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Real exchange rate overshooting and capital controls in a crisis*

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This paper investigates the impact of a financial crisis on the attitude towards financial reforms and on exchange rate overshooting. We construct a model of a dependent economy partially integrated with the global capital market. Domestic agents have unrestricted access to the international capital market, but foreign agents are prevented from inward FDI. We identify conditions under which a crisis induces greater financial openness, leading to capital inflows, and thereby eroding the initial overshooting of the real exchange rate. Our discussion also implies that the welfare gains from opening the capital market may not be large -- gains from alleviating the shortage of funds in the short run should be balanced with the cost of selling domestic equities at a discount. Evan if the net gain from opening up the capital market is significant, it will exceed the gain from temporary capital controls only if the FDI is associated with significant favorable productivity effects.

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1. Introduction and overview

A common characteristic of countries affected by the crisis in the Far East is the apparent overshooting of their real exchange rate following the financial crisis. The onset of the crisis had lead to deep real depreciation, which was sharply reversed after less than a year. For example, Korea's monthly real exchange rate is plotted in Figure 1, where the bold curve depicts the log of the real exchange rate, and the dotted line corresponds to the "predicted" real exchange rate (where a drop in the real exchange rate indicates real depreciation).[1] The broken lines around the forecast are the 95% upper and lower confidence intervals. Following the onset of the crisis, the real exchange rate depreciated by about 50%. More than half of this depreciation was reversed within a year.[2] Another startling observation was the dramatic change in the current account position, moving from a deficit of about 4% in 1996 to a surplus of 12% in 1998 (see Figure 2)! Within a year (1997-98), Korea went through a current account adjustment of about 14%. While the experience of Korea is dramatic both in terms of the magnitude of the real depreciation and its fast reversal, a similar pattern applies to other affected countries in the region.

The onset of the crisis has provided the impetus for some countries to reconsider their attitude towards financial integration with the global capital market. In the case of

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[1] The prediction is obtained by fitting an AR(1) process to the exchange rate in 1990(1)-1997(6). The estimated equation is used to provide the one period "prediction" for the real exchange rate before 1997(6), and to forecast the real exchange rate path from the onset of the crisis [1997(7)].

[2] Notice the tight fit of the predicted real exchange rate to the actual one prior to the crisis, and the sharp divergence of the realized real exchange rate from the 'forcasted' one after the crisis. Figure 1 is consistent with the view that practically nobody anticipated the crisis and its depth.

Korea, the pressure induced by capital flight and the resultant real deprecation contributed to the willingness to liberalize inward Foreign Direct Investment (FDI). The purpose of this paper is to provide an interpretation for the dynamics triggered by the financial crisis. We would like to explain the changing attitude towards inward Foreign Direct Investment, and the feedback between the capital market adjustment and the real exchange. We would like to show that these developments are intertwined -- the forced adjustment of the current account brought about by the financial crisis, explains both the real deprecation and the changing attitude towards FDI. No attempt is made in the paper to explain the dynamics leading to the crisis, and the sequence described here is consistent with various scenarios.[3] Our analysis suggests that a large debt overhang may be a precondition for the regime switch. Ultimately, the higher the debt overhang is relative to the borrowing constraint imposed by the crisis, the greater is the pressure to open up to inward FDI. The policy switch towards greater openness accounts partially for the reversal of the real exchange rate depreciation.

Section 2 describes the economy, comparing the welfare of the representative agent with and without restrictions on inward FDI, before and after a financial crisis.

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[3] The crisis can be explained in several ways. Radelet and Sachs (1998) and Chang and Velasco (1998a, 1998b) attribute the crisis to an investor panic, but without addressing the origin of the panic. Caballero and Krishnamurthy (1998) suggest it may be due to the real or perceived inadequacy of international collateral stemming from microeconomic contractual problems. Calvo (1999) hypothesizes that poorly informed investors may misread a shift out of emerging-market assets by liquidity-constrained informed traders as signaling low returns and this confusion may lead to a market collapse. The moral hazard problem associated with domestic bailouts has been cited by various observers as a contributing factor in the Asian financial crisis [see Krugman (1998) and Corsetti, Pesenti, and Roubini (1998)]. The implications of greater uncertainty on the supply of international credit (and its disappearance) are studied in Aizenman and Marion (1999).

Section 3 provides a simulation of a detailed example of the model. Section 4 concludes with a discussion.

2. The model

Consider a 2 period economy, producing traded and non-traded goods, with the help of labor and capital.

Preferences

The utility of the representative agent is given by

$$(1) \qquad U = \frac{\left[(c_{1,T})^{\delta}(c_{1,N})^{1-\delta}\right]^{1-\phi}}{1-\phi} + \frac{1}{1+\rho *}\frac{\left[(c_{2,T})^{\delta}(c_{2,N})^{1-\delta}\right]^{-\phi}}{1-\phi} \quad ; \qquad 0 < \phi, \delta < 1$$

where $u(c_{i,T};c_{i,N})$ is the periodic utility at time i (i = 1, 2) associated with the consumption of traded ($c_{i,T}$) and non-traded ($c_{i,N}$) goods in period i. The supply of labor is inelastic, $L^s = \overline{L}$.

Production and endowment

The traded sector is capital intensive relative to the non-traded. For simplicity, we assume

$$(2) \qquad \begin{aligned} &X_{1,T} = (L_{1,T})^{\beta}; \quad X_{2,T} = (1+a)(L_{2,T})^{\beta}; \quad \beta < 1 \\ &X_{1,N} = L_{1,N}; \quad X_{2,N} = L_{2,N} \end{aligned}$$

where $X_{i,j}$ denotes the production of sector j at time i, using labor input $L_{i,j}$ (j =T, N; i =1, 2).

Labor moves freely between the sectors, hence

(3) $\bar{L} = L_{i,N} + L_{i,T}; \quad i = 1,2.$

We normalize the price of the traded good to 1, and denote the real exchange rate, defined by the relative price of the non-traded to the traded good, by $p_{i,N}$ (i = 1, 2). Note that (2) implies that the real wage equals the real exchange rate.

The outstanding foreign debt at the beginning of period 1 ('debt overhang') is D_1. The gross international borrowing in period one is F, at a real interest rate ρ. The stock of capital is owned by domestic entrepreneurs in period 1. In the absence of capital market reforms, it will continue to be domestically owned in period 2.

2.1 A Closed Domestic Equity Market

The current account in the absence of capital market reforms is

(4) $X_{1,T} - c_{1,T} = D_1 - F; \quad X_{2,T} - c_{2,T} = F(1+\rho).$

Solving the labor market equilibrium at period i (i = 1; 2) yields

$$X_{1,T} = \left[\frac{\beta}{p_{1,N}}\right]^{\beta\tilde{\beta}}; \quad X_{2,T} = (1+a)^{\tilde{\beta}}\left[\frac{\beta}{p_{2,N}}\right]^{\beta\tilde{\beta}}; \quad for \quad \tilde{\beta} = \frac{1}{1-\beta}$$

(5) $L_{1,T} = \left[\frac{\beta}{p_{1,N}}\right]^{\tilde{\beta}}; \quad L_{2,T} = \left[\frac{(1+a)\beta}{p_{2,N}}\right]^{\tilde{\beta}}$

$$X_{i,N} = \bar{L} - L_{i,T}$$

With unrestricted access to the global capital market, allowing lending and borrowing at a real interest rate of ρ, the problem of the representative price taker agent is

$$(6) \qquad \max_{\{c_{1,T};c_{1,N};c_{2,T};c_{2,N};F\}} V, \qquad \text{where}$$

$$V = U - \lambda_1[c_{1,T} + p_{1,N}c_{1,N} - \{p_{1,N}\overline{L} + (1-\beta)X_{1,T} + F - D_1\}]$$
$$-\lambda_2[c_{2,T} + p_{2,N}c_{2,N} - \{p_{2,N}\overline{L} + (1-\beta)X_{2,T} - F(1+\rho)\}].$$

The first order conditions for optimal borrowing and consumption can be reduced to,[4]

$$\text{(7)} \quad \text{a.} \quad \left[\frac{C_{1.T}}{C_{2.T}}\right]^{1-\theta(1-\phi)}\left[\frac{C_{1.N}}{C_{2.N}}\right]^{\theta(1-\phi)} = \frac{1+\rho^*}{1+\rho}$$

$$\text{b.} \quad c_{i,T} = \frac{\delta}{1-\delta}p_{i,N}c_{i,N}; \qquad c_{i,N} = X_{i,N}; \quad i = 1, \quad 2$$

Equation (7a) provides the intertemporal linkage between the marginal utilities of consumption and the real interest rate. Equation (7b) provides the demand for non-traded goods. Applying (4), (5), and (7) we infer that,

$$(8) \qquad X_{1,T}(1+\frac{\beta\delta}{1-\delta}) - \frac{\beta\delta}{1-\delta}p_{1,N}\overline{L} = D_1 - F; \quad X_{2,T}(1+\frac{\beta\delta}{1-\delta}) - \frac{\beta\delta}{1-\delta}p_{2,N}\overline{L} = F(1+\rho).$$

Integrating (5) and (8), the real exchange rate can be reduced to

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[4] It is convenient to present the optimization problem facing the domestic agent in a way that allows a comparison between full and restricted access to international borrowing. This can be done by dealing separately with the budget constraints in each period, as is the case in (6).

(9) $$\overset{+}{p_{1,N} = p_{1,N}(F - D_1)} \quad ; \quad \overset{-}{p_{2,N} = p_{2,N}(F(1+\rho))} \; ,$$

where $\dfrac{dp_{1,N}}{d(F-D_1)} = \dfrac{1}{\dfrac{\beta\delta}{1-\delta}\bar{L} + L_{1,T}\tilde{\beta}(1+\dfrac{\beta\delta}{1-\delta})}$.

Hence, a given inflow of capital leads to smaller real exchange rate appreciation in countries with higher share of traded goods.

2.2 Reforming the Capital Market

We consider now the case where the domestic economy reforms the capital market in period 1, allowing foreign ownership of the capital stock in the second period. We assume that foreign entrepreneurs purchase in period 1 a fraction ξ of the domestic stock of capital. This equity position is associated with second period rents of $\xi(1-\beta)X_{2,T}$. Foreign entrepreneurs discount future income at a rate of ρ, as would be the case with a linear intertemporal foreign utility function. We would like to consider the possibility that both the domestic and the foreign entrepreneurs operate in an oligopolistic market (like automobiles, etc.). In these circumstances, the equity price offered to the domestic producer in the first period may be the outcome of bargaining, splitting the future rent according to the bargaining power of the two parties. Specifically, the future surplus is divided between the domestic and the foreign entrepreneurs according to weights (κ , $1-\kappa$), respectively. Consequently, the price of the equity purchased in period 1 by the foreign entrepreneur is his discounted value of $\kappa\xi(1-\beta)X_{2,T}$ [5]

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[5] An illustration of the process determining the selling price is the case where both the foreign and the domestic agents have linear utilities. Specifically, if the threat point of the domestic capitalist is not to sell the equity, the selling price P is determined by maximizing the

(10) $\dfrac{\kappa\xi(1-\beta)X_{2,T}}{1+\rho}$.

Hence, the current account is

(4') $X_{1,T} - c_{1,T} = D_1 - F - \dfrac{\kappa\xi(1-\beta)X_{2,T}}{1+\rho}; \quad X_{2,T} - c_{2,T} = F(1+\rho) + \xi(1-\beta)X_{2,T}$.

Selling the equity modifies the domestic agent's problem to

(11) $$\max_{\{c_{1,T};c_{1,N};c_{2,T};c_{2,N};F\}} V_r(\xi)$$

where

$$V_r(\xi) = U - \lambda_1[c_{1,T} + p_{1,N}c_{1,N} - (p_{1,N}\overline{L} + (1-\beta)X_{1,T} + \kappa\frac{\xi(1-\beta)X_{2,T}}{1+\rho} + F - D_1)]$$
$$-\lambda_2[c_{2,T} + p_{2,N}c_{2,N} - \{p_{2,N}\overline{L} + (1-\beta)(1-\xi)X_{2,T} - F(1+\rho)\}] \quad .$$

The domestic agent would support opening the capital market for foreign ownership only if it would increase his net income, which is equivalent to

(12) $$\frac{\partial V_r(\xi)}{\partial \xi}\Big|_{\xi=0} > 0$$

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corresponding Nash product, $\underset{P}{MAX}\left[P - \dfrac{\xi(1-\beta)X_{2,T}}{1+\rho^*}\right]^{\tau}\left[\dfrac{\xi(1-\beta)X_{2,T}}{1+\rho} - P\right]^{1-\tau}$, where τ measures the bargaining power of the domestic agent. The resultant selling price is $P = \dfrac{\xi(1-\beta)X_{2,T}}{1+\rho}[1-(1-\tau)\dfrac{\rho^*-\rho}{1+\rho^*}]$, corresponding to a domestic bargaining share $\kappa = 1-(1-\tau)\dfrac{\rho^*-\rho}{1+\rho^*}$. A similar procedure applies for non linear utilities.

Applying the first order conditions corresponding to (11), it follows that, with unrestricted access to international borrowing,

$$(13) \qquad sign\left\{\frac{\partial V_r(\xi)}{\partial \xi}\Big|_{\xi=0}\right\} = sign\{\kappa - 1\} \quad .$$

Hence, the domestic agent would not sell the equity as long as the foreign party has some bargaining power (and would be indifferent to the outcome if $\kappa = 1$).

This is not the case, however, if the agent faces borrowing constraints, so that $F \leq F_0 < F(\rho)$, where $F(\rho)$ stands for the borrowing with full access to the international capital market. In the presence of a binding foreign borrowing constraint, one expects a domestic loan market to emerge, segmented from the international market. Specifically, let F_d denote the domestic borrowing, at a real interest rate ρ_d. The existence of a foreign borrowing constraint, and segmented domestic borrowing modifies the problem facing the representative agent to

$$(14) \qquad \max_{\{c_{1,T};c_{1,N};c_{2,T};c_{2,N};F_d\}} \tilde{V}_r(\xi)$$

where

$$\tilde{V}_r(\xi) = U - \lambda_1[c_{1,T} + p_{1,N}c_{1,N} - (p_{1,N}\overline{L} + (1-\beta)X_{1,T} + \kappa\frac{\xi(1-\beta)X_{2,T}}{1+\rho} + F_d + F_0 - D_1)]$$
$$-\lambda_2[c_{2,T} + p_{2,N}c_{2,N} - \{p_{2,N}\overline{L} + (1-\beta)(1-\xi)X_{2,T} - F_d(1+\rho_d) - F_0(1+\rho)\}] \quad .$$

In these circumstances, the agent will support opening the capital market if [6]

$$(15) \qquad \kappa > (1+\rho)\frac{u'_{C_{2,T}}}{1+\rho^*} / u'_{C_{1,T}}$$

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6 This condition is obtained by optimizing (14), for an exogenously given F, F = F_0.

The F.O.C. characterizing the internal capital market is

$$(16) \quad 1+\rho_d = u'_{C_{1,T}} \Big/ \frac{u'_{C_{2,T}}}{1+\rho*}$$

Applying this condition to (15), we infer that opening the domestic capital market is desirable if the premium of the domestic real interest rate above the foreign one, exceeds the bargaining share of foreign entrepreneurs --

$$(17) \quad \frac{\rho_d - \rho}{1+\rho_d} > 1-\kappa$$

This condition is more likely to hold, the greater is the credit shortage in period 1 (as will be the case the greater the debt overhang is); the lower is the first period borrowing constraint, F_0; and the weaker is the market power of the foreign entrepreneur. If (17) holds, the F.O.C. characterizing the equilibrium selling of domestic capital to foreigners, denoted by $\xi *$, is

$$(18) \quad \frac{\partial \tilde{V}_r(\xi)}{\partial \xi} = 0 .$$

3. Example and interpretation

Consider the case where $\beta = 0.5$. Applying (5) and (8) we can solve for the real exchange rate as a function of the current account

(19)

a. $$p_{1,N} = \frac{F - D_1 + \sqrt{(F - D_1)^2 + \frac{\delta}{1-\delta}\overline{L}(2 + \frac{\delta}{1-\delta})}}{2\frac{\delta}{1-\delta}\overline{L}}$$

b. $$p_{2,N} = \frac{-(1+\rho)F + \sqrt{[(1+\rho)F]^2 + \frac{\delta}{1-\delta}\overline{L}(1+a)^2(2 + \frac{\delta}{1-\delta})}}{2\frac{\delta}{1-\delta}\overline{L}} \quad .$$

It is easy to verify that

(20) $$p_{1,N} = p_{1,N}(\overset{+}{F - D_1};\ \overset{-}{\delta}) \qquad p_{2,N} = p_{2,N}(\overset{-}{F};\ \overset{-}{\delta})$$

Following similar steps, we find that the real exchange rate with a capital market reform (denoted by the upper index r) is given by

(21) $$p^r_{1,N} = \frac{F + \frac{\kappa 0.5\xi}{1+\rho}\frac{(1+a)^2}{2p^r_{2,N}} - D_1 + \sqrt{(F + \frac{\kappa 0.5\xi}{1+\rho}\frac{(1+a)^2}{2p^r_{2,N}} - D_1)^2 + \frac{\delta}{1-\delta}\overline{L}(2 + \frac{\delta}{1-\delta})}}{2\frac{\delta}{1-\delta}\overline{L}}$$

(22) $$p^r_{2,N} = \frac{-(1+\rho)F + \sqrt{[(1+\rho)F]^2 + \frac{\delta}{1-\delta}\overline{L}(1+a)^2\{2(1-0.5\xi) + \frac{\delta}{1-\delta}\}}}{2\frac{\delta}{1-\delta}\overline{L}} .$$

We apply now the above equations to plot the utility *V* as a function of the first period borrowing, F. The bold curve in Figure 3, U, depicts welfare in the absence of reforms, where foreigners are hindered from buying domestic equities. The broken curve, U_r, depicts the utility in the reformed regime, for the case where the bargaining share of the domestic entrepreneurs is 0.5 and $\xi = 0.71$. Note that, in the absence of any restrictions on borrowing, there are no welfare gains from opening up the economy to equity trade. However, if the country faces a credit ceiling, e.g. $F_0 = 0.20$, the utility will be higher in the reformed regime. This will be the case, for example, if a financial crisis will induce the creditors to demand immediate repayment of 3/4 of the debt overhang. The optimal equity sale for $F_0 = 0.20$ turned out to be $\xi^* = 0.71$. The utility U_r reported in Figure 3 correspond to this optimal equity sale.

A key factor determining the willingness to sell domestic equities is the size of the outstanding debt relative to the borrowing constraint. First, a critical size of the external debt may be a precondition for the credit ceiling to bind. Second, the actual size of the debt determines the willingness to sell domestic equity to foreigners, as a way to gain resources in the first period. This point is confirmed in Figure 4, plotting the dependence of the equity sold on the first period debt overhang (solved from (18)). Higher openness has the effect of mitigating the real depreciation induced by a given change in the current account. It also reduces the equity sold for a given debt overhang, as is confirmed by comparing Figure 4a (drawn for $\delta = 0.3$) with Figure 4b (drawn for $\delta = 0.5$).

The bottom part of Figure 3 plots the first period real exchange rate. Curve p corresponds to the regime where inward FDI is prohibited, p_r corresponds to reformed regime, where the domestic equity market is opened to foreigners. In the absence of a crisis, optimal borrowing is about 0.74, and the real exchange rate is at point *A*. The financial crisis, and the resultant borrowing constraint F_0, induces a real depreciation, and the new first period equilibrium is depicted at point *B*. The financial panic has the effect of moving leftward, along the p curve. Opening the equity market to foreigners induces the inflow of equity investment, causing the real appreciation (depicted in

Figure 3 in the move from point *B* to point *C*). Hence, part of the reversal of the real exchange rate overshooting is attributed to financial reforms.

4. Discussion and Concluding remarks

The purpose of this paper is to explain the impact of a financial crisis on the attitude towards financial reforms and exchange rate overshooting. We identified the key role of the crisis and of the resultant capital flight in inducing the country to open up. The capital inflows induced by financial liberalization lead to an appreciation, eroding thereby the initial overshooting of the real exchange rate. Our discussion also implies that the welfare gains from opening the capital market may not be large -- gains from alleviating the shortage of funds in the short run should be balanced with the cost of selling domestic equities at a discount. Evan if the net gain is significant, one may argue that temporary capital controls preventing the capital flight may lead to similar welfare effects from the point of view of the domestic economy. For example, imposing controls on capital flight, forcing old lenders to "recycle" at least half of the old debt ($F \geq 0.4$) would result in a domestic welfare that exceeds the one achieved by opening up the equity market [see Figure 3]. Indeed, this policy resembles the one followed by Malaysia. Even if the country adopts financial reform following a crisis, one may wonder whether the attitude change towards foreign capital predicted by our model would turn out to be permanent. Will the reform pass the test of time, beyond the financial crisis that has led to it?

An extended version of our model suggests that the ultimate success of financial opening may hinge on the productivity changes resultant from the reform. For simplicity of exposition, we assumed so far that opening the domestic capital market does not impact directly on the productivity of the domestic capital. The calculus of the welfare gain from financial opening would differ, however, if the transfer of ownership would increase the productivity of domestic capital. For example, suppose that FDI that transfers a fraction ξ of the domestic capital to foreign entrepreneurs would increase the productivity of capital from a to $\xi a_M + (1-\xi)a$, where $a_M > a$. This would imply that the welfare in the reformed regime is higher, improving the odds of enduring financial liberalization [in terms of Figure 3, it would shift curve U_rU_r upwards]. Indeed, if this effect is powerful enough, financial liberalization is superior, from the point of view of domestic agents, to temporary capital controls inhibiting capital flight. This situation is illustrated in Figure 5, where we show an example where the higher productivity of capital induced by FDI leads to welfare higher than the welfare achieved in the absence of a crisis.[7] Hence, the willingness to adopt an enduring financial reform is enhanced by favorable productivity effects of FDI.[8]

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7 The possibility that a financial reform would lead to welfare higher than the welfare prior to a crisis raises the question of why did the country not reform before the crisis. Addressing this issue would require adding uncertainty and political economy considerations. Specifically, one may argue that in the presence of downside risk concerning the ultimate productivity effects of the reform, domestic agents may refrain from the reform [see Fernandez and Rodrik (1991)]. In addition, political economy considerations frequently imply that policies are determined by a narrow interest group. In these circumstances one should go beyond the welfare assessment of the representative agent in order to explain the design of policies, and a crisis may be needed to tilt the balance in favor of a reform [for further discussion see Alesina and Drazen (1991) and Aizenman and Yi (1998), and Aizenman (1999)].

8 The evidence, however, cautions us that the favorable impact of FDI on domestic productivity may be small [see Aitken and Harrison (1999), and Haddad and Harrison (1993)].

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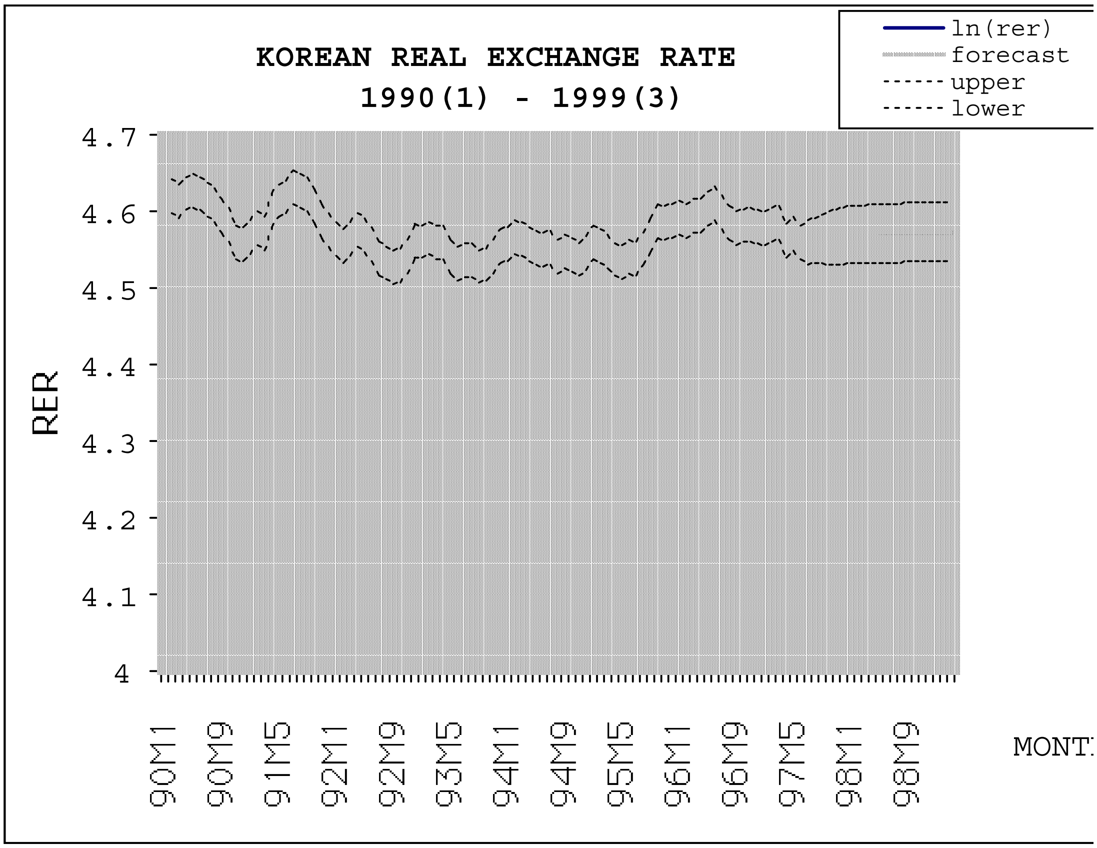

Figure 1

Data source -- the IMF

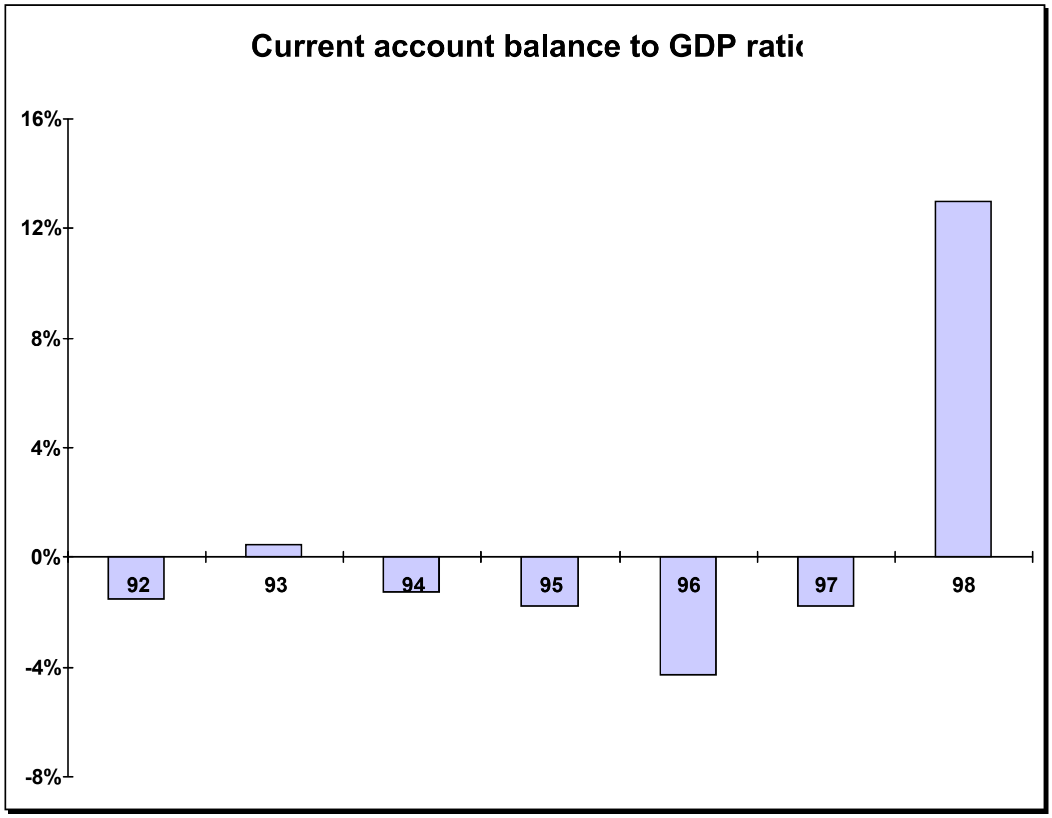

Figure 2

Korea's Current Account/GDP, 1992-1998

Data source -- the World Bank

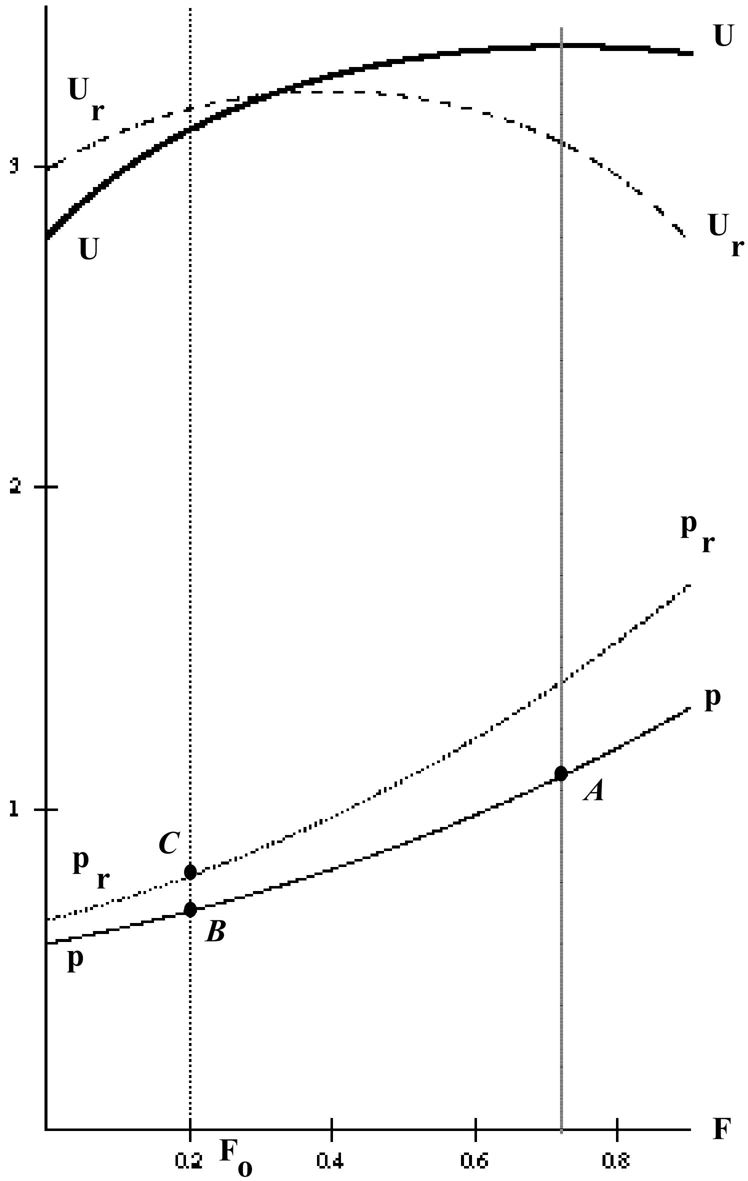

Figure 3
Borrowing and welfare -- the representative agent
Plotted for $\bar{L} = 1$; $D_1 = 0.8$; $\kappa = 0.5$, $\xi^* = 0.71$; $\delta = 0.3$; $\phi = 0.7$; $a = 0.8$
$\rho = 0.1$; $\rho^* = 0.1$

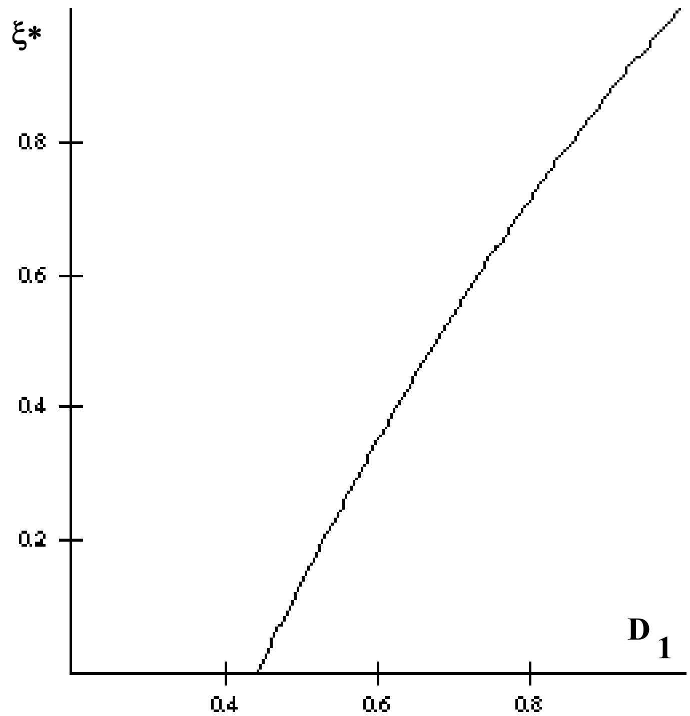

Figure 4a $\delta = 0.3$

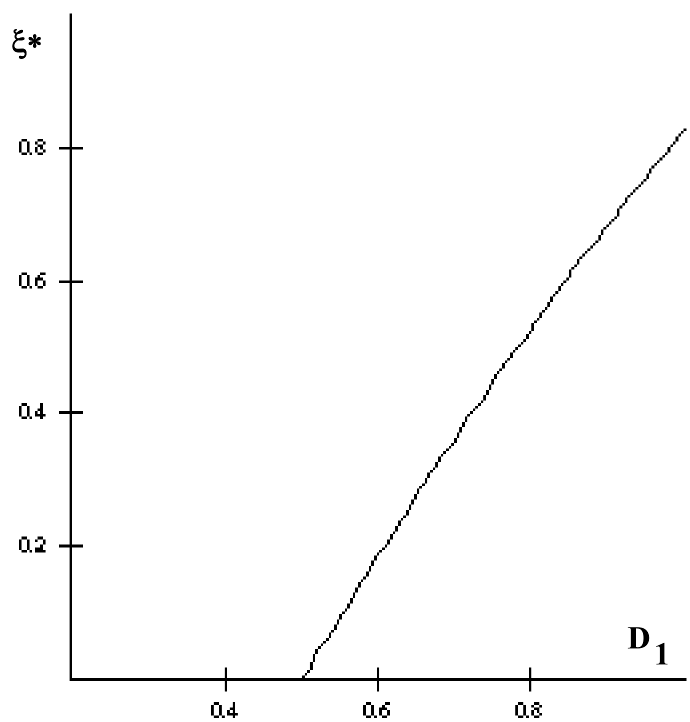

Figure 4b $\delta = 0.5$

Optimal equity sale and debt overhang

Plotted for $\overline{L} = 1$; $F_0 = 0.20$; $\kappa = 0.5$; $\phi = 0.7$; $a = 0.8$

$\rho = 0.1$; $\rho^* = 0.1$

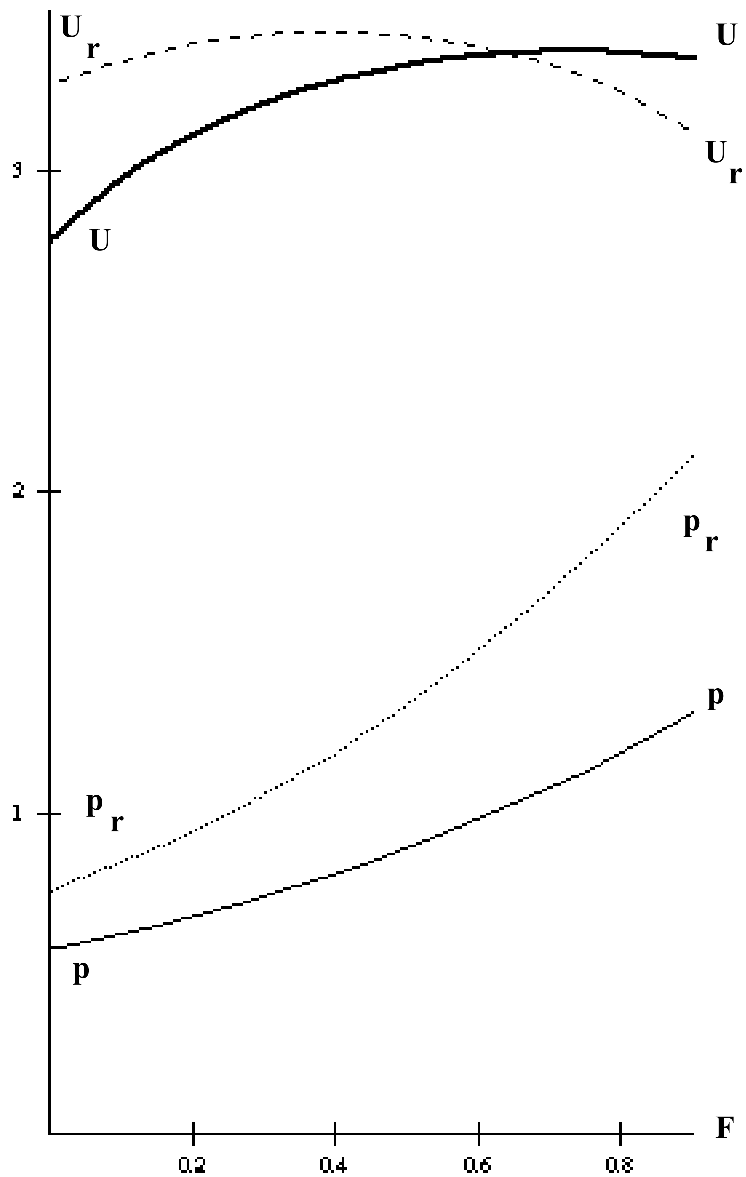

Figure 5
Borrowing and welfare when FDI increase productivity
Plotted for $\bar{L} = 1; \quad D_1 = 0.8; \quad \kappa = 0.5, \quad \delta = 0.3; \quad \phi = 0.7; \quad a = 0.8; \quad a_M = 1.6; \quad \xi = 1$
$\rho = 0.1; \quad \rho^* = 0.1$