_t(i)$ from ownership of the firm. Household budget constraints are then

(1.3) $P_0C_0(i) + P_0B_1(i) = W_0(i)H_0(i) + \Pi_0 + P_0T_0$

(1.4) $P_1C_1(i) = (1+r)P_1B_1(i) + W_1(i)H_1(i) + \Pi_1 + P_1T_1$

where T_t is a transfer from the government, and P_t is the price of the consumer good. Assume that purchasing power parity holds, and the foreign price level is normalized at unity so that $P_t = S_t$.

The first order conditions for each consumer-worker *i*, taking the demand for labor schedule (1.1) into account, are:

(1.5) $U'(C_0(i)) = \beta E_0 U'(C_1(i))(1+r)$

(1.6) $E_t\left(U'(C_t)H_t(i)\frac{W_t}{S_t} - \tilde{\lambda}V'(H_t(i))H_t(i) \right) = 0, \quad t = 0,1.$

where $\tilde{\lambda} = \frac{\lambda}{\lambda - 1}$. Equation (5) is the Euler equation for optimal consumption growth, while (1.6) implicitly determines the pre-set wage for each period.

Now assume all workers are alike, so that

$$W(i) = W, \quad H(i) = H.$$

Fiscal Authority

Assume that the fiscal authority implements a system of capital controls, choosing whether to levy a tax or subsidize international capital flows. If the world real interest rate is r^*, we define the effective tax on foreign borrowing (or the subsidy on foreign lending) as $r - r^*$. Hence, we can simply define the fiscal authority's choice variable as r. The fiscal authority then redistributes to household

any revenue it receives from levying capital taxes (or taxes households to finance any capital subsidies). Then the fiscal authority's budget constraint will be

$$T_0 + \frac{T_1}{1+r^*} = \frac{(r-r^*)B_1}{1+r^*}. \tag{1.8}$$

The left hand side is the transfer made to the consumer, while the right hand side is the present value of revenue from capital controls. Combining (8) and the consumer budget constraint implies that the economy's overall budget constraint must be:

$$C_1 = F(H_1) + (1+r^*)(F(H_0) - C_0). \tag{1.9}$$

Central Bank

We must also make some assumption regarding the determination of the exchange rate. We have not allowed for an explicit role for money in the model. But this doesn't matter, as we can instead simply assume that the monetary authority directly chooses the exchange rate, or an exchange rate rule, as a policy tool. For the analysis below, the time period 1 exchange rate is irrelevant. Hence we assume it is fixed at unity. We assume also that the monetary authority faces no credibility problem, and can commit to an exchange rate rule. The consequences of the lack of credibility in monetary policy have been extensively investigated in previous literature, both for open and closed economies (e.g. Lane 1998). Our main focus in this paper is to explore the determination of capital controls by the fiscal authority, and to show how this depends on the commitment ability of the fiscal authority as well as the stance of the central bank. In the conclusions below, we will briefly discuss the case where both monetary and fiscal authorities lack the ability to commit to rules.

The time 0 exchange rate is assumed to follow a policy rule given by

$$S_0 = S(r) \tag{1.10}$$

Hence, the monetary authority follows a rule relating the exchange rate to the domestic real interest rate. A natural assumption would be that this was an increasing function, so that a rise in the borrowing real interest rate that agents in the small economy face leads to a nominal exchange rate depreciation. But we allow for different properties of the exchange rate rule below.

Equilibrium

For a given value of r, an equilibrium is very easy to define. In an equilibrium; a) consumer workers maximize utility subject to their budget constraints and their individual labor demand constraint, b) firms maximize profits, and c) the labor market clears.

As a benchmark, we make the assumption that $\beta(1+r^*)=1$. This ensures that in an equilibrium without capital controls, the current account is zero, and consumption and employment are equal in both periods.

Determination of capital controls

We now go on to examine the determination of the capital tax or subsidy by the fiscal authority. We assume that the fiscal authority is benevolent, choosing a capital tax to maximize utility of the representative household. But the fiscal authority may or may not have commitment ability. If the authority can commit, it sets the tax before the wage for period *0* is predetermined. It then takes account of how its current choice of r affects both consumption and employment in both periods *0* and *1*. If the fiscal authority cannot commit, then it takes the nominal wage as given in period *0*, and chooses a capital tax to maximize the household's utility.

2. Capital controls with commitment

Under full commitment, we can represent the choice of capital controls in the following manner. The fiscal authority chooses r to maximize utility taking into

account the consumers optimal borrowing constraints and labor market clearing in both periods. Table 1 illustrates these constraints. The three conditions in Table 1 implicitly determine the values of C_0, H_0, H_1.

Table 1: Constraints facing the fiscal authority: commitment	
Euler equation	$U'(C_0) = \beta E_0 U'(F(H_1) + (1+r^*)(F(H_0) - C_0))(1+r)$
Labor market clearing	$F'(H_0)U'(C_0) = \tilde{\lambda}V'(H_0), \quad F'(H_1)U'(C_1) = \tilde{\lambda}V'(H_1)$

Implicitly, we may write these as functions of the authority's decision, so that $C_0 = C_0(r), H_0 = H_0(r), H_1 = H_1(r)$, where these functions satisfy the property that $C_0'(r) < 0, H_0'(r) > 0$, and $H_1'(r) < 0$ [1]. A rise in the real interest rate rate reduces period 0 consumption, increases period 1 consumption, which, through adjustment in the real wage, increases period 0 employment and reduces period 1 employment. Moreover, under the assumptions made above, we must have

$C_0(r^*) = F(H_0(r^*)) = F(H_1(r^*))$.

Note that under commitment, the fiscal authority's problem is independent of the exchange rate rule. When the authority can pre-commit, it takes account of how the nominal wage set by workers will adjust to exchange rate. Hence the exchange rate rule cannot affect the decision over capital controls.

The fiscal authority's problem is then defined by the problem

P1 $$\max_{r} \quad U(C_0(r)) - V(H_0(r)) + \beta U(C_1(r)) - \beta V(H_1(r))$$

$$\text{subject to } C_1(r) = F(H_1(r)) + (1+r^*)(F(H_0(r)) - C_0(r)).$$

[1] Under the assumptions on the curvature of preferences and technology, an equilibrium exists.

Proposition 1

Under commitment, the optimal tax (subsidy) on foreign borrowing (lending) is zero.

Proof. Using Table 1, the first order condition for problem *P1* is

$$\begin{aligned}(2.1)\qquad &\left[U'(C_0)-\beta U'(C_1)(1+r^*)\right]C_0'(r)\\ &+\left[U'(C_0)F'(H_0)-V'(H_0)\right]H_0'(r)+\beta\left[U'(C_1)F'(H_1)-V'(H_1)\right]H_1'(r)=0\end{aligned}$$

The expression on the top line captures the effect on utility of the revision of inter-temporal consumption generated by a capital tax/subsidy. A rise in *r* will reduce consumption in period *0*, so that $C_0'(r)<0$. If $r>r^*$ ($r<r^*$) it must be that $U'(C_0)>\beta U'(C_1)(1+r^*)$, ($U'(C_0)<\beta U'(C_1)(1+r^*)$), since the first order condition for the consumer implies that $U'(C_0)=\beta U'(C_1)(1+r)$. Then, if this was the full effect on utility, it is clear that the fiscal authorities would set $r=r^*$, because they wish to reduce (increase) r when $r>r^*$ ($r<r^*$). As regarding the two expressions on the second line, it is shown in the appendix, that $\beta H_1'(r^*)=-H_0'(r^*)$. Then, since when $r=r^*$, we have $C_1=C_0$, $H_1=H_0$, it follows that these two expressions also sum to zero when capital controls are zero.

The explanation for proposition 1 is quite straightforward. In an economy with monopoly wage setting, there is a labor market distortion in each period, due to the fact that the marginal product of labor exceeds the marginal disutility of working. That is $F'(H)>V'(H)/U'(C)$. Hence, employment is inefficiently low in each period. The fiscal authority would like to increase employment. But under pre-commitment, a capital tax or subsidy will have opposite effects on employment in each period. For instance, a capital tax will reduce consumption in period 0, and increase consumption in period 1. This will lead to a rise in employment in period 0, as wage setters will reduce their desired wage, given that the disutility of working in

period 0 has fallen. But by the same token, employment in period 1 will fall. The rise in employment in period 0 increases household utility (the first expression in the above first order condition), since employment is inefficiently low to begin with. But the fall in employment in period 1 will reduce household utility, since the distortion of inefficiently low employment in period 1 is exacerbated. Under the symmetry assumptions we have made, these two effects exactly offset each other. Hence there is no benefit to the fiscal authority, acting under commitment, from levying a capital tax. Likewise, there is no benefit from enacting a capital subsidy, using the reverse logic. As a result, under commitment, the fiscal authority has no incentive to interfere with international capital flows[2].

3. Capital controls without commitment

Now we look at the decision faced by the fiscal authority when it cannot pre-commit to a capital tax or subsidy. In this case, it chooses capital controls after the period *0* wage has been set. Table 2 illustrates the set of conditions facing the authority. The critical difference between this and the case with commitment is that employment in time period *0* is not directly dependent on the domestic interest rate *r*, given that the nominal wage is predetermined. Nevertheless, employment depends on r indirectly through the exchange rate rule $S_0(r)$. If a rise in the domestic real interest rate generates a nominal exchange rate depreciation, this increases employment in period *0*, for a given nominal wage. Hence the exchange rate rule followed by the monetary authority becomes a critical determinant of the decision to impose capital controls.

[2] When the initial current account is unbalanced, so that $\beta(1+r^*) \neq 1$, the fiscal authority may have an incentive to levy capital taxes (or grant subsidies) even in the precommitment case. Nevertheless,

Table 2: Constraints facing the fiscal authority: no commitment	
Euler equation	$U'(C_0) = \beta E_0 U'(F(H_1) + (1+r^*)(F(H_0) - C_0))(1+r)$
Labor market	$S_0 F'(H_0) = W_0 \qquad U'(C_1)F'(H_1) = \tilde{\lambda} V'(H_1)$
Wage determination	$E_{-1}\left(U'(C_0)\frac{W_0}{S_0} - \tilde{\lambda} V'(H_0) \right) H_0 = 0$
Exchange rate rule	$S_0 = S(r)$

From Table 2, we may define the implicit functions underlying the authority's decision without commitment as $C_0 = C_0(r, s(r)), H_0 = H_0(s(r))$ and $H_1 = H_1(r, s(r))$, where $s(r) = \frac{S_0(r)}{W_0}$. It is straightforward to show that these functions satisfy the conditions $C_{0r} < 0, C_{0s} > 0, H_0'(s) > 0$, $H_{1r} < 0,$ and $H_{1s} < 0$. A period 0 real depreciation (defined as a fall in the period 0 real wage) increases employment. The increase in income directly increases period 0 consumption. But, through the income effects on labor supply, this raises the period 1 real wage, and reduces employment in time period 1.

Without commitment the fiscal authority's problem is defined as follows

P2 $\max_r \quad U(C_0(r,s)) - V(H_0(s)) + \beta U(C_1(r,s)) - \beta V(H_1(r,s))$

subject to $C_1(r,s) = F(H_1(r,s)) + (1+r^*)(F(H_0(s)) - C_0(r,s))$, and

$s(r) = \frac{S_0(r)}{W_0}$.

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the incentives to deviate from the $r = r^*$ case are always greater without commitment (as shown

The choice of the fiscal authority depends critically upon the form of the exchange rate rule followed by the central bank. We first establish the following result

Proposition 2.

Under a fixed exchange rate, where $s'(r) = 0$, the fiscal authority subsidizes international borrowing, so that $r < r^*$.

Proof. A fixed exchange rate rule implies that $s'(r) = 0$. Then the first order condition for the fiscal authority under problem P2 is given by

(3.1) $$\left[U'(C_0) - \beta U'(C_1)(1+r^*)\right]C_{0r} + \beta\left[U'(C_1)F'(H_1) - V'(H_1)\right]H_{1r} = 0$$

The first expression is the same as that in proposition 1, capturing the impact on utility of distorting the inter-temporal consumption choice. The second expression captures the effect on utility from the revision of period 1 employment following the capital tax/subsidy. This expression is always negative, since, from the workers optimal wage setting decision, we have $U'(C_1)F'(H_1) = \tilde{\lambda}V'(H_1)$, with $\tilde{\lambda} > 1$, and H_{1r} <0. If the sum of the two expressions is to equal zero, it must be that the first expression is positive, which can only be the case if $r < r^*$.

Hence, under a fixed exchange rate, the fiscal authority subsidizes international borrowing. Consumers borrow at below the world real rate of interest, and the economy runs a current account deficit. The intuition behind this proposition is quite easy to see. Imagine for a moment that $r = r^*$, so that the economy faces the world rate of interest rate, and there is zero international borrowing. Then the impact on utility of a small increase in the real interest rate facing home consumers (i.e. the impact of a small capital tax) is

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below).

$$\left[U'(C_1)F'(H_1) - V'(H_1)\right]H_{1r}.$$

This is unambiguously negative. That is, a small rise in the capital tax reduces utility. This contrasts with the results under commitment. The reason is that without commitment, the fiscal authority takes the period 0 real wage as given, under fixed exchange rates. Therefore, the authority cannot affect the first period level of employment. But if it reduces the domestic real interest rate slightly, this means that it will raise current consumption, and reduce future consumption. At the initial point $r = r^*$ the welfare cost of this inter-temporal consumption distortion is negligible. But the reduction in period 1 consumption leads to an increase in period 1 employment. Because period 1 employment is inefficiently low to begin with, this has first order positive welfare effects. Thus the fiscal authority has an incentive to subsidize borrowing, essentially because it can increase period 1 employment without a concomitant reduction in period 0 employment. In an equilibrium, it will subsidize borrowing so much that the welfare benefits from an increase in period 1 employment are offset by the welfare costs of the inter-temporal consumption distortion. Therefore, under fixed exchange rates, the equilibrium configuration of capital controls implies that $r < r^*$.

Note that welfare is lower in an equilibrium without commitment. Given that wage setters will adjust period 0 wages to account for the higher period 0 consumption, the net impact of the excess borrowing on the labor market distortion is zero, because, in equilibrium the benefit of higher employment in period 1 is offset by lower employment in period 0. But the inter-temporal consumption distortion generated by the capital subsidy leaves the home consumer worse off. In fact, the home consumer is worse off in this equilibrium than she would be under complete capital market autarky.

A fixed exchange rate rule therefore gives rise to `over-borrowing' in this model, in the absence of fiscal pre-commitment. Other writers have argued that pegged exchange rates encourages inefficiently high borrowing in emerging markets. For instance, in McKinnon and Pill 1998, pegged exchange rates encourage excessively risky, unhedged borrowing in foreign currency. Similarly Burnside, Eichenbaum, and Rebelo (1999) develop a model of implicit government guarantees which remove the incentive to hedge exchange rate risk. In our model, the mechanism interlinking fixed exchange rate and over-borrowing is quite different. Under a fixed exchange rate, a fiscal authority can have no impact on current output, but can increase future output through borrowing subsidies. Excessive borrowing takes place simply because under fixed exchange rates, optimal government policy reduces the private cost of funds below the world opportunity cost.

Although our model abstracts from investment, exactly the same channel would be present in an economy with endogenous capital accumulation and investment. A subsidy on current capital inflows would increase domestic investment and the future capital stock, generating a higher level out future output, in this way acting so as to minimize the underlying distortion faced by the fiscal authority.

We now focus on the case where the monetary authority follows a more general exchange rate rule.

Proposition 3.

When the exchange rate rule satisfies $s(r) = \tilde{s}(r)$, such that

$$\tilde{s}'(r) = \frac{-\beta\left[U'(C_1)F'(H_1) - V'(H_1)\right]H_{1r}}{\Delta} > 0 \tag{3.2}$$

where $\Delta = \left[\left[U'(C_0)F'(H_0) - V'(H_0)\right]H_0' + \beta\left[U'(C_1)F'(H_1) - V'(H_1)\right]H_{1s}\right]$, then the optimal capital tax/subsidy is zero, and $r = r^*$.

Proof. The first order condition for the fiscal authority under a general exchange rate rule is given by

$$\begin{aligned}&\left[U'(C_0)-\beta U'(C_1)(1+r^*)\right](C_{0r}+C_{0s}s'(r))\\&+\left[U'(C_0)F'(H_0)\left(\frac{1+r^*}{1+r}\right)-V'(H_0)\right]H_0s'(r)\\&+\beta\left[U'(C_1)F'(H_1)-V'(H_1)\right](H_{1r}+H_{1s}s'(r))=0\end{aligned}\tag{3.3}$$

This extends the condition of Proposition 2 in two ways. First, an interest rate change now affects period 0 employment, if it affects the nominal exchange rate. A rise in the interest rate increases first period employment if the exchange rate rule is increasing in the interest rate. This follows, because with a fixed money wage, a nominal exchange rate depreciation reduces the real wage and increases employment. Second however, an interest rate change increases first period consumption and second period employment through separate channels, since the rise in first period income (following the increase in output) leads to a rise in consumption in period 0 (and period 1), and a fall in employment in period 1. Note however, that if the exchange rate rule satisfies the condition given above, then the second two expressions in the above first order condition sum to zero. But then the first expression must be always zero (under the condition that $(C_{0r}+C_{0s}s'(r))<0$), since we have shown above that this expression is always positive (negative) if $r<r^*$ ($r>r^*$). In other words, the fiscal authority would never want to intervene in capital markets only to distort the intertemporal consumption decision alone. The role of the exchange rate rule (3.2) is to eliminate the incentive for the fiscal authority to intervene in international capital markets so as to increase period 1 output. If the authority reduces the domestic real interest rate below the world rate, this generates a real exchange rate appreciation (i.e. a real wage increase), which reduces period 0 employment and output. This offsets the incentive to subsidize borrowing. In fact,

the exchange rate rule given by (3.2) actually restores the full commitment case, eliminating the presence of government subsidized over-borrowing.

It is clear that the rule given by (3.2) is also an optimal exchange rate rule that would be chosen by a central bank, under commitment, were it to design a rule to maximize the utility of the representative individual. If the central bank could design a rule to ex ante, it would face the same objective as would the fiscal authority, if the fiscal authority were acting with commitment. In that case the central bank would choose the rule to sustain the commitment outcome for capital controls.

If the exchange rate rule is not designed optimally, however, there is no guarantee that it will do better than a fixed exchange rate. While the rule in (3.2) ensures fully open capital markets in this economy, if the response of the exchange rate to the real interest rate is too high, then it may actually outweigh the incentives to subsidize capital inflow. Then the fiscal authority will begin to subsidize capital outflow (i.e. $r > r^*$). This will happen if the impact of a rise in r on the exchange rate is so great that the rise in period 0 employment resulting from an exchange rate depreciation is more important in utility terms than the fall in period 1 employment. In this case, an equilibrium without commitment involves `overlending'.

Numerical Example

The properties of the model may be illustrated by a numerical example. We take the following functional forms. Let the utility and production functions be given by

$$U = \frac{C^{1-\sigma}}{1-\sigma} - \frac{H^{1+\psi}}{1+\psi} \qquad Y = AH^{\alpha}.$$

We take the following parameter values. The intertemporal elasticity of substitution is set at 0.5, so that $\sigma = 2$. The consumption-constant elasticity of labor supply is

assumed to be unity, so $\psi = 1$. The labor share is set at 0.7. We allow for the real wage markup to take on values of 10 percent and 20 percent. Finally, we allow the exchange rate rule to take on the form $S = (\beta(1+r))^{\mu}$.

Figure 1 illustrates the relationship between the elasticity of the exchange rate rule μ and the equilibrium interest rate, for different values of the markup. In both cases, a value of $\mu = 0.11$ achieves the pre-commitment outcome. For values of μ below this, capital inflows are subsidized. For values of μ above this, capital outflows are subsidized. Note that the distortion on both sides of the optimal exchange rate rule is greater, the higher is the real wage markup. Thus, for $\mu < 0.11$ ($\mu > 0.11$) in the Figure, the capital inflow (outflow) subsidy is greater, the higher is the value of the markup.

4. A Currency Crisis Extension

We have suggested that the results may be helpful in understanding exchange rate crises in emerging markets. However, in the model so far a fixed exchange rate policy gives rise to over-borrowing, but it does not generate an exchange rate crisis. The exchange rate may remain fixed in both periods of the model without any difficulty. But this is only due to a key simplifying assumption that we have made; namely that the fiscal authority has access to lump-sum taxes as a revenue source. Now we make a more realistic assumption with respect to the source of revenue. By doing this, we can retain all the implications of the previous model, but in addition, we now show that an episode of over-borrowing may precipitate a currency crisis.

Following Krugman (1979), we assume that governments must finance their capital subsidies with money creation. For emerging market economies with weak ability to levy taxes on income or expenditure, this may be a realistic assumption. Burnside, Eichenbaum, and Rebelo (2001) stress the fiscal implications of Asian

deficits through pressures on money creation. We therefore now assume that the fiscal burden of the capital subsidies has to be met by the government selling bonds to the central bank. But as in the previous sections, we continue to assume that the central bank can make a temporary commitment to a fixed exchange rate. Thus, the central bank can maintain a fixed exchange rate in the first period. As before however, the fixed exchange rate generates an incentive for the fiscal authority to grant subsidies to domestic borrowers. These subsidies must be finance by money creation. This implies that the fixed exchange rate may have to be abandoned in the second period if the fiscally induced money creation violates the constraints placed by the fixed exchange rate regime.

Hence, our assumption is that the central banks commitment ability is only temporary, and ultimately, it must give up its control over the exchange rate in order to satisfy the government budget constraint. While this is specific set of assumptions over the relative predominance of the central bank and fiscal authority, it accords quite well with the original Krugman (1979) model of speculative attacks and the large literature which followed it.

In order to illustrate this model more clearly, we must extend the basic preference structure to encompass a demand for real balances. Now assume that the home resident has preferences given by

$$U(C_t(i)) + G(\frac{M_t}{P_t}) - V(H_t(i)), \quad t = 0,1,$$

where $G(.)$ is increasing, concave, and continuously differentiable. Household budget constraints are now amended to encompass money holdings:

(4.1) $$P_0 C_0(i) + M_0(i) - M_{-1}(i) + P_0 B_1(i) = W_0(i) H_0(i) + \Pi_0$$

(4.2) $$P_1 C_1(i) + M_1(i) = (1+r) P_1 B_1(i) + W_1(i) H_1(i) + \Pi_1 + M_0(i)$$

Households no longer pay taxes explicitly. All taxes are levied implicitly through seignorage alone. Initial money holdings are $M_{-1}(i)$. Now the optimality conditions for consumer i are as in (1.5) and (1.6), with the addition of the conditions determining money demand in periods 0 and 1. These additional conditions are described as

$$(4.3) \quad G'(\frac{M_0(i)}{P_0}) = U'(C_0(i))\left(1 - \frac{U'(C_1(i))}{P_1}\frac{P_0}{U'(C_0(i))}\right)$$

$$(4.4) \quad G'(\frac{M_1(i)}{P_1}) = U'(C_1(i))$$

Conditions (4.3) and (4.4) implicitly give the demand for money schedules of household i. The conditions contain an asymmetry, because while there is an interest rate opportunity cost of holding money rather than bonds in the first period, there is none in the second period. Again, we make the assumption that all households are alike, so we drop the *i* notation hereafter.

The fiscal authority now has the following budget constraint. It receives income in the first period from the central bank's money creation; $M_0 - M_{-1}$, and from savings of consumers $P_0 B_1$ (which may be negative). With this, it purchases foreign bonds. In the second period, it receives income from its holdings of foreign bonds, money creation, and with this, finances payments of interest and principal to households. Thus, the two budget constraints are:

$$P_0 B_{g1}^* = M_0 - M_{-1} + P_0 B_1$$

$$P_1 B_1 (1+r) = M_1 - M_0 + (1+r^*) P_0 B_{g1}^* .$$

Again, we make the assumption of PPP, so that $P_0 = S_0$, $P_1 = S_1$. Putting these together, we can establish that the government's inter-temporal budget constraint is

(4.5) $$\frac{M_0 - M_{-1}}{S_0} + \frac{M_1 - M_0}{(1+r^*)S_1} = \frac{(r-r^*)B_1}{1+r^*}.$$

Thus, total subsidies to households (the right hand side) must be financed with money creation.

Assume that the fiscal authority is concerned with household utility, net of the utility of real balances. This follows a standard procedure in the literature (e.g. Obstfeld and Rogoff 2001, 2002), and is made for convenience – it simply avoids taking account of optimal inflation tax issues. The assumption can be easily motivated by a situation where the $G(.)$ function becomes small relative to the other arguments of the utility function.

Now combining (4.1), (4.2), and (4.5), it is straightforward to see that the economy's inter-temporal budget constraint is still given by (1.9). This has an immediate implication; Proposition 2 still applies as before when the period 0 exchange rate is taken as given by the fiscal authority. Thus, under a first period fixed exchange rate, the fiscal authority will still subsidize domestic borrowing, and set $r < r^*$. Moreover, the real side of the economy is still pinned down by condition (3.1) from Proposition 2 and Table 2, with $s'(r) = 0$.

Now however, we cannot ignore the implication of the economy's borrowing on the second period exchange rate. This is because the government's budget constraint (4.5) has implications for the size of money creation. Taking conditions (4.3), (4.4), and the government's intertemporal budget constraint, we have the following three conditions. For given values of r, C_0, B_1, and C_1, the following conditions determine the nominal side of the economy;

(4.6) $$G'(\frac{M_0}{S_0}) = U'(C_0)\left(1 - \frac{U'(C_1)}{S_1}\frac{S_0}{U'(C_0)}\right)$$

(4.7) $$G'(\frac{M_1}{S_1}) = U'(C_1)$$

(4.8) $$\frac{M_0 - M_{-1}}{S_0} + \frac{M_1 - M_0}{(1+r^*)S_1} = \frac{(r-r^*)B_1}{1+r^*}.$$

Under a flexible exchange rate regime, these three equations determine S_0, S_1, and either M_0 or M_1, or some combination. Given that money creation must finance the government deficit, a flexible exchange rate regime allows only one degree of freedom with respect to the issue of money; we cannot have both M_0 and M_1 determined independently and still satisfy (4.8). Nevertheless, it is easy to establish that if the monetary authority places no restriction on the period 0 exchange rate, then it has enough leeway to design an exchange rate rule identical to that of Proposition 3. Hence, even when lump-sum taxes are unavailable, a flexible exchange rate rule given by $\tilde{s}(r)$ can eliminate the incentive for the fiscal authority to subsidize borrowing. But then in fact, the absence of lump-sum taxes is irrelevant, since the fiscal authority no longer needs to raise revenue to finance fiscal subsidies. For clarity, we then restate:

Proposition 3'

When the period 0 exchange rate rule is governed by $\tilde{s}(r)$, the equilibrium capital subsidy is zero, even in the absence of lump-sum taxes.

Now however, assume that the monetary authority places an ex ante restriction that the period 0 exchange rate is fixed, independent of the domestic interest rate. The three equations in (4.6)-(4.8) can be rearranged to determine the two variables M_0 and S_1. M_0 is taken as endogenous, given that the first period nominal exchange rate is fixed. From (4.6), we may define the implicit demand for money in period 0 as

$\frac{M_0}{S_0} = L_0(C_0, C_1, \frac{S_1}{S_0})$. The function *L* is increasing in C_0, decreasing in C_1, and decreasing in $\frac{S_1}{S_0}$. Likewise, from (4.7), we may define the implicit money demand schedule $\frac{M_1}{S_1} = L_1(C_1)$. Substituting from (4.7) , we have the conditions:

(4.9) $$\frac{M_0}{S_0} = L_0(C_0, C_1, \frac{S_1}{S_0})$$

(4.10) $$\frac{M_0}{S_0}(1 - \frac{S_0}{(1+r^*)S_1}) - \frac{M_{-1}}{S_0} + L_1(C_1) = \frac{(r - r^*)B_1}{1+r^*}.$$

The first condition just represents money market equilibrium in period 0. The second equation represents the government budget constraint, combined with money market equilibrium in period 1. We first state the following proposition:

Proposition 4

When the initial exchange rate S_0 satisfies the equation

(4.11) $$\frac{M_{-1}}{S_0} = r^* \frac{L_0(F(\tilde{H}), F(\tilde{H}), 1)}{(1+r^*)} + \frac{L_1(F(\tilde{H}))}{1+r^*}$$

then the peg is sustainable under full fiscal pre-commitment.

Proof: under full fiscal pre-commitment, there are no capital subsidies. Then the government has no revenue requirement in period 1. If initial real balances satisfy (4.11), then the initial fixed exchange rate S_0 satisfies both the government budget constraint and the money market clearing conditions for each period.

This proposition is useful only in the sense that we may use it to contrast with the case of no pre-commitment. The two equations (4.9) and (4.10) may be illustrated in Figure 2. The MM curve represents the money market equilibrium in period 0. It is downwards sloping in M_0 and S_1 space. A rise in S_1 raises the nominal interest

rate facing the household, and reduces current demand for money, given a first period exchange rate. The SS curve represents the government budget constraint. It is downwards sloping also, since a rise in S_1 raises implicit seignorage revenue, and allows a fall in M_0 to balance the government budget. Under weak conditions on the interest elasticity of demand, the MM curve is flatter than the SS curve, and so cuts the SS curve from below.

Using this, we can examine the implications of the absence of pre-commitment in fiscal policy-making.

Proposition 5.

If the initial exchange rate satisfies (4.11), and the following condition on the set of equations (4.9)-(4.10) apply

$$\left.\frac{dM_0}{dr}\right|_{SS} < \left.\frac{dM_0}{dr}\right|_{MM}$$

then in the absence of pre-commitment;

a) the economy is characterized by over-borrowing in the sense of Proposition 2

b) the fixed exchange rate regime must collapse in the second period.

Proof: The condition above amounts to the requirement that a fall in *r* generated by the capital subsidies shifts up the SS curve more than the MM curve in Figure 1. Then the period 1 nominal exchange rate must rise. This just means that the increase in government financing requirements that are implied by a capital inflow subsidy cannot be fully met by the seignoriage revenue that the government receives from an increase in period 0 money demand, following the rise in period 0 consumption. This is a weak condition, and is essentially a simple requirement that, in terms of seignorage revenue, the economy is on the right side of the `Laffer' curve, so that the subsidy cannot `pay for itself'.

Thus we have an outcome where capital subsidies are tied to fixed exchange rates, the economy over-borrows, and the fixed exchange rate regime collapses at the same time as the economy's current account switches from deficit to surplus. Hence, we have the characteristics of a joint exchange rate and capital market crisis, as discussed in much of the recent literature. Moreover, the key feature of this outcome is that the `crisis' is generated solely by the fixed exchange rate rule. Without fixed exchange rates, there is no over-borrowing. Moroever, without a fixed exchange rate, the exchange rate can remain stable - there is no exchange rate crisis at all! But an explicit policy of pegging the exchange rate generates a fiscal policy that encourages over-borrowing. The financing of this over-borrowing then requires an abandonment of the fixed exchange rate. Paradoxically, it is the imposition of a fixed exchange rate rule itself that generates both the collapse of the fixed exchange rate and the capital market crisis. Thus, in a novel sense, the fixed exchange rate policy sows the seeds of its own demise.

5. Conclusions

There have been many papers written on currency and capital market crises in emerging market countries. Elements of our analysis have been stressed in many other papers; e.g. the subsidization of capital inflows, the role of fixed exchange rates, and the fiscal foundations of currency crises. The key differentiating feature of our paper is to tie all these pieces together in a way that reveals a simple and powerful message – fixed exchange rates cause excessive borrowing and subsequent currency crises.

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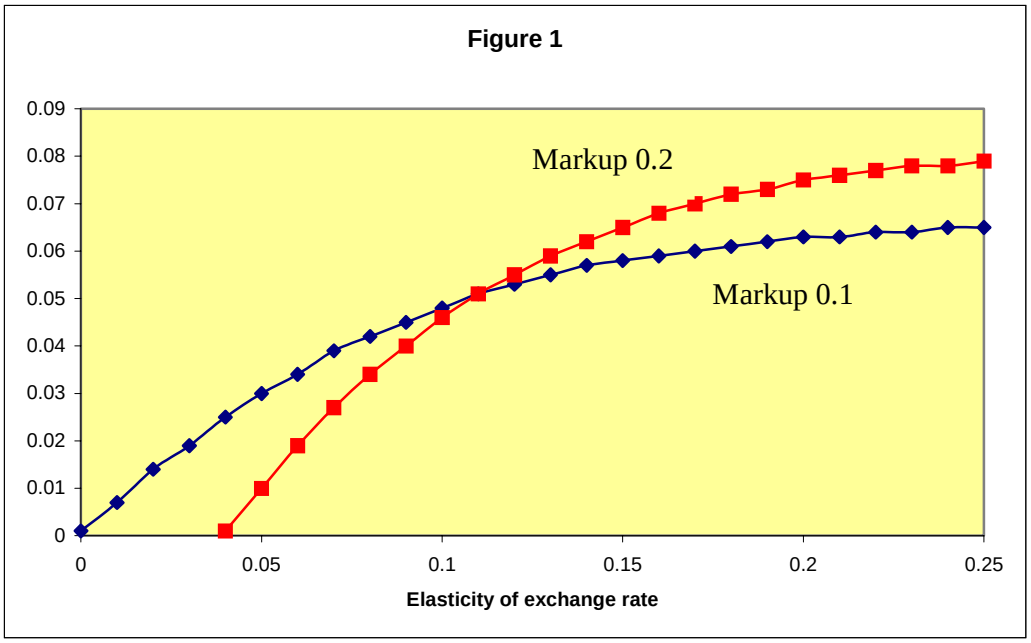
Figure 1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Markup 0.2
Markup 0.1
0
0.05
0.1
0.15
0.2
0.25
Elasticity of exchange rate

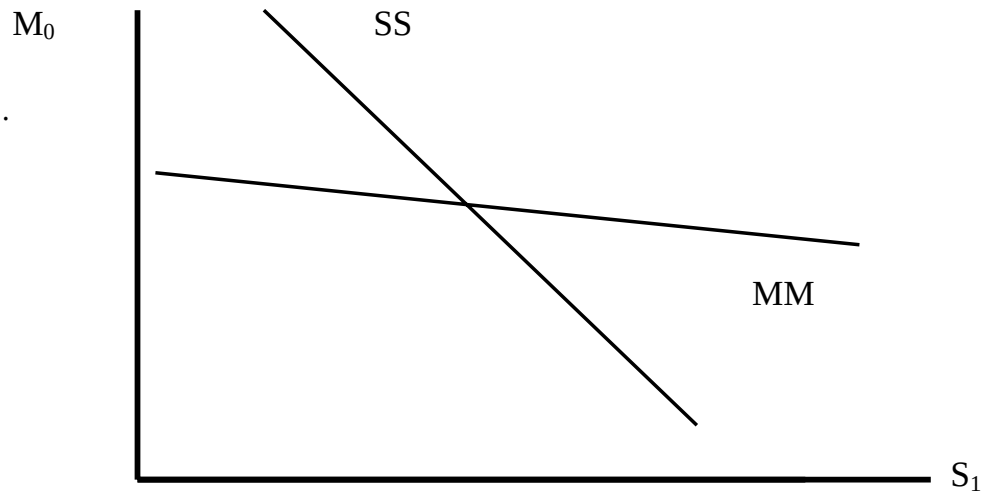
M0
SS
MM
S1

Figure 2

Other poss. extensions:

Infinite Horizon extension

-Precommitment – stationary
-No precommitment and fixed exchange rate, persistent CA deficits

Extension to Capital accumulation – excessive investment