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FINANCIAL LIBERALIZATIONS AND CAPITAL FLOW REVERSALS:

OPTIMAL POLICY FOR SHORT AND LONG TERM DEBT MANAGEMENT*

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Abstract

The recent crisis in Asia has focused economists' interests on capital flows and their determinants. This paper examines three possible economic fundamentals that are likely to have contributed to the capital flow reversals. First, as in Eicher, Turnovsky and Walz (2000), financial market liberalizations alone turn out to be sufficient to generate capital flow reversals if the decentralization of the financial sector is not accompanied by the correct taxes. These taxes are shown to represent incentives for domestic capital accumulation and disincentives to excessive foreign borrowing. Second we extend the analysis to show that the term structure also matters for capital flow reversals. The share of debt held in long and short term assets, is shown to be a determinant of the optimal tax during financial liberalization. The greater the share of international debt held in short term assets, the greater the optimal tax on foreign borrowing and the greater the subsidies to domestic capital accumulation, to reduce the international debt exposure and minimize the effects of a crisis. The crisis itself is aggravated by exchange rate movements, as shown in the extension of the model, which proves to be consistent with the data presented in the paper.

1. Introduction

The steady rise of the dollar, combined with increasingly open capital markets and large amounts of short term lending, all contributed significantly to the recent Asian Crisis. In this paper we seek a unified approach to the observed capital flow reversals and their detrimental impact on key economies in Asia. The objective is to how both the positive and negative effects of financial liberalization are amplified by the term structure of foreign debt and how exchange rate movements are aligned with capital flows and external indebtedness.

We build on the model by Eicher, Turnovsky and Walz (2000) who show that one-time policy changes, such as financial liberalizations, may endogenously generate initial periods of strong economic growth and "excessive" capital inflows, followed by major contractions and capital outflows at a later stage. We augment the model by introducing the term structure of foreign debt and by allowing for exchange rate movements, thereby enabling us to compare the predictions of the model to the data.

A common feature in those countries that were hurt most by the Asian Crisis -- Thailand, Indonesia and Korea -- is that all experienced some degree of financial liberalization, subsequent growth booms and excessive short term borrowing in conjunction with unusual exchange rate fluctuations. We argue that in all three cases, the investment and growth booms that were financed largely by foreign capital inflows and the associated financial liberalization were accompanied with inappropriate public policy. As a consequence, eventually in 1997, the countries' indebtedness became a source of concern for lenders. Capital outflows, balance of payments crises, and exchange rate deprecations all developed and coincided with increased costs of foreign capital to each country, all being reflections of increased perceived country risk.

Aside from a country's debt to equity ratio, which increases a country's financial risk, the analysis of the crisis economies reveals that the term structure of the outstanding debt also served as a major catalyst of the crisis, see Aizenman and Marion (1999). Careful scrutiny of the external debt positions of the Asian economies reveals the detrimental effects of short term financing. Excessive exposure to short term debt that can easily be refinanced in good times and convey the impression of seemingly healthy balance sheets, aggravated the crisis; refinancing became less of an option as the market for short term financing dried up or was only available at exorbitant costs.

The objective of this paper is to show how such capital flow reversals can be generated as part of the intrinsic dynamic adjustment resulting from a *unique* initial policy event, which in our case takes the form of financial liberalization. In addition we will show how such capital flow reversals may be exacerbated by the term structure. Finally we establish a relation between a country's external debt position and real exchange rate movements via an adjustment mechanism that is shown to be consistent with the empirical data.

A key feature of our analysis is the recognition of uncertainty and risk, which we use to motivate an upward sloping supply schedule of foreign funds that each country faces. This supply schedule reflects the borrowing premium that highly indebted countries must remit to foreign creditors. Initial representations of international credit market imperfections were originally introduced by Bardhan (1967), and subsequently motivated more formally by Eaton and Gersovitz (1981, 1989) and Kletzer (1984), on the basis of asymmetric information and default risk. The assumption is intended to reflect the reality that international capital markets require borrowing premiums to compensate for sovereign risk, and is particularly appropriate when considering developing economies. Empirical support for such a relationship is provided by Edwards (1984).

In addition we proxy the uncertainty that international lenders experience with respect to the term structure of the country-specific debt. The reversal of capital flows has been associated not only with increased intrinsic risk about specific projects in the various countries, but also with the uncertainty about the size of external debt. Since short term debt can be disguised relatively more easily than long term debt, international lending is found to be more sensitive to potential off-balance sheet (short term). The term structure of debt has become a major culprit, and in fact an indicator for financial crisis and capital flow reversals, as documented by Rodrik and Velasco (1999). Birdsall, Gavin and Hausman (1997) showed even before the Asian crisis occurred that "the Mexican Crisis illustrates the dangers of short term debt." Empirical support and microfoundations how debt term structure or overhang may affect international lending is provided by Aizenman and Marion (1999).

In order to avoid the above-described capital flow reversals, financial liberalization must be accompanied by specific policy measures, that are shown to be contingent on the term structure of foreign borrowing, interest parity rate fluctuations - and thus exchange rate movements and countries' debt to equity ratios. The economy features three externalities: one in the production technology, the second one arises from an upward sloping supply curve of debt, and the third is the fact that the individuals do not fully take into account that the term structure of debt matters to international lenders. To correct for these externalities, we find that an optimal financial liberalization must, under all circumstances, be accompanied by an optimal tax on both foreign borrowing and consumption, while subsidizing domestic capital accumulation. Intuitively, financial liberalization increases the openness of the capital account, which increases foreign borrowing at the cost of domestic capital accumulation. However, the increase in foreign debt raises the country's borrowing premium to foreign investors, and the decline of domestic assets relative to the debt level increases the risk even further. Consumption needs to be curtailed to save for domestic investment and to finance the subsidy on domestic capital accumulation. The greater the share of debt held in foreign liabilities, the greater the tax on foreign borrowing and the higher the optimal subsidies to domestic investment to brace for possible large fluctuations in interest rates, exchange rates and capital flows.

We show that if an economy's financial sector is decentralized with an inadequately low tax on foreign borrowing, the country initially finances an investment and growth boom with foreign debt. However, the subsequent increase in the exchange rate, and the lending rates that foreigners are willing to charge the country increase the interest payments and leave even less output for domestic investment. This further raises the country's level of indebtedness, eventually the economy must contract to repay its debt and remit the foreign capital that fueled the initial growth boom. At this time the country experiences significant capital outflows. Our results do not argue against financial liberalization *per se*. Instead, we highlight that decentralization must be accompanied by the appropriate institutional structure, such as a government body to oversee borrowing activity and to set appropriate tax rates, so as to generate the correct domestic investment incentives.

In addition, the paper yields results relating to the term structure of the international debt and exchange rate movements. We also show that when the short-term interest elasticity with respect to the debt to capital ratio exceeds the long-term elasticity, the tax on foreign debt increases in the share of debt held in short term bonds. Intuitively, the public policy in this case is meant to prepare the country for greater and faster capital outflows by building up an appropriately large domestic capital stock. The greater the share of domestic debt held in short term assets thus increases the burden on the economy, via a high optimal tax on foreign borrowing. More transparent, long term international debt arrangements thus reward the country with lower average interest rates, because it lowers the level of uncertainty to international investors.

The model is also able to examine the effects of a country specific risk indicator, which distinguishes countries with various levels of development, openness, and ability to serve foreign debt also increases the tax on bonds, and the subsidy on capital accumulation. We show that if a country's level of development (due to debt service ability, or openness or capital controls) increases the interest rate's sensitivity to changes in its debt to equity ratio, optimal policy must impose a greater tax on foreign borrowing and a greater subsidy on domestic capital accumulation to counterbalance the factor that lead to the increased interest sensitivity.

Finally we examine the implications for the behavior of the real exchange rate. By employing the interest parity condition, it is possible to examine the implied movements in the exchange rate in our model. The model then establishes a direct link between the interest differential between domestic and foreign rates, as determined by the international debt and domestic capital, and changes in the exchange rate. Hence the above-described loop in debt and capital should be mirrored by both the interest rate and by change in the exchange rate. While causality is an issue in that we cannot identify if exchange rate changes influence the interest differential and debt structure, or vice versa, we can take the implication to the data and find a surprisingly strong correlation between the models predictions and observed exchange rate movements.

In comparing the models implications to the data we examine the experiences of three Asian countries, Thailand, Indonesia, and South Korea, three prominent cases in which recently capital flow reversals have been observed, starting in the latter half of 1997. We report the findings of Eicher, Turnovsky and Walz (2000), that indeed these countries did not only experience capital flow reversals, but also debt reversals, where initial increases in the level of debt after financial liberalizations were likely used to finance domestic investment and growth booms. In all three cases, an eventual negative growth rate of fixed investment preceded the crisis, which culminated in a exchange rate depreciation, currency crises and a sharp reversal of capital inflows. Thus, the observed patterns in these countries mirror the time path predicted by our model in a striking manner.

In addition, all countries reported significant increases in the external debt positions as their balance of payments accounts came under increasing scrutiny. Especially the effects of short-term borrowing and the associated uncertainty were pronounced in mid 1997. For example, shortly before the crisis, Thailand was forced to revise its external debt upward by 21 and 26 percent for 1995 and 1996, respectively. Also in late 1997, the Korean government had to revise the estimates of the country's external debt upward by more than 60 percent over previously published reports in the same year. The sheer size of these discrepancies was only possible due to short-term loans that eluded tight reporting measures for significant periods of time. Indeed we show that for all three countries the exchange rate fluctuations and the interest rate fluctuations mirror the loop of debt and domestic capital to a surprising extend. While the real exchange rate is relatively sticky in the pre crisis quarters, the change in debt and capital accumulation is accompanied by an equally dramatic variation in both the exchange rate and the interest differential, providing additional support for the mechanism described in the paper.

The rest of the paper proceeds as follows. Section 2 sketches the structure of the small open economy (as described in Eicher and Turnovsky, 1999), the equilibrium dynamics in a centrally planned economy (as in Eicher, Turnovsky and Walz, 2000). Section 3 reviews the optimal policy, and provides theoretical foundations for potential capital flow reversals. We discuss the impact of the term structure of debt, country specific factors and exchange rate fluctuations. Each prediction is also compared to the data from Thailand, Indonesia and Korea. Our main findings are briefly summarized in Section 5.

2. The Analytical Framework

As mentioned above the base model that will be extended to feature exchange rate movements and the effects of the term structure of debt is based in Eicher and Turnovsky (1999). The details of the analysis can be found in the original paper, here we sketch the basic model and highlight extensions. We consider a small open economy that consumes and produces a single traded commodity. Each individual is identical and is endowed with a fixed quantity of labor, L_i. Labor is fully employed so that total the labor supply equals the size of the population, *N*, which grows at the steady rate $\dot{N} = nN$. Individual domestic output, Y_i, is determined by the individual's private capital stock, K_i, his labor supply, L_i, and the aggregate capital stock $K = NK_i$. Assuming a Cobb-Douglas production function, individual output is determined by

$$Y_i = a' L_i^{1-s} K_i^s K^h \equiv a K_i^s K^h \qquad 0 < s < 1, h \gtrless 1. \tag{1a}$$

One is to interpret *K* as knowledge capital or intra-industry spillovers of knowledge. A negative exponent on *K* can be interpreted as reflecting congestion externalities. Each factor of production has positive, but diminishing, marginal physical productivity.

Aggregate consumption in the economy is denoted by *C*, so that per capita consumption at time *t* is $C/N = C_i$, yielding the individual agent utility over an infinite time horizon represented by the intertemporal isoelastic utility function:

$$\Omega \equiv \int_0^\infty (1/g)(C/N)^g e^{-rt} dt; \quad -\infty < g < 1. \tag{1b}$$

Individual agents accumulate physical capital, with expenditure on a given change in the capital stock, I_i, involving adjustment (installation) costs that we incorporate in the quadratic (convex) function

$$\Phi[I_i, K_i] \equiv I_i + h I_i^2 / 2K_i \quad = I_i (1 + hI_i / 2K_i). \tag{1c}$$

so that the individual's net rate of capital accumulation is given by

$$\dot{K}_i = I_i - nK_i. \tag{1d}$$

Agents may borrow internationally on a world capital market. The innovation in this paper is to allow agents to borrow in either short term or long term assets, whose respective return is r_S and r_L. The key institutional factor that we wish to take into account is that the creditworthiness of the economy influences its cost of borrowing from abroad. Essentially we assume that world capital markets assess an economy's ability to service debt and its associated default risk. Much like the *Standard and Poor's* credit ratings, we assume that the key indicator of risk is the country's debt-capital (equity) ratio. As a result, the interest rates a country is charged on world capital markets increases with this ratio. This leads to the upward sloping supply schedule for debt, expressed by assuming that the aggregate borrowing rate, $r[Z/K]$, charged on foreign debt, Z, is of the form:

$$r_S[Z/K] = r^* + x(Z/K)^{c_S} \quad c_S > 0 \text{[1]}, \tag{2a}$$

$$r_L[Z/K] = r^* + x(Z/K)^{c_L} \quad c_L > 0, \tag{2b}$$

where r^* denotes the exogenously given world interest rate, for example given by the London Interbank Borrowing Rate (LIBOR). Both the long and the short-term rates increase n the debt to equity ratio, and we assume that the short-term rate is more sensitive to changes in the ratio, as $\partial r_S[.]/\ /\partial(Z/K) > \partial r_L[.]/\partial(Z/K)$. The parameter x denotes the country-specific borrowing premium, which indicates the development level of an economy, as countries tend to differ sharply in their competitiveness and their debt service ability, as well as the degree of financial openness.

Observed costs of capital in the data generally involve averages of short and long term rates. Due to paucity of data, precise knowledge of the debt structure of developing economies is not known. Hence we will assume that the observed interest rate can be derived via the weighted average

$$r[Z/K] = l r_S + (1 - l) r_L \tag{2c}$$

which implies $\partial r'[Z/K]/\partial l > 0$. Several variants of the borrowing constraint can be found in the literature. The original formulation by Bardhan (1967) expressed the borrowing premium in terms of the *absolute* stock of debt, although this cannot sustain a balanced growth equilibrium. Sachs (1984) and Cooper and Sachs (1985) argue in support of a *relative* form of borrowing premium, as specified in (2). They suggest how a country, by adopting growth-oriented policies, can shift the upward-sloping supply curve outward, so that at each level of debt a lower borrowing premium is charged. This effect can be incorporated by assuming that the borrowing premium depends upon the level of debt relative to some measure of debt-servicing capacity, such as capital or output that depends upon

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[1] To simplify the exposition, we assume $c_S < 1, c_L > 1$.

capital; see also van der Ploeg (1996). Edwards (1984) provides empirical evidence that finds a robust and significant positive relationship between the spread over LIBOR (e.g. r^*) and the debt-GNP ratio.

While (2) is plausible and suffices for our purposes, it should be interpreted as a reduced form relationship, one that implicitly assumes the existence of risk. Eaton and Gersovitz (1989) show that whether or not the presence of default risk leads to an upward sloping supply of capital, depends upon the nature of the penalty function in the event of default. Aizenman and Turnovsky (1999) show how an upward sloping supply curve will obtain in the case of an economy facing default risk and probability of bailout, as long as the (positive) resource costs necessary to enforce the agreed repayment scheme in the event of partial default is not too large. Finally, in specifying (2) we are viewing the imperfection of the bond market from the standpoint of a borrowing nation. This seems natural in the sense that it is the debtor nation that is the source of the underlying risk.

The relationships, (1a), (1c) and (1d) relate to individual agents. Our objective is to analyze the dynamics of the aggregate economy and thus it is necessary to define the relevant aggregate quantities. First, summing the individual production functions, (1a), over the *N* agents, the aggregate production function is

$$Y = aK^{h+s}N^{1-s} \equiv aK^{s_K}N^{s_N}, \tag{3a}$$

where $s_N \equiv 1-s$ represents the share of labor in aggregate output, and $s_K \equiv s+h$ identifies the share of capital in aggregate output.

Long-run equilibrium is a balanced growth path along which aggregate output and aggregate capital are assumed to grow at the same constant rate, so that the aggregate output-capital ratio remains unchanged. Taking percentage changes of (3a) and imposing the long-run condition of a constant capital-output ratio, the long-run equilibrium growth of capital and output, *g*, is given by

$$g \equiv \left(\frac{s_N}{1-s_K}\right)n. \tag{4}$$

Equation (4) exhibits the key characteristic of non-scale growth models, namely that the long-run growth rate depends upon the technological elasticities in conjunction with the population growth rate, and is independent of policy. It is also apparent from (4) that the balanced growth rate is positive if and only if $s_K < 1$. Under constant returns to scale, the equilibrium rate of growth of the economy equals the rate of population growth, *n*. Otherwise, *g* exceeds *n* or is less than *n*, implying positive or negative per capita growth, according to whether returns to scale are increasing or decreasing, $h \gtrless 0$.

Summing over the individual capital stocks and investment in combination with (1d) the nation's aggregate rate of debt accumulation, its current account deficit, can be shown to be

$$\dot{Z} = C + I\left[1 + \frac{h}{2}\frac{I}{K}\right] - aK^{s_K}N^{s_N} + r[Z/K]Z\,. \qquad (5)$$

where $\dot{K} \equiv I = NI_i$ denotes the aggregate rate of investment.

2.1 The Centrally Planned Economy

Financial liberalizations are essentially decentralizations of any state controls of the financial sector. Hence it is convenient to begin by considering a centrally planned economy to establish a benchmark for the decentralized economy and the optimal tax structure as part of the financial liberalization program. The central planner chooses aggregate rates of consumption, *C*, investment, *I*, capital accumulation, $\dot{K}$, and debt accumulation, $\dot{Z}$, to maximize the utility of the representative agent, (1b), subject to the aggregate accumulation equations (3c) and (5). The Hamiltonian to this maximization problem is represented by:

$$H \equiv \frac{1}{g}\left(\frac{C}{N}\right)^{g} e^{-rt} + we^{-rt}\left[C + I\left(1 + \frac{h}{2}\frac{I}{K}\right) - aK^{s_K}N^{s_N} + r[Z/K]Z - \dot{Z}\right] + q'e^{-rt}\left(I - \dot{K}\right)$$

where w is the shadow value of aggregate wealth in the form of internationally traded bonds, q' is the shadow value of the aggregate capital stock, and $q \equiv q'/w$ measures the market value of capital in terms of the (unitary) price of foreign debt.

The relevant optimality conditions with respect to *C* and *I* are respectively

$$\frac{C^{g-1}}{N^{g}} = w \qquad (6a)$$

$$1 + h\frac{I}{K} = q \qquad (6b)$$

Condition (6a) equates the marginal utility of consumption to the shadow value of wealth, while equation (6b) sets the marginal cost of an additional unit of investment, which includes the marginal installation cost hI/K, to the market value of capital. The latter relation may be immediately solved to yield the following expression for growth rate of the aggregate capital stock,

$$\frac{\dot{K}}{K} = \frac{I}{K} = \frac{q-1}{h} \equiv f \tag{7}$$

Thus, starting from an initial level K_0, the national stock of capital at time t is $K(t) = K_0 e^{\int_0^t f(s)ds}$. The optimality conditions with respect to debt and capital lead to the arbitrage relationships:[2]

$$r - \frac{\dot{w}}{w} = r\left[\frac{Z}{K}\right] + r'\left[\frac{Z}{K}\right] \cdot \frac{Z}{K} \tag{6c}$$

$$\frac{s_K Y}{qK} + \frac{\dot{q}}{q} + \frac{(q-1)^2}{2hq} + \frac{r'[Z/K]}{q}\left(\frac{Z}{K}\right)^2 = r\left[\frac{Z}{K}\right] + r'\left[\frac{Z}{K}\right] \cdot \frac{Z}{K} \tag{6d}$$

Equation (6c) is the standard Keynes-Ramsey consumption rule, equating the marginal return on consumption to the marginal cost of borrowing. It is important to observe that in determining the latter, the central planner recognizes that increasing his stock of debt raises the cost of borrowing. Likewise, (6d) equates the return on domestic capital to the marginal cost of borrowing. The return on domestic capital consists of four components. The first is the contribution to output per unit of installed capital, (valued at the price *q*), while the second term is the rate of capital gain. The third element, which equals $(qI - \Phi)/qK$, reflects the fact that an additional benefit of a higher capital stock is to reduce the installation costs associated with new investment. The fourth element stems from the fact that an increase in capital lowers the debt cost, thereby providing a further benefit to investing in capital.

Finally, in order to ensure that the agent's intertemporal budget constraint is met, the following transversality conditions must be imposed:

$$\lim_{t\to\infty} wZe^{-rt} = 0; \quad \lim_{t\to\infty} q'Ke^{-rt} = 0 \tag{6e}$$

The transversality condition on debt is equivalent to the national intertemporal budget constraint.

To examine the transitional dynamics about the stationary equilibrium, we normalize key variables

$$c \equiv \frac{C}{N^{(s_N/(1-s_K))}}; \quad k \equiv \frac{K}{N^{(s_N/(1-s_K))}}; \quad z \equiv \frac{Z}{N^{(s_N/(1-s_K))}}. \tag{8a}$$

2.1.1 Centralized Macrodynamic Equilibrium

Differentiating the quantities given in (8a) and recalling (4) implies the following relationships:

$$\frac{\dot{c}}{c} = \frac{\dot{C}}{C} - g; \quad \frac{\dot{k}}{k} = \frac{\dot{K}}{K} - g; \quad \frac{\dot{z}}{z} = \frac{\dot{Z}}{Z} - g. \tag{8b}$$

If we combine the time derivative of (6a) with (6c) we obtain the growth rate of scale-adjusted per capita consumption

$$\frac{\dot{c}}{c} = \frac{r(z/k) + r'(z/k)\cdot(z/k) - r - gn}{1-g} - \left(\frac{s_N}{1-s_K}\right)n \equiv y - g\,. \tag{9a}$$

The growth rate of scale-adjusted capital can be obtained by combining (7) with (8b):

$$\frac{\dot{k}}{k} = \frac{q-1}{h} - \left(\frac{s_N}{1-s_K}\right)n \equiv f - g\,, \tag{9b}$$

while (6d) provides the evolution of the relative price of capital:

$$\dot{q} = \left(r[z/k] + r'[z/k](z/k)\right)q - r'[z/k]\cdot(z/k)^2 - \frac{(q-1)^2}{2h} - a s_K k^{s_K - 1}. \tag{9c}$$

Finally, combining (8b) with (5), the dynamics of the scale-adjusted per capita debt stock is

$$\dot{z} = \left(r[z/k] - g\right)z - ak^{s_K} + c + \left(\frac{q^2-1}{2h}\right)k\,. \tag{9d}$$

The system of equations (9a-d) is an autonomous system in the four variables c, k, z, q, all of which are linked in an interdependent fourth order system. All variables in the system are subject to transitional dynamics.

The steady state growth path is obtained when $\dot{c} = \dot{k} = \dot{z} = \dot{q} = 0$, so that the corresponding steady state values of c, k, z, q, denoted by tildes, are determined by:

$$\frac{r\left[\tilde{z}/\tilde{k}\right] + r'\left[\tilde{z}/\tilde{k}\right]\cdot\left(\tilde{z}/\tilde{k}\right) - r - gn}{1-g} = g \tag{10a}$$

$$\tilde{q} = 1 + h\left(\frac{s_N}{1-s_K}\right)n = 1 + hg \tag{10b}$$

$$\frac{a s_K \tilde{k}^{s_K - 1}}{\tilde{q}} + \frac{(\tilde{q}-1)^2}{2h\tilde{q}} + \frac{r'\left[\tilde{z}/\tilde{k}\right]\left(\tilde{z}/\tilde{k}\right)^2}{\tilde{q}} = r\left[\tilde{z}/\tilde{k}\right] + r'\left[\tilde{z}/\tilde{k}\right]\cdot\frac{\tilde{z}}{\tilde{k}} \tag{10c}$$

$$\tilde{c} + \left(\frac{\tilde{q}^2 - 1}{2h}\right)\tilde{k} - a\tilde{k}^{s_K} + \left(r\left[\tilde{z}/\tilde{k}\right] - g\right)\tilde{z} = 0\,. \tag{10d}$$

This steady state has a simple recursive structure. First, the steady-state price of installed capital is determined by (10b), so that the equilibrium growth rate equals *g*. Given the non-scale nature of our model, the restricted access to the world financial market has no adverse impact on the

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[2] To economize on notation we write the derivative of the interest rate (2c) in its general functional form $r'[Z/K]$.

country's long-run growth rate of output. In contrast to some previous small open economy growth models the long-run domestic consumption grows at the same rate as does output. This equality is achieved through the adjustment in the country's debt to capital ratio, $\tilde{z}/\tilde{k}$, and hence in the cost of borrowing. Having determined both $\tilde{q}$ and $\tilde{z}/\tilde{k}$, (10c) determines the scale adjusted capital-labor ratio, $\tilde{k}$, such that the after-tax return on capital equals the marginal cost of debt. Finally, given $\tilde{q}$, $\tilde{z}/\tilde{k}$, and $\tilde{k}$, (10d) determines the equilibrium scale-adjusted per capita consumption, $\tilde{c}$. Following Eicher and Turnovsky’s (1999) discussion for the decentralized economy, we can identify weak conditions under which the fourth order dynamic system (9) has two stable eigenvalues, so that with *q* and *c* being free to jump instantaneously, the centralized economy is saddlepath stable.

Having characterized the equilibrium of a centrally planned economy, we can ask if it might be decentralized in such a way that the socially optimal levels of foreign borrowing and domestic investment are maintained, but agents act only in their own best self interest. To compare the centralized economy to the decentralized, we review the latter, as discussed by Eicher and Turnovsky (1999), noting how individual agents neglect the two externalities we have introduced.

2.2 The Decentralized Economy

The representative agent's decisions in the decentralized economy are to choose his individual consumption, C_i, rate of investment, I_i, and rates of accumulation of capital K_i, and debt Z_i to maximize his utility function (1b), subject to his accumulation of capital (1d) and his flow budget constraint, now expressed as

$$\dot{Z}_i = (1+t_c)C_i + I_i\left(1+(h/2)(I_i/K_i)\right) - (1-t_y)Y_i + \left((1+t_z)r[Z/K] - n\right)Z_i - T_i \qquad (11)$$

The individual constraint, (11), differs from the aggregate constraint, (5) in the centrally planned economy in several respects. Because of the growing population, part of the costs of debt is incurred by future agents, reducing the cost of debt to the representative agent by the rate of population growth, *n*. Current production is taxed at rate t_y, debt payments are taxed at the rate t_z, while consumption is taxed at rate t_c, and all taxes are rebated as lump sum transfers, T_i. The tax on income has it real world analog in income taxes, which can be negative (and frequently are in the case of corporations) if public policy is to encourage capital accumulation. The tax on foreign borrowing can indeed have many alternative forms. It could be as simple as differential taxation of domestic and foreign capital gains (which is prevalent in the developing economies in Asia). Alternatively the tax might be a high markup that the central bank charges private agents for foreign exchange transactions, or it could be differential taxation of profits on direct foreign investment as compared to profits generated by domestic corporations.

It is important to emphasize that in performing his optimization, the representative agent takes the interest rate as given. This is because the interest rate facing the debtor nation, as reflected in its upward sloping supply curve of debt, is a function of the economy's *aggregate* debt to capital ratio, which the individual agent in making his decisions assumes he is unable to influence.

Performing the optimization, the optimality conditions with respect to C_i and I_i are

$$C_i^{g-1} = w_i(1+t_c) \tag{6a'}$$

$$1 + h\frac{I_i}{K_i} = q_i \tag{6b'}$$

The equilibrium conditions with respect to debt and capital can now be modified to

$$r - \frac{\dot{w}}{w} = (1+t_z)r[Z/K] \tag{4a'}$$

$$(1-t_y)\frac{sY_i}{qK_i} + \frac{\dot{q}}{q} + \frac{(q-1)^2}{2hq} = (1+t_z)r\left[\frac{Z}{K}\right] \tag{4b'}$$

which reflect (i) the presence of taxes, and (ii) the fact that the agent takes the interest rate as given.

As noted, all tax revenues are rebated. Aggregating over the *N* individuals, this implies the government budget constraint:

$$T = rt_zZ + t_yaK^{s_K}N^{s_N} + t_cC \tag{12}$$

Summing (11) over the individuals and combining with (12) leads to the economy's net rate of accumulation of debt:

$$\dot{Z} = C + I\big(1 + (h/2)(I/K)\big) - aK^{s_K}N^{s_N} + r[Z/K]Z \tag{5}$$

which is identical to the relationship in the centrally planned economy.

2.2.1 Decentralized Macrodynamic Equilibrium

Expressing the system in terms of the stationary "scale-adjusted" per capita variables defined in (8a), together with the price of capital, *q*, the equilibrium dynamics are now expressed by:

$$\frac{\dot{c}}{c} = \frac{\big(r[Z/K](1-t_z) - r - gn\big)}{1-g} - \left(\frac{s_N}{(1-s_K)}\right)n \equiv y - g \tag{9a'}$$

$$\frac{\dot{k}}{k} = \left[\left(\frac{q-1}{h}\right) - \left(\frac{s_N}{1-s_K}\right)n\right] = f - g \tag{9b}$$

$$\dot{q} = r[z/k](1+t_z)q - (q-1)^2/2h - (1-t_y)ask^{s_K-1} \tag{9c'}$$

$$\dot{z} = \left(r[z/k] - g\right)z - ak^{s_K} + c + \left((q^2 - 1)/2h\right)k \qquad (9d)$$

Eicher and Turnovsky (1999) characterize the aggregate dynamics of this decentralized system in detail. Linearizing around the steady state, they have shown that under weak conditions the system is saddlepath stable (with two stable eigenvalues).

The key components of the dynamics are the solutions for *k* and *z*, which are of the form:

$$k(t) = \tilde{k} + B_1 e^{m_1 t} + B_2 e^{m_2 t} \qquad (13a)$$

$$z(t) = \tilde{z} + B_1 n_{21} e^{m_1 t} + B_2 n_{22} e^{m_2 t} \qquad (13b)$$

where: (i) m_1, m_2, with $m_2 < m_1 < 0$ denote the two stable eigenvalues; (ii) $(1, n_{2i}, n_{3i}, n_{4i})$ (i=1, 2) is the normalized eigenvector associated with the stable eigenvalue, m_i, and (iii) B_1, B_2 are arbitrary constants, obtained from initial conditions (See Eicher and Turnovsky, 1999). To analyze the change in *z* and *k* along the transitional path in *z*-*k* space to a shock in t_z, we find:

$$\frac{dz}{dk} = \frac{\left(n_{21} m_1 e^{m_1 t} - n_{22} m_2 e^{m_2 t}\right)}{m_1 e^{m_1 t} - m_2 e^{m_2 t}} \qquad (14')$$

The key point to observe is that both at $t = 0, t \to \infty$, $dz/dk > 0$, so that the transitional adjustment begins its transition and converges to its new steady state in a positive direction, as drawn in Fig. 1. Since the long-run stock of capital is unchanged, this must imply a transitional loop that involves capital flow reversals.

3. Financial Market Liberalization

3.1 Optimal Financial Market Liberalizations

We are now in the position to discuss the means by which state controls on the financial sector might be relaxed to introduce financial liberalizations. The model predicts that the transition dynamics of the centrally planned and decentralized economies share the same structure, as the aggregate debt accumulation equation, (9d), and the aggregate capital accumulation equation, (9b), are identical in the two economies. Comparing (9a') to (9a) and (9c') to (9c) we see that the rates of return to consumption, capital accumulation and debt costs will be the same, and therefore the dynamics of the decentralized economy will mimic that of the centrally planned economy, if and only if:

$$r[z/k](1 + t_z) = r[z/k] + r'[z/k].(z/k) \qquad (15a)$$

$$(1 - t_y) a s k^{s_K - 1} = r'[z/k] \cdot (z/k)^2 + a s_K k^{s_K - 1} \qquad (15b)$$

Substituting in for the cost of short and long term debt, (2), we find

$$r[z/k](1+t_z) = r[z/k] + x\left\{c_L(1-l)(z/k)^{c_L} + c_S\, l\,(z/k)^{c_S}\right\} \tag{15a'}$$

$$(1-t_y)a\,s\,k^{s_K-1} = x\left\{c_L(1-l)(z/k)^{c_L} + c_S\, l\,(z/k)^{c_S}\right\}\cdot(z/k) + a\,s_K k^{s_K-1} \tag{15b'}$$

From (15a') and (15b') we can now solve for the optimal tax on foreign debt and income:

$$t_z = \frac{x\left\{c_L(1-l)(z/k)^{c_L} + c_S\, l\,(z/k)^{c_S}\right\}}{r[z/k]} \tag{16a}$$

$$t_y = -\left(\frac{h}{s} + \frac{x\left\{c_L(1-l)(z/k)^{c_L} + c_S\, l\,(z/k)^{c_S}\right\}\cdot(z/k)}{a\,s\,k^{s_K-1}}\right) \tag{16b}$$

Given the optimal tax rates in (16a) and (16b), a consumption tax and/or lump sum transfer is in general necessary to maintain fiscal balance, (12). With an inelastic labor supply, the consumption tax functions like the lump sum transfer, *T*, which can be set arbitrarily to zero, without loss of generality. Substituting (16a, (16b), and $T = 0$ into (12) we find

$$t_c = \frac{1}{s\,c}\left[ak^{s_K}h + \frac{r'z^2}{k}(1-s)\right] > 0 \tag{17}$$

which implies that consumption is taxed in the economy, both to decrease consumption financed by foreign capital, and to alter the incentives and increase the domestic accumulation of capital to expand the domestic asset base.

If decentralization is accompanied by the optimal tax on foreign debt, and domestic consumption in conjunction with the optimal subsidy to domestic capital, the economy will not experience any transitional adjustment, as it replicates exactly the optimal levels of debt and domestic capital. The optimal tax structure reflects the externalities facing the economy. First, the upward sloping supply curve of debt introduces an externality associated with foreign debt that is internalized by the central planner, but ignored by the representative agent in the decentralized economy. Related to this externality is that agents ignore that higher debt to equity ratio will raise both short and long term interest rates. Since short-term rates are assumed to respond more sensitively to changes in the debt to equity ratio, agents also neglect this differential effect of debt on short and long-term rates. Finally all agents neglect the positive spillovers in production. Each individual effect on the optimal tax is discussed below.

3.2 Financial Market Liberalization and Capital Flow Reversals: Theory and Evidence

Financial Liberalizations are often associated with a reduced cost of foreign borrowing. One reason might be an increased competitiveness in the financial sector, another might be excessive incentives on the governments' part to further domestic development via foreign borrowing. In each of the case studies below, we find evidence for excessive incentives to engage in international borrowing. In that case, t_z is set too low during the liberalization, in some countries the tax even turned into a subsidy.

The transitional adjustments for the case where the tax on debt is too low at the start of the financial liberalization, is given by (14') and Figure 1. The country accumulates excess debt and goes through a boom-bust cycle accompanied by capital flow reversals. The intuition for the transition loop in *z-k* space coincides with the three segments in Figure 1. The first segment (**PQ** in Figure 1) is a *borrowing boom* where capital inflows finance capital accumulation and a growth boom. The second segment (**QR** in Figure 1) is an *interest crunch,* which occurs as the increased debt service cost leaves ever less output available for future investment. The rate of capital accumulation slows and eventually starts to decline as the growth boom comes to a halt. Finally the country experiences *capital flow reversal* (**RS** in Figure 1**).** This reversal occurs as the increase in the level of debt raises the cost of foreign borrowing (due to the upward sloping supply curve of debt). This increase in the cost of foreign funds which eventually increases the countries debt payments to be point where the economy returns to a recession, and reduced capital expenditures finance a reduction in foreign debt. The economy approaches a new equilibrium, one represented a higher level of debt while the growth rate is unaltered, due to the non-scale nature of the model.

Figure 2, first reported in Eicher, Turnovsky and Walz (2000) indicates the time path of debt and capital stocks for Korea, Thailand and Indonesia. All three countries experienced financial liberalizations in the 1990's, albeit to different degrees.[3] The correspondence to the predictions the model are stunning, in all three cases the loop of the model is mirrored by the debt and capital data.

3.3 Financial Market Liberalization and Short-Term Debt

Ample evidence indicates the detrimental effects of short term borrowing. Not only is short term capital more liquid and can leave the country faster, but recent research has indicated that short-term borrowing also increases the degree of uncertainty that international lenders face. Hence international short-term lending rates are thought to be more sensitive to observed changes in the debt to equity ratio of a country. In our notation, this implies, $c_S > c_L$. The impact on the optimal tax is

3 Thailand liberalized its financial market gradually between 1990 and 1993. Most significant for our purposes were the developments in 1992-3. Four important tax cuts can be identified. First, a cut in taxes on foreign owned assets, second, a cut in taxes on interest payments to foreigners, third, a tax cut on dividends remitted abroad, fourth, an eight year holiday from corporate taxes on imported capital. Indonesia's first round of liberalizations in 1989 was suspended in 1991 and returned in 1992/3. Restrictions on direct investment inflows were relaxed leading to a reduction in the cost of foreign capital. Limitations on public sector were not removed until 1996. In South Korea financial

twofold. First, the tax on foreign debt increases in the share of debt held in short term bonds, l. The subsidy to domestic capital accumulation in turn is even more pronounced, the greater the share of the domestic borrowing is the short-term debt. In fact the subsidy to domestic capital accumulation is meant to build up additional equity in order to weather the sharp increases in the (short-term) interest rate as the debt to equity ratio increases. A second effect stems from the sensitivity of the short-term debt, itself. The greater the response of the short-term rate to changes in the debt to equity ratio, c_S, the higher again the optimal tax on foreign borrowing and the greater the subsidy to domestic to domestic capital accumulation. Hence we show that a simple misjudgment of the interest sensitivity to and increased debt to equity ratio on the part of the government may lead to capital flow reversals!

3.4 Financial Market Liberalization and Country Specific Factors

Countries differ naturally in their level of political and economic development, depth of their capital markets, or openness of the current and capital account. Such differences are captured in our model by, x, which proxies country specific factors. Countries that are judged riskier in terms of political or economic risk, whose exports are sensitive to terms of trade shocks, or whose capital markets are shallow are thought to exhibit a relatively larger x, essentially shifting up the upward supply curve of debt. For low levels of indebtedness, relative to the domestic capital stock, the proxy is hardly noticeable, however, in times of crisis, when debt overhangs loom, the rise in the interest rate is amplified by the country specific proxy. The optimal tax on foreign debt for countries with high x is thus increasing, since the government seeks to build the domestic capital stock to brace or substantially increased borrowing rates in times of crisis.

3.5 Financial Market Liberalization and Production Externalities

Positive long-term economic growth in this model is driven by the positive spillover in production. Such spillovers are commonly motivated by knowledge spillovers in production, learning by doing, that are often thought to be external to either the firm or the individual. Hence, even without access to international lending the government should internalize the externality by subsidizing capital accumulation. The subsidy on capital is increasing in the size of the externality, h. In the first best optimum, where the optimal financial liberalization takes place, the production externality does not influence the optimal tax on foreign borrowing. The optimal tax on foreign capital depends only on the sensitivity of the international lending rate with respect to the domestic

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liberalizations was gradual and a comprehensive plan was not adopted until 1992/3. At that time the country was to foreign portfolio investments and regulations on foreign exchange transactions.

debt to equity ratio. In a second-best world, in which either tax is set non-optimally, for example if the subsidy on domestic capital is non-optimally, the levels of domestic capital, debt and consumption are then also non-optimal.

3.6 Financial Market Liberalization and the Exchange Rate; Theory and Evidence

The key variable in the model, which links the economy with the rest of the world is the domestic interest rate. Defining E as the real exchange rate, we can utilize the interest parity condition,

$$r[z/k] - r^* = \dot{E}/E \qquad (18)$$

to analyze the effects of real exchange rate movements, $\dot{E} = dE/dt$, on the differential between real domestic and foreign interest rates. The interest parity condition (18) can be obtained as an optimality condition in the case where the domestic government issues a domestically denominated bond; see, for example, Turnovsky (1997, Chapter 3). Essentially (18) is an arbitrage equation that renders clear predictions about the time path of the interest rate differential and changes in the exchange rate. Clearly if the exchange rate is pegged, $\dot{E}/E = 0$, and the equation is equally valid under pegged or floating exchange rates.

The arbitrage condition does render it impossible, however, to determine if interest differentials induce exchange rate fluctuations or vice versa. Nevertheless, the time path of both variables must mirror the movements in foreign debt and domestic capital. Hence, optimal financial liberalizations have no effect on the interest differential, while insufficiently low taxes on foreign debt causes a loop in all variables. The intuition is that insufficiently low taxes cause a loop in the debt and capital ratios, as discussed above in figure 1. Changes in the debt to capital ratio translate into changes in the short and long-term interest rates, influence the domestic interest rate as given by equations (2a), (2b), and (2c), which implies that r - r^* also undergoes a transition loop. Finally through the interest arbitrage link as given in (18), motivated by the pressure exerted on the exchange rate due to the capital flow dynamics, the exchange rate is predicted to show a similar fluctuation as the interest differential and the debt to capital ratio. Equation (18) does not explicitly account for risk, rigidities, or expectations, factors that generate Dornbush style overshooting. The arbitrage equation predicts that the loop in exchange rates and interest rates should be proportional, implying that in the interest and exchange rate space, increases (decreases) in the debt to capital ratio should be associated with upward (downward) movements along a positively sloped line.

Figure 3 reports the differentials in domestic and US real interest rates and the real exchange rate (in terms of the US dollar). The findings provide strong support for the predictions of the model, in that it shows that the crises generate closely related increases in the interest differentials and the exchange rates. As the crises faded, both the interest and the exchange rates declined, in each case however, with some overshooting. While we observe more of a loop, rather than the expected linear relation, there is a clear, positive relation between the variables. The real exchange rate does not rise smoothly before each country's crisis, because the rates were fixed (in the Indonesian case in real terms) hence the rising debt to equity ratios in Figure 2 do not have exact analogs in the interest-depreciation graphs of Figure 3. Once the exchange rates are allowed to fluctuate, however, all three countries replicate the rise in both the interest and the exchange rates associated with capital flow reversals in figure 2.

In light of the data in Figures 2 and 3, an alternative, exchange rate based explanation of the crises explanation for the crisis can be put forth. One could argue that the appreciations of the currencies in the crisis countries were caused by progressive increases in the debt to capital ratios (or visa versa) which then had an equal effect on the country's interest rate differentials. Initially stable interest differentials and exchange rates could be maintained only until the time of the crisis, when debt payments and declining domestic capital formation forced a deprecation of the currencies.

5. Conclusions

The objective of the paper was to link Asian capital flow reversals to changes in exchange rates, and interest differentials, but most importantly to the specific country's external debt position. Not only did we indicate the effects of the absolute size of debt and how it relates to the domestic capital stock, but also how the term structure of foreign debt might impact financial liberalizations.

The key to the model is that we prove that the observed capital flow reversals may indeed be the result of one unique policy decision, specifically an inappropriately low tax on foreign borrowing. The policy is shown to have deceptive consequences. First the country experiences a boom, financed by foreign capital inflows, while the increased debt burden limits the amount forever fewer domestic capital accumulation. Eventually the country dips into a recession to repay the accumulated debt

The emphasis in this paper is on the crucial debt-tax variable and its determinants. We provide additional structure in that we allow for a variable term structure and identify how changes in both the term structure and the international sensitivity to country risk and debt might influence the optimal tax. This provides ample evidence that (1) unless the elasticities of foreign interest to the domestic debt to capital ratio is in fact known, or (2) the country specific risk premium is adequately calculated, or (3) the share of short term debt is accurately reported, it is highly unlikely that the policy maker can indeed determine the optimal amount of tax on foreign assets. Hence the paper provides additional evidence why financial liberalizations lead to capital flow reversals.

The country evidence presented supports the mechanics predicted by our model surprisingly well. Not only do the data indicate the capital flow reversal patter suggested by the model, but we can extend the model to allow for exchange rate movements and find that here, too, the model provides accurate descriptions one the real exchange rates were liberalized. The reversals in debt, capital, interest differential and exchange rate changes are closely linked in this model. All four variables emerge as the key factors that determine capital flow reversals.

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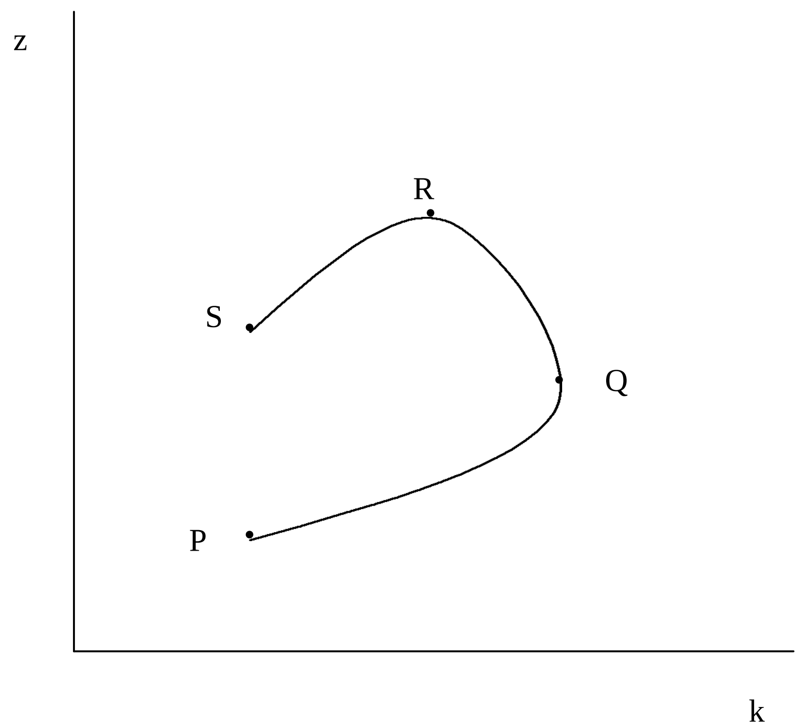
<u>Figure 1</u>

Capital (k) And Debt (z) Flows After Financial Liberalization

With Insufficiently High Tax On Foreign Borrowing



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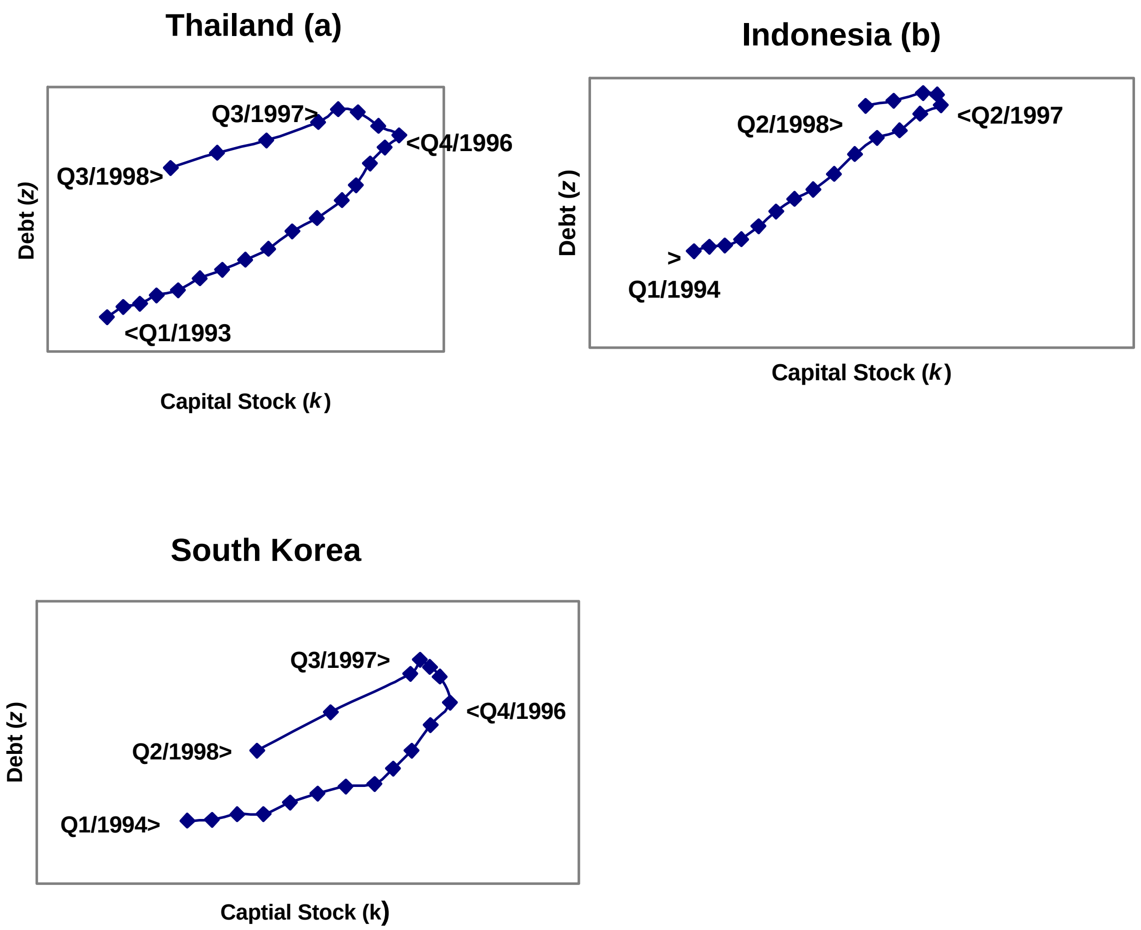
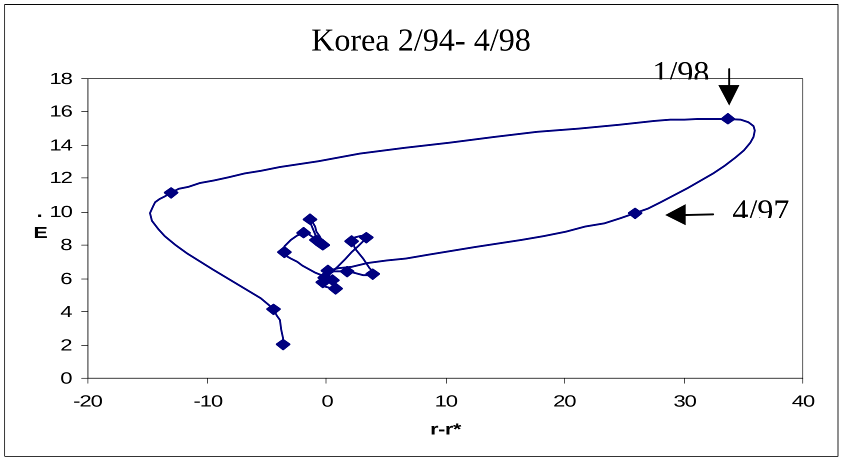


Figure 2

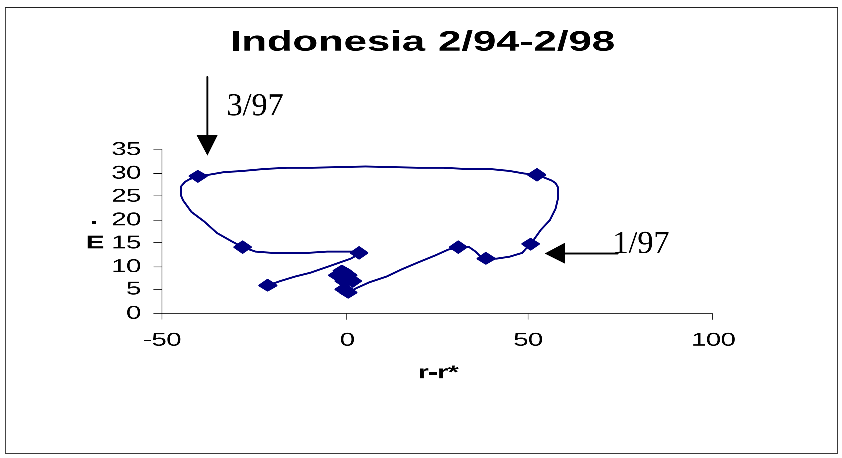
Quarterly Debt vs Capital Flows

(Source: Eicher et. al. 2000)

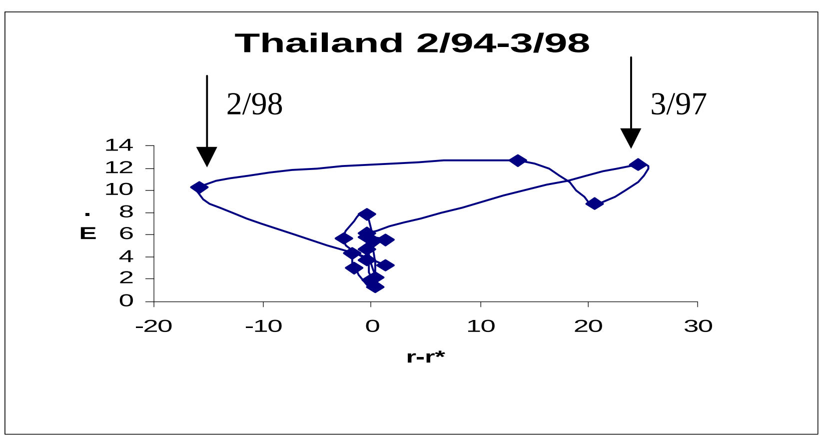
The IMF's *Global Finance* and *International Finance Statistics* provided the debt levels and the current account deficits to render *z*. Domestic capital accumulation is geometrically extrapolated from annual *International Institute of Finance* data on gross fixed investment.



Real money market rate = r, *E* = Won/$



Real discount rate = r, *E* = Rupiah/ $



Real money market rate = r, *E* = Baht/$, r* = real short-term US treasury rate

FIGURE 3