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CAPITAL INFLOWS AND DEVELOPING COUNTRY FINANCIAL CRISES: IMPLICATIONS OF COMPETING EXPLANATIONS FOR POLICY INTERVENTIONS

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Foreword

Prof. Ken Kletzer of University of California, Santa Cruz has been engaged in collaborative research with ICRIER faculty on issues relating to capital flows, financial liberalisation and financial integration of India with the world economy. This paper, “Capital Inflows and Developing Country Financial Crises: Implications of Competing Explanations for Policy Interventions”, by Prof. Ken Kletzer discusses some alternative policy proposals in the light of the recent theoretical literature on financial and currency crises in developing countries.

The paper discusses the potential costs and benefits of financial openness. It attempts to compare the costs of alternative proposals and policies for controlling short term capital flows. While all the proposals have drawbacks, the paper concludes that a proportionate transactions tax on capital flows may be less desirable than an entry tax or contingent temporary suspensions of convertibility.

I have no doubt the analysis in this paper will lead to a better understanding of the issues involved in the opening up of the financial sectors of the developing economies.

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Capital Inflows and Developing Country Financial Crises: Implications of Competing Explanations for Policy Interventions

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1. Introduction

Recent financial crises have raised concerns that international financial market integration creates more risks than benefits for the real economic performance of developing countries. These concerns have focussed attention on the potential volatility of short-term capital flows and on proposals that measures be taken to regulate or protect against rapid reversals of capital flows to developing countries. Capital controls have been adopted by Chile and Malaysia in recent years for just this purpose. Many economists have proposed that countries self-protect against financial crises through the accumulation of reserves or by arranging contingent lines of credit that can be drawn against in the event of a crisis.

This paper discusses some of these alternative policy proposals in light of the recent theoretical literature on financial and currency crises in developing countries. I first discuss the potential costs and benefits of financial openness, albeit in a non-comprehensive way. In particular, a simple approach is proposed for making benchmark estimates of the potential costs of financial crises that can be compared with estimates of the gains from full optimizing liberalization of world financial markets.

Next, I compare two competing explanations of the causes of international financial crises for the purpose of understanding how sensitive policy proposals may be to the assumed theoretical model. One of these views is that financial crises are driven by incompatibility between an exchange rate peg and other macroeconomic policies. The other approach argues that financial crises occur as one of many equilibria that are possible in the presence of a maturity mismatch between external liabilities and domestic real assets.

The proposal that countries accumulate reserves to cover short-term debt obligations is analyzed in the context of these two approaches to modelling financial crises. I argue that reserve accumulations intended to thwart a speculative attack can be counterproductive. Instead, they may result in a currency crisis that would not otherwise occur when the fiscal consequences of interest rate differentials between

developing and advanced-industrialized country public debt are taken into account. It is shown that the use of a contingent lines of credit does not have the same implications for the sustainability of a pegged exchange rate regime. This is a main point of the paper.

Lastly, a comparison is made of the costs of alternative recent proposals and policies for controlling short-term capital inflows and outflows. The four policies are a Chilean entry tax on capital flows, a Tobin tax on capital inflows or outflows, contingent suspensions of capital account convertibility (as imposed by Malaysia in 1997) and direct controls on short-term debt accumulations by the domestic banking system. It is shown that all have drawbacks, but that a proportionate transactions tax on capital flows may be less desirable than an entry tax or contingent temporary suspensions of convertibility.

2. Benefits of Financial Openness and Costs of Financial Crises

Liberalizing international financial transactions can create opportunities for the residents of a country to diversify their savings portfolios across a broader range of risky assets than may be available on domestic financial markets. Financial integration allows domestic savings and investment decisions to become separated. When domestic residents can take advantage of international risk diversification, the share of domestic investment devoted to riskier capital rather than low return safe financial instruments can rise. When domestic firms are able to take advantage of a more broadly diversified international financial market, the cost of investing in high variance and high mean return projects falls. Under the critical caveat that international financial markets are undistorted, there should be gains from international financial trade just as there are for international goods trade.

A benchmark for considering the gains from financial liberalization is provided by Obstfeld [1994]. He quantifies these gains in a stochastic model of endogenous growth. In Obstfeld's model, the only market imperfection is the closure of national economies to international financial asset transactions so that liberalizing financial flows is always welfare improving. Opening the capital account in the model economy causes a greater share of savings to be invested in higher return capital in an endogenous growth model. This leads to a higher equilibrium growth rate, which in turn yields large gains from financial market integration. These gains arise because the standard deviation of the household savings portfolio decreases in equilibrium with international integration. In simulations using national stock market returns from 1960 to 1987, Obstfeld estimates the welfare gains over *status quo* portfolios for

regions of the world from introducing the optimal global mutual fund. These gains can be enormous, ranging from 23 percent for East Asia to over 450 percent for Africa and Northern Asia.

These estimates have to be taken carefully in terms of the assumptions of financial market completeness and no policy distortions, including sovereign risk. In particular, workers face very few opportunities to diversify labor income risk. Integration that causes a greater proportion of total financial resources to be allocated to risky domestic capital typically raises labor income risk. For households with little or no financial wealth, integration may raise the aggregate mean growth rate while increasing the riskiness of their human wealth. This increase can have adverse effects on income distribution and on the accumulation of human capital or other household investments. If integration leads to an increase in the variance of the net returns to total wealth for some residents, then the endogenous growth model implies that a reduction in the welfare for those households results from financial liberalization.

In the presence of incomplete financial markets subject to intrinsic (noise trading) or extrinsic (sunspot) noise, financial market liberalization can raise the aggregate risk for domestic residents lowering overall national welfare. Liberalizing financial markets can expose the country to speculative capital flows that can be disruptive to domestic investment and incomes and reduce long-run rates of economic growth.

One concern is that capital account liberalization leads to financial crises. In one of the views of financial crises discussed below, crises arise as a consequence of policy distortions associated with government guarantees of foreign financial claims. In this case, a portion of the risk of domestic investment is transferred from foreign residents to domestic residents. The net effect of financial integration under such implicit or explicit public insurance of foreign capital inflows can be an increase in the volatility of domestic residents' consumption. In another view, financial crises occur in some of several possible equilibrium outcomes that arise as a consequence of a maturity mismatch between short-term capital inflows and long-term productive investment. Short-term capital flows can also increase the variance of investment and income in this view. The impact of liberalization and short-term capital flows on the standard deviation of aggregate incomes and on the distribution of income is an empirical matter. A benchmark estimate of the welfare costs or benefits of capital market liberalization could be calculated using the endogenous growth framework given estimates of the change in standard deviations of GDP growth from historical data.

The welfare costs of financial crises can be estimated when crises are taken as isolated events using a simple endogenous growth model in continuous-time without uncertainty. The technology displays constant returns to scale with respect to accumulable factors of production, labelled as capital k. The production function is given by

$$y_t = r_t k_t, \tag{1}$$

where the rate of return to capital varies over time in response to a shock. The household sector is modelled by a single representative household with the utility function,

$$U_t = \int_t^{\infty} \frac{c_s^{1-\sigma} - 1}{1-\sigma} e^{-\rho(s-t)} ds. \tag{2}$$

The equilibrium growth rate of per capita consumption, output and wealth are given by

$$g = \frac{\dot{c}}{c} = \frac{\dot{k}}{k} = \frac{r_t - \rho}{\sigma}. \tag{3}$$

Welfare in equilibrium welfare is given by

$$U_t = \frac{c_t^{1-\sigma}}{1-\sigma} \int_t^{\infty} e^{(1-\sigma)\int_t^s \frac{r_v - \rho}{\sigma} dv} e^{-\rho(s-t)} ds - \frac{1}{\rho(1-\sigma)}. \tag{4}$$

Given a constant average and marginal productivity of capital, this equals

$$U_t = \frac{k_t^{1-\sigma}}{1-\sigma} \left(r - \frac{r-\rho}{\sigma} \right)^{-\sigma} - \frac{1}{\rho(1-\sigma)}, \tag{5}$$

as a function of initial financial wealth per capita and the growth rate of consumption per capita. This calculation used the solution for the consumption function,

$$c_t = k_t \left(r - \frac{r-\rho}{\sigma} \right)^{-1}. \tag{6}$$

The welfare implications of temporary or permanent decreases in the growth rate are calculated by comparing *ex post* household welfare in the absence and in the presence of the shock. The welfare costs of a growth reduction are determined by calculating the equivalent variation of wealth. This is the increase in wealth that would be required to achieve the *status quo ante* level of utility under the growth shock.

For a permanent growth reduction (with $\sigma \neq 1$ for simplicity's sake), welfare under the two different rates of return to all accumulable factors of production are given by

$$U_t = \frac{k_t^{1-\sigma}}{1-\sigma} \left(r - \frac{r-\rho}{\sigma} \right)^{-\sigma} = \frac{k_t^{1-\sigma}}{1-\sigma} \left((\sigma - 1) g + \rho \right)^{-\sigma} \tag{7}$$

and

$$\widehat{U}_t = \frac{\widehat{k}_t^{1-\sigma}}{1-\sigma}\left(\widehat{r} - \frac{\widehat{r}-\rho}{\sigma}\right)^{-\sigma} = \frac{\widehat{k}_t^{1-\sigma}}{1-\sigma}\left((\sigma-1)\,\widehat{g}+\rho\right)^{-\sigma}, \tag{8}$$

where $\widehat{r}$ is the post-shock productivity of capital and $\widehat{g}$ is the post-shock per capita output growth rate. Setting $\widehat{U}_t = U_t$ determines the level of wealth, $\widehat{k}_t$, necessary to make post-shock welfare equal to domestic welfare before the productivity shock. $\widehat{k}_t$ is the actual capital stock, k_t, plus the equivalent variation in wealth needed to achieve the *status quo ante* welfare. The equivalent variation is given by $\frac{\widehat{k}_t}{k_t} - 1$, where

$$\frac{\widehat{k}_t}{k_t} = \left(\frac{(\sigma-1)\,g+\rho}{(\sigma-1)\,\widehat{g}+\rho}\right)^{\frac{\sigma}{\sigma-1}}. \tag{9}$$

For example, let the pure subjective rate of discount, ρ, equal 0.02 and the intertemporal elasticity of substitution, $1/\sigma$, be 0.5. For an initial growth rate of per capita GDP equal to 4 percent falling permanently to 3 percent, the loss in welfare measured by the equivalent variation equals 56 percent.

For a temporary reduction in the growth rate of per capita output, the equivalent variation in terms of financial wealth is given by

$$\frac{\widehat{k}}{k} = \left[\left(1 - \frac{(\sigma-1)\,g+\rho}{(\sigma-1)\,\widehat{g}+\rho}\right)\exp^{-((\sigma-1)\widehat{g}+\rho)T} + \left(\frac{(\sigma-1)\,g+\rho}{(\sigma-1)\,\widehat{g}+\rho}\right)\right]^{\frac{\sigma}{\sigma-1}}. \tag{10}$$

In this equation, the growth rate temporarily falls to an average of $\widehat{g}$ from g for T periods. Using the same values for the discount rate and the intertemporal elasticity of substitution and letting the growth rate fall from 5 percent per annum to zero percent per annum for T years, we have

$$\frac{\widehat{k}_t}{k_t} = \left[-2.5\exp\left(-.02T\right)+3.5\right]^2. \tag{11}$$

For a two-year reduction in growth, the equivalent variation is 20.6 percent.

The calculation of the equivalent variation is last modified to allow for time-varying annual growth rates. The utility of the representative household under a time-varying disturbance (again, letting $\sigma \neq 1$ for simplicity) is given by

$$\begin{aligned}\widehat{U}_t &= \frac{\widehat{c}_t^{1-\sigma}}{1-\sigma}\left[\left(\rho+(\sigma-1)\,g_j\right)^{-1} e^{-\sum_{i=1}^{T+1}(\rho+(\sigma-1)g_i)}\right. \\ &\quad \left. + \sum_{j=1}^{T}\left(\rho+(\sigma-1)\,g_j\right)^{-1}\left(1-e^{-(\rho+(\sigma-1)g_j)}\right)e^{-\sum_{i=1}^{j}(\rho+(\sigma-1)g_i)}\right].\end{aligned} \tag{12}$$

The solution for the consumption function for the household is

$$\widehat{c}_t = \widehat{k}_t\left[\left(\rho+(\sigma-1)\,g_j\right)^{-1} e^{-\sum_{i=1}^{T+1}(\rho+(\sigma-1)g_i)}\right.$$

$$+\sum_{j=1}^{T}\left(\rho+(\sigma-1)\,g_j\right)^{-1}\left(1-e^{-(\rho+(\sigma-1)g_j)}\right)e^{-\sum_{i=1}^{j}(\rho+(\sigma-1)g_i)}\Bigg]^{-1}. \tag{13}$$

This is compared to welfare under the assumption that the steady-state growth rate prevails forever,

$$U_t=\frac{k_t^{1-\sigma}}{1-\sigma}\left(\rho+(\sigma-1)\,g\right)^{-\sigma}. \tag{14}$$

Together, these yield a measure of the welfare cost of a crisis episode in terms of wealth,

$$\begin{aligned}\frac{\widehat{k}_t}{k_t} \;=\; &\Bigg[\left(\frac{\rho+(\sigma-1)\,g}{\rho+(\sigma-1)\,g_j}\right)e^{-\sum_{i=1}^{T+1}(\rho+(\sigma-1)g_i)}\\ &+\sum_{j=1}^{T}\left(\frac{\rho+(\sigma-1)\,g}{\rho+(\sigma-1)\,g_j}\right)\left(1-e^{-(\rho+(\sigma-1)g_j)}\right)e^{-\sum_{i=1}^{j}(\rho+(\sigma-1)g_i)}\Bigg]^{\frac{\sigma}{\sigma-1}}.\end{aligned} \tag{15}$$

The growth rate of per capita GDP in Asian crisis countries was roughly 5 percent before the crisis. The growth rate for Korea fell by approximately 7-8 percent in the first year followed by a partial recovery in the second. The equivalent variation of the welfare loss for a fall in the growth rate of 8 percent in the first year, 5 percent (from the pre-crisis rate) in the second and full recovery in the third is 28 percent. For Thailand, the growth rate fell approximately 13 percent in the first year and 10 percent in the second relative to the pre-crisis growth rate. The equivalent variation for these rough numbers with a return to the pre-crisis growth rate in the third year is 54 percent. For Obstfeld's stochastic version of this model, the net gain from optimal global diversification for all of East Asia was 22.6%. This suggests that the costs of a one-time only crisis as part of the adjustment to financial liberalization might not be insignificant without intervention.

An alternative estimate of the costs of liberalization could be made using the stochastic endogenous growth model of Obstfeld [1994] if estimates of the permanent effect on the standard deviation of consumption are available. The equation for the utility of a representative household implies that

$$U_t=\left(\frac{k^{1-R}}{1-R}\right)\left(\frac{\sigma-1}{\sigma}\left(r+\frac{R\nu^2}{2}\right)-\rho\right), \tag{16}$$

where R is the coefficient of relative risk aversion and ν^2 is the standard deviation of per capita consumption growth.

3. Sources of Financial Crises

Two competing views of currency and financial crises have emerged in the theoretical literature in

recent years (see, for example, Calvo [1998a, b], Caballero and Krishnamurthy [1998], Chang and Velasco [1998], Corsetti, Pesenti and Roubini [1998a,b,c], Furman and Stiglitz [1998], Mishkin [1996], among many others). In one view, economic fundamentals are the source of a currency crisis and its consequent financial crisis. In the basic version, a speculative attack on the exchange rate regime results from fiscal and monetary policies that are inconsistent with the chosen exchange rate peg. This is the familiar model of a collapsing exchange rate regime due to Krugman [1979]. Capital account and financial liberalization without adequate domestic prudential regulation can lead to a banking crisis as intermediaries take on excessive levels of debt and risk in the presence of moral hazard. In the fundamentals view, there is a mismatch between policies that leaves the country vulnerable to a financial crisis.

The second view regards recent financial and currency crises as financial panics that result from the simultaneous actions of creditors and need not have occurred. The extension of currency crises models by Obstfeld [1986] demonstrates the possibility of multiple equilbria so that a crisis may occur but is not inevitable. A financial crisis is one possible outcome in an international economy with multiple equilibria. Illiquidity of the financial sector rather than policy unsustainability plays the central role in recent theoretical models taking this perspective. In these models there is a maturity mismatch between the foreign liabilities and domestic assets of the private or public sector. In the pure liquidity view, short-term borrowing to finance long-term investments is the Achilles heel of the system that exposes nations to potential financial panics.

The diversity of macroeconomic conditions preceding currency crises suggests that both views, separately or in combination, deserve attention in policy analysis. It is also evident that the impact of policy prescriptions may be quite different depending on the source of financial crises. Both approaches can be used to analyze the vulnerability of national economies to rapid financial capital inflows and outflows. I first discuss the traditional model (also known as the first-generation model) as it has been applied to the explanation of the Asian financial crises. I explain that it can yield either an inevitable, fundamentals driven crisis or a crisis that occurs as one possible but not inevitable equilibrium. I then discuss the role of short-term lending for generating a liquidity crisis.

3.1 Public sector guarantees and financial crises

The most recent version of the fundamentals view emphasizes government subsidization of private

sector foreign borrowing. The importance of implicit or explicit public sector guarantees of foreign debt repayment for developing country financial crises was raised by Diaz Alejandro [1985]. His observations and arguments form the basis for recent models that emphasize the role of governments as underwriters of foreign debts accumulated by private banks and firms (see, for example, Calvo [1998b], Burnside, et al [1999] and Dooley [1999]). In particular, Diaz Alejandro argued that it is at best difficult for a debtor country government to refuse to assume private foreign debt in the event of a financial crisis. *Ex post* debt guarantees may be implicit even if explicitly denied *ex ante*.

While the subsidization of foreign borrowing may be subject to cronyism or other forms of corruption, distortions in the flow of capital to developing countries due to sovereign risk can also provide a rationale for public sector intervention. The value of loans made to domestic intermediaries is sensitive to domestic monetary, fiscal and regulatory policies that are chosen by the government to advance domestic interests. When sovereign immunity is a binding constraint on financial integration, we should expect the domestic rate of return to capital to exceed the foreign opportunity cost of financial capital. Foreign creditors are naturally reluctant to lend in domestic currency because the sovereign determines its own monetary policy. Even if all loans are denominated in foreign currency, the ability of domestic intermediaries or firms to service foreign debts is impaired by sudden devaluations or depreciations of the domestic currency. Exchange rate pegs are often adopted as part of a policy package to provide a stable monetary environment for foreign creditors. Experience has shown that when an exchange peg is abandoned, governments guarantee foreign currency liabilities in part or whole. A government may seek to promote efficiency-enhancing capital inflows by insuring foreign creditors against losses caused by its own policy changes but not against individual project risk or bank failure.

A government debt guarantee must be calculated into the public sector budget as a contingent increase in public debt. When a government guarantee is invoked, there is an increase in outstanding public debt and subsequent interest obligations. In the event that the guarantee is invoked and the subsequent increase in the public sector budget deficit is monetized, a traditional (first-generation) speculative attack on a pegged exchange rate can occur. The details of how the government accumulates contingent liabilities determine whether such guarantees might actually be invoked.

A standard monetary model of the exchange rate that takes account of the public sector solvency constraint is useful for illustrating the role of government guarantees in financial crises. A simple

discrete-time model is given by equations (1) through (4):

$$m_t - p_t = \varphi y_t - \delta i_t, \tag{17}$$

$$p_t = s_t + p_t^* \tag{18}$$

and

$$i_t = i_t^* + E_t s_{t+1} - s_t, \tag{19}$$

where m, p, p^*, y and s are the logarithms of the monetary base, price level, foreign price level, real income and spot nominal exchange rate, respectively. The shadow exchange rate is given by

$$\widetilde{s}_t = (1+\delta)^{-1}\left[\widetilde{m}_t - p_t^* - \varphi y_t + \delta i_t^* + \delta E_t \widetilde{s}_{t+1}\right]. \tag{20}$$

The monetary base if an attack just occurs at time t is given by $\widetilde{m}_t = \log\left(M_t - S_t R_t\right)$, where M_t is the level of the money supply, R_t is the stock of central bank reserves and S_t is the pegged exchange rate.

The public sector budget identity is given by

$$S_t\left(B_{t+1} - B_t\right) = i_t^* S_t B_t + D_t + S_t\left(R_{t+1} - R_t\right) - r_t^* S_t R_t - \left(M_{t+1} - M_t\right), \tag{21}$$

where B_t is outstanding stock of public debt denominated in foreign currency at the beginning of period $t$and D_t is the primary public sector budget deficit. i^* is the nominal (in foreign currency) rate of interest for domestic government debt, while r^* is the foreign nominal rate of interest paid to reserves. It is assumed that $i^* \geq r^*$. If $i^* = r^*$, the government pays no interest premium on its debt relative to foreign reserves. For developing countries we expect i^* to exceed r^*.

Under the contingent government liabilities story, domestic credit expansion,

$$\left(M_{t+1} - S_t R_{t+1}\right) - \left(M_t - S_t R_t\right) = i_t^* S_t B_t + D_t - r_t^* S_t R_t - S_t\left(B_{t+1} - B_t\right), \tag{22}$$

is consistent with the pegged rate before a crisis occurs. The deficit and required domestic credit creation rise conditionally on the crisis and lead to depreciation afterwards.

First, consider a case in which the contingent increase in the deficit, ΔD, is fixed. Suppose that the exchange rate peg is consistent with pre-crisis fiscal policy. That is, the peg would be sustainable in the absence of the contingent insurance. In this case, when initial reserves are sufficiently large, the shadow exchange is less than the pegged rate and will never rise above the peg. A currency crisis will never occur. However, if the shadow rate equals the pegged rate, then multiple equilibria are possible. In one equilibrium, there is no crisis and the shadow rate does not rise above the pegged rate. In another equilibrium, the crisis occurs and the deficit increases by ΔD. This is an example of

a second-generation model of a collapsing exchange rate regime, as in Obstfeld [1986]. Given fiscal policies and the structure of the economy, an exogenous increase in the reserves that the central bank commits to defending the exchange rate regime lowers the shadow exchange rate. If the increase in committed reserves is sufficiently large, then the crisis equilibria are eliminated. Below, I consider how borrowing reserves affects this outcome.

Things are different if the contingent liability can rise over time. In many countries, the cost of government guarantees appear to have risen with outstanding private foreign currency debt. Chinn and Kletzer [1999] and Burnside, Eichenbaum and Rebelo [1999] consider currency crisis models in which private banks accumulate foreign debt which is guaranteed implicitly by the government in the event of a collapse of the exchange regime. The ratio of non-performing assets to liabilities for the banking system rises endogenously over time. The government's contingent liabilities rise over time until the reserves that the central bank will use in defending the peg and the implied post-crisis increase in domestic credit expansion just make the shadow exchange rate, $\widetilde{S}_t$, equal to the pegged rate, S_t. In these models, crises are inevitable and banking crises and currency crises are simultaneous. Output growth collapses with the financial crisis in the endogenous growth version of Chinn and Kletzer [1999].

3.2 Short-term debt and liquidity crises

The standard model of the liquidity view of recent financial crises (see, for example, Chang and Velasco [1998], Goldfajn and Valdes [1997] and Sachs, Tornell and Velasco [1996]) is based on the Diamond and Dybvig [1983] model of bank runs. Short-term debt finances long-term productive investments. Risky capital is productive after two periods, yielding an expected return in excess of the riskless rate of return. If a project is liquidated early, the return is less than the riskless rate.

An investment of size k made at date t yields $r < i^*$ in period $t+1$ and R in period $t+2$ where $E_t(1+R) > (1+i^*)^2$. r may be negative (but larger than -1). A domestic bank makes this loan using credit extended by foreign savers. It is assumed that a lender receives net interest i^* for each period as long as the bank has liquid resources to meet withdrawal demand. An early withdrawal of size xk requires the liquidation of part of the capital to pay the amount $(1+i^*)\,xk$. This reduces the remaining capital by the amount

$$\frac{(1+i^*)\,xk}{(1+r)} \tag{23}$$

The present value net return to a domestic investor equals

$$E_t\left[\left(\frac{1+R}{(1+i^*)^2}\right)\left(1-\frac{(1+i^*)\,x}{(1+r)}\right)-(1-x)\right] \tag{24}$$

per unit invested in period t, where x is the ratio of short-term debt that is liquidated in period $t+1$. This is decreasing in x if

$$E_t\left(\frac{1+R}{(1+r)(1+i^*)}\right)>1 \tag{25}$$

which is assumed so that long-term investments are desirable. Whenever x satisfies the condition,

$$(1+r)(1+i^*)\,(1-x)>E_t\,(1+R)\left(1-\frac{(1+i^*)\,x}{(1+r)}\right), \tag{26}$$

every lender that can should withdraw her funds, receiving $(1+r)$ per unit lent in period t and earning the opportunity gross interest $(1+i^*)$ between periods $t+1$ and $t+2$. Long-term lenders receive a net rate of return less than i^* if

$$E_t\left(\frac{(1+R)-(1+i^*)^2}{\left(\frac{1+i^*}{1+r}\right)(1+R)-(1+i^*)^2}\right)=\overline{x}<x, \tag{27}$$

where $\overline{x}<1$.

Therefore, if all debt is short-term, self-fulfilling runs are possible in this economy. In one equilibrium, no lender withdraws her funds in period t and the project yields maximum surplus. In another, all lenders withdraw in period t receiving a total return of $(1+r)\,k$ and there is no period $t+2$ production. In this approach, a currency crisis takes place in the same fashion as in Obstfeld [1986]: if all participants demand reserves, reserves are exhausted forcing the central bank to abandon an exchange rate peg that would have been otherwise sustainable. Financial crises arise because domestic liquid assets are insufficient to cover the short-term liabilities of the domestic financial sector leading to a run on central bank reserves. Gestation lags in investment generate a collapse in output consequent to a financial crisis.

In the absence of government intervention, the Diamond-Dybvig model of bank runs provides a rationale for self-fulfilling currency and financial crises. However, liquidity crises can only occur if market imperfections restrict the use of long-term debt contracts. Under optimal loan contracts, the possibility of Pareto-inferior multiple equilibria is eliminated. Short-term lending can dominate in an equilibrium with imperfect financial markets. Rodrik and Velasco [1999] demonstrate that short-term borrowing can arise in the equilibrium of the model outlined above as a consequence of the possibility of bank panics. Sovereign risk can also lead to short maturity loans by creating a short-leash on

government or private behavior. The appendix explains these rationale for why we may observe short-maturity foreign debt.

4. Policy Interventions

Both government guarantees and short-term lending can be explained as responses to financial market imperfections arising from sovereign risk. Appropriate prudential regulation of the domestic financial industry may be the best way to mitigate the potential problems of volatile short-term international capital flows. Another may be overcoming the "fear of floating" by developing country governments during financial liberalization and reform. However, managed flexibility and exchange rate pegs have their own justification at times and sophisticated financial regulation requires significant administrative capacity to achieve. Several alternative policy remedies have proposed for helping debtor nations to manage volatile short-term capital flows and reduce the incidence of financial crises in either magnitude or frequency. I consider the impact of this in light of both views of the sources of recent financial crises.

4.1 Reserves and contingent credit facilities

One approach to policy intervention that has been widely advocated is the accumulation of larger levels of reserves by developing countries and the creation of contingent credit lines (see, for example, Feldstein [1999]). Alan Greenspan has proposed the accumulation of reserves equal to the amount of debt maturing within one year. Lines of credit could be provided by official sources (such as the IMF, as proposed by the Clinton Administration and endorsed by the G-7 in 1998), private financial institutions or a combination of the two. The models of Section 2 are useful for considering the usefulness of these ways of achieving higher levels of central bank liquidity.

A sufficiently high level of foreign currency reserves held by the central bank would allow a country to avoid a currency crisis generated as an inferior equilibrium in a multiple equilibrium world. In the government guarantees model or the liquidity crisis model, a sufficiently high level of reserves assures that the shadow exchange rate always remains below the pegged rate when macroeconomic policies are consistent with the chosen exchange rate regime. In such cases, the central bank has the resources to successfully fend off an attempted attack on the exchange parity or to act as a domestic lender of last

resort meeting the demands of all foreign creditors to the private sector. If fundamentals disfavor the exchange rate, then the regime is ultimately unsustainable. The simple model from the literature shows that higher reserves postpone the day of reckoning for the peg.

Unfortunately, reserves do not exogenously increase. Feldstein [1999] suggests that countries accumulate higher levels of reserves to protect themselves against speculative attacks or liquidity crises. There is a cost to raising central bank reserves for many countries. This is the difference between the interest paid on the country's public debt and the interest earned on foreign reserves, typically the rate of interest for U.S. Treasury or similar debt. This is the interest rate differential, $i^* - r^*$, included in equations (21) and (22). An increase in reserves implies an equal increase in public debt; equivalently, if the additional reserves were not added to the central bank's assets, then the same amount of government debt could have been purchased by the central bank. For all purposes, a debtor government borrows to increase central bank reserves for self-protection under this proposal.

The act of accumulating reserves when $i^* > r^*$ is identical to the problem of sterilizing capital inflows in the presence of quasi-fiscal costs as defined by Calvo [1991]. The costs of sterilizing capital inflows have been estimated by Khan and Reinhart [1994] for Latin American countries and by Kletzer and Spiegel [1998] for Pacific Basin countries. They both find that the net costs of sterilization were between 0.25% and 0.5% of gross domestic product during periods of large capital inflows post-1985. Kletzer and Spiegel find further that these costs can be as high as one percent of GDP for brief episodes of capital inflows. Because these estimates represent the quasi-fiscal costs of reserve accumulated during attempts to sterilize capital inflows, the costs of raising reserves to match one year of debt amortization are likely to be much higher.

The interest rate differential between developing country debt and foreign reserves has consequences for using reserves for self-protection. To show this, I begin by adding an increase in reserves in the amount ΔR_t to the flow budget identity of the government:

$$(M_{t+1} - S_t R_{t+1}) - (M_t - S_t R_t) = i_t^* S_t (B_t + \Delta R) + D_t - r_t^* S_t (R_t + \Delta R) - S_t (B_{t+1} - B_t) . \quad (28)$$

The costs of borrowed reserves, $(i_t^* - r_t^*) S_t \Delta R$, can be financed by current or future public spending cuts, tax revenue increases or monetization. Given fiscal policies, solving this forward and imposing the conventional solvency criterion on the government implies a net present value increase in domestic

credit creation due to borrowing foreign reserves given by

$$E_t \sum_{s=t}^{\infty} \left(\prod_{j=t}^{s} \frac{1}{1+i_j^*} \right) \Delta \left(M_{s+1} - M_s \right) = E_t \sum_{s=t}^{\infty} \left(\prod_{j=t}^{s} \frac{1}{1+i_j^*} \right) \left(i_s^* - r_s^* \right) S_s \Delta R. \tag{29}$$

When $i^* > r^*$, current or future monetization of the increase in the public sector budget deficit must rise.

This increase in the growth rate of the monetary base is a change in fundamentals. Suppose that a pegged exchange rate was consistent with macroeconomic fundamentals before the accumulation of reserves. The borrowing of reserves now makes that peg unsustainable in the absence of fiscal adjustment. Eventually, the exchange rate regime will collapse following the Krugman [1979] or Flood and Garber [1984] models. If the accumulation of reserves was undertaken to avoid a possible liquidity crisis, it is self-defeating. The additional reserves cause a financial crisis, instead of preventing one.

In the case of a self-fulfilling crisis unjustified by fundamentals, increasing central bank reserves can be helpful if the interest rates are equal. Whether this can work depends on the maturity of government debt. If the government borrows long-term, then foreign creditors only demand immediate repayment of private debts. In this event, the government spends its reserves and assumes private debts (either through government guarantees or by providing liquidity to the domestic financial sector). However, if government debt is short-maturity, then foreign creditors demand repayment by the government, leaving no extra resources from the borrowed reserves for bailing out the private sector. Short-term public borrowing to accumulate foreign reserves is at best costless and useless.

If the exchange rate peg is inconsistent with macroeconomic fundamentals, then borrowing reserves can either postpone or advance the date of a currency crisis. This has been shown by Buiter [1987] for the Flood and Garber [1984] model when domestic and foreign government debt pay the same rate of interest ($i^* = r^*$). Borrowing reserves, ΔR, raises the post-crisis rate of domestic credit creation by the amount $i^* \Delta R$ although it does not raise the pre-crisis rate of domestic credit creation. This is because the interest-bearing reserves are gone after the defense of the exchange regime is over but the public debt incurred raising them remains. Before a crisis, there are two opposing effects of reserve accumulation: the rate of growth of the shadow exchange rate rises and current reserves are higher. If the reserves are borrowed close to the onset of a speculative attack, it is postponed because the reserve increase dominates. Accumulating reserves well in advance of the date of the attack brings the crisis

forward because the rate of growth of the shadow exchange rate is the dominate effect.

Drawing on official contingent credit lines during a crisis can be effective for stopping a self-fulfilling liquidity crisis. If the government borrows reserves from a contingent credit facility at the same interest cost that foreign reserves earn, then the shadow exchange rate,

$$\widetilde{s}_t = (1+\delta)^{-1}\left[\widetilde{m}_t - p_t^* - \varphi y_t + \delta i_t^* + \delta E_t \widetilde{s}_{t+1}\right], \tag{30}$$

falls because $\widetilde{m}_t = \log\left(M_t - S_t R_t\right)$ falls with a rise in reserves, R_t. A fundamentals-driven crisis will be postponed as demonstrated by Buiter. This may be a superior policy reform for preventing or stopping liquidity crises but it is costly if crises are caused by inconsistencies in macroeconomic policies.

Some proposals have called for the private provision of contingent credit facilities for the purpose of bailing private creditors into the resolution of financial crises. These have been criticized on the basis that private creditors can hedge against the contingent loans they write. This hedging, called dynamic hedging, consists of reducing other loans to the country in an equal amount to the contingent credit when the contingency arises. These means that the contingent lines of credit need not increase the resources available to the government in the event of a crisis. This problem of non-additivity is identical to the neutrality of issuing short-term debt to borrow reserves at equal rates of interest noted above. The contingent borrowing facilities would be of no consequence if the offset is complete.

4.2 Capital controls

The analog of bank runs to developing country financial and currency crises suggests that a remedy lies in attaining a better match between the maturities of domestic assets and foreign liabilities. Restrictions on short-term borrowing address this issue and have drawn renewed interest from economists and policymakers since the onset of the Asian financial crisis.

Four types of capital account restrictions have received the most attention. The first of these is a Tobin tax, a proportionate tax on capital inflows or outflows (Eichengreen, Tobin and Wyplosz [1995]). The second is a one-time tax on capital inflows as adopted by Chile and recently relaxed. The third are contingent controls on capital outflows as imposed by Malaysia during the Asian crisis. Lastly, Calvo [1997] and others have proposed direct controls on short-term bank borrowing.

Each of these is subject to concerns that they can be circumvented and will not effectively control

capital flows as intended. That issue has been discussed widely (see, for example, Garber and Taylor [1995]). Here, I consider the resource allocation effects of the different approaches in light of the popular models of recent financial crises.

First, consider the costs of restricting short-term but not long-term debt. As noted, short-term debt may be an equilibrium solution for capital mobility under market imperfections associated with sovereign risk. Short-term lending may provide a short-leash allowing lenders to withdraw funds quickly in anticipation of a policy or regime change that would reduce their returns. Unfortunately, longer term lending is associated with countries whose policy regimes are perceived to be more stable and pose a lower risk of sovereign default. This makes it difficult or impossible to estimate how restricting short-term lending might affect total capital flows in a cross-section of countries. Another reason for short-term debt, as observed by Rodrik and Velasco, is that individual investors do not take into account the social costs of borrowing short. In this case, eliminating short-term debt for all but short maturity investments is beneficial rather than costly. On net, we do not have a clear idea of the costs of restricting short-term debt. However, the models of financial crises do imply that there are gross benefits of achieving superior maturity matches. In the time-to-build economy, discouraging short-term in favor of long-term lending reduces the possibility of bank runs *ceteris parabis*.

I consider each of these types of controls in turn.

1. A proportionate tax on capital outflows taxes short and long-term lending equally in the efficient equilibrium. All short-term debt is rolled over. In a steady-state growth path, foreign savers will repatriate the returns net of the growth of the loans made in equilibrium. This amount is given by

$$(1-\tau)\left[(1+i)^2-(1+n)^2\right]k_{t-2}, \tag{31}$$

for a constant proportionate growth rate equal to n and tax on capital outflows equal to τ. The equilibrium long-term lending rate satisfies

$$(1-\tau)\left[(1+i)^2-(1+n)^2\right]=(1+i^*)^2-(1+n)^2, \tag{32}$$

implying

$$(1+i)^2=\frac{(1+i^*)^2-\tau(1+n)^2}{(1-\tau)}. \tag{33}$$

This calculation assumes that repayments are rolled over into new loans with investments growing at the constant rate n, so that the tax is only applied to actual capital outflows not full net earnings. The

term $-\tau (1+n)^2$ represents the tax deduction realized by relending interest earnings within the country.

The tax raises the cost of foreign capital, even though it discourages net outflows of capital. Foreign returns net of the tax on full repatriation of loans would be

$$(1-\tau)(1+i)^2 k_{t-2} + (1-\tau)(1+i) x k_{t-1}, \tag{34}$$

if $x \leq (1+r)/(1+i)$ where x equals the share of short-term debt in total debt, and

$$(1-\tau)(1+i)^2 k_{t-2} + (1-\tau)(1+r) k_{t-1}, \tag{35}$$

if $x > (1+r)/(1+i)$.

For short-term capital outflows x, the returns to withdrawing short-term capital for the next creditor are exceed the returns to staying put if

$$E_t \left(\frac{1+R}{1-x}\right)\left[1 - \frac{x(1-\tau)(1+i)}{(1+r)}\right] < (1-\tau)(1+r)(1+i^*). \tag{36}$$

This condition is satisfied for $x > \widehat{x}$ where $\widehat{x} < 1$ because $\frac{(1-\tau)(1+i)}{(1+r)} > \frac{(1+i^*)}{(1+r)} > 1$ by equation (33). $\widehat{x}$ is increasing in τ for fixed i^* and n but is always strictly bounded away from unity. Imposing the Tobin tax on capital outflows cannot eliminate the possibility of a financial panic.

Other potential problems arise for the Tobin tax in the presence of intrinsic asset market noise. Kupiec [1995] in a model of the stock market shows that an asset transactions tax can lead to a rise in the volatility of rates of returns to assets. This occurs in general equilibrium (he adopts an overlapping generations model) because mean asset prices fall along with asset price volatility as a consequence of the transactions tax. Translating this to the case of short-term international capital flows, it implies that a Tobin tax can raise domestic interest rates while lowering the variance of exchange rates and reducing capital flows so that the volatility of real asset yields rises.

2. In May 1992, Chile increased its reserve requirement on capital inflows to 30% (paid zero interest) for a period of one year (Agosin and Ffrench-Davis [1998]). The consensus for the Chilean case appears to be that capital controls changed the maturity composition of capital inflows with limited long-run impact on the volume of net inflows (see, for example, Budnevich and Lefort [1997] and Montiel and Reinhart [1997]). Edwards [1998] argues that the controls did not insulate Chile from the disturbances to international capital markets of the Asian financial crises. He notes that the interest rate response was greater in Chile than in Hong Kong and interprets this as evidence that the controls were ineffective. I argue that the change in the maturity structure of capital inflows and interest rate

volatility are evidence that the controls worked as intended. They reduced short-term debt exposure without reducing integration with international capital markets. The interest rate responses are evidence of continued capital market integration.

This policy imposes a tax that is diminishing with maturity. This differential tax is easy to represent in time-to-build models. The contractual interest for a loan made in period t and held for T periods satisfies

$$\prod_{j=t+1}^{t+T}\left(1+i_j^*\right)=(1-\tau)\prod_{j=t+1}^{t+T}\left(1+i_j\right) \tag{37}$$

if repayment in full is certain.

The potential benefits of this policy can be seen by considering a given probability p of a panic. The short-term interest rate is given by

$$1+i^S=\left(\frac{1+i^*}{1-\tau}\right), \tag{38}$$

if $x\leq(1+r)(1-\tau)/(1+i^*)$, and by

$$1+i^S=\left(\frac{1}{1-\tau}\right)\frac{1}{1-p}\left[(1+i^*)-p\frac{(1+r)}{x}\right], \tag{39}$$

if $x>(1+r)(1-\tau)/(1+i^*)$. The long-term interest rates are given by

$$\left(1+i^L\right)^2=(1+i^*)\left(\frac{1+i^*}{1-\tau}\right), \tag{40}$$

for $x\leq\overline{x}'$, where $\overline{x}'$ satisfies

$$\frac{(1+i^*)^2}{1-\tau}=\left(\frac{1+R}{1-\overline{x}'}\right)\left(\frac{(1+i^*)\,\overline{x}'}{(1-\tau)(1+r)}-1\right). \tag{41}$$

For $\overline{x}'\leq x\leq(1+r)(1-\tau)/(1+i^*)$, the long-term interest rate is given by

$$p(1+R)\left(1-\frac{\left(1+i^S\right)x}{(1+r)}\right)\frac{1}{1-x}+(1-p)(1-\tau)\left(1+i^L\right)^2=(1+i^*)^2, \tag{42}$$

and for $x>(1+r)(1-\tau)/(1+i^*)$ by

$$\left(1+i^L\right)^2=\frac{1}{1-p}(1+i^*)\left(\frac{1+i^*}{1-\tau}\right). \tag{43}$$

These expressions imply that the gap between the long-term equilibrium interest rate and the short-term equilibrium interest rate decreases with the capital inflows entry tax. The term structure of interest rates favors longer term borrowing. This has the correct incentive effects if short-term borrowing is socially inefficiently high.

3. Krugman [1999] suggests imposing restrictions on capital outflows in the instance of a crisis. Such controls were imposed by Malaysia and recently removed. If contingent suspensions of convertibility

are imposed during a liquidity crisis, they are a perfect instrument for halting a run. In the model of financial panics contingent controls eliminate the Pareto inefficient equilibria. They are never invoked in equilibrium, but their presence rules out bad outcomes. In the models, contingent controls invoked during a crisis that is not justified by fundamentals are Pareto improving.

Contingent suspensions of convertibility can result in lower capital inflows if lenders perceive that they might be imposed when a capital outflows is caused by deteriorating economic fundamentals. They may also be used to defend an exchange rate regime that is not sustainable under current fiscal and monetary policies. In this case, such controls can reduce welfare because they imply that domestic financial repression is being used to maintain the *status quo* exchange rate regime and fiscal policy. It is difficult to evaluate whether these controls will only be used to defend against a financial panic rather than a capital outflow reflecting adverse lender information about future real returns. A reasonable interpretation is that Malaysia suspended convertibility in the face of potential contagion during the Asian financial crisis. This fits the justification in terms of the Chang and Velasco approach to financial crises.

4. With perfect information direct controls on short-term borrowing can be used to target an appropriate mix of short-term and long-term borrowing. In the pure financial panics view, eliminating short-term debt solves the problem. Calvo [1997] discusses the arguments for such controls. While quantitative controls have well-known disadvantages compared with price-based restrictions, this could be an appropriate approach for countries seeking to take advantage of international financial capital market access for the private sector without a sophisticated and well-regulated domestic financial sector.

5. Conclusion

This paper provides a preliminary and partial assessment of the costs and benefits of policy interventions aimed at reducing the impact of short-term capital mobility on real income volatility in developing countries. The analysis of contingency funds versus reserve accumulations suggests that neither may be very useful. Reserve accumulations may bring about the very currency collapses they are intended to protect against. The analysis of the costs of capital controls gives an edge to both entry taxes as imposed by Chile and temporary suspensions of convertibility in a crisis over proportionate taxes on foreign exchange transactions.

Appendix A: Rationale for short-term lending

There are several reasons why we might observe short-term lending in an economy with gestation lags in capital formation. One is uncoordinated borrower behavior when there are a large number of borrowers. It is easy to calculate equilibrium interest rates for short and long term debt given a probability of a bank run. This has been done by Rodrik and Velasco [1999]. In the notation used in this paper, if $\overline{x} \leq x \leq (1+r)/(1+i^*)$, the short-term interest rate is i^* and the long-term interest rate (expressed as a single-period rate) is given by

$$p(1+R)\left(1-\frac{(1+i^*)x}{(1+r)}\right)\frac{1}{1-x}+(1-p)\left(1+i^L\right)^2=(1+i^*)^2. \tag{A-1}$$

If $x > (1+r)/(1+i^*)$, the short-term interest rate is given by

$$1+i^S=\frac{1}{1-p}\left[(1+i^*)-p\frac{(1+r)}{x}\right], \tag{A-2}$$

where it has been assumed that short-term lenders are paid proportionately in a run. The long-term interest rate is simply

$$\left(1+i^L\right)^2=\frac{1}{1-p}(1+i^*)^2. \tag{A-3}$$

A simple calculation shows that the investor maximizes expected surplus by taking only long-term debt in this model when she takes account of the endogeneity of the long-term and short-term interest rates to x given p. If she does not internalize the effect of her financing decision on i^S and i^L, then the expected return to borrowing short-term is positive. Sovereign immunity provides a reason why lenders will prefer to lend on short maturities. In reputational models of sovereign borrowing, threats of lending moratoria provide repayment incentives. Kletzer and Wright [1999] demonstrate that punishments that are proof to renegotiation provide the same incentives as permanent exclusion from credit market access in a very general model. The borrowing moratorium needs to last only one period. The important quantity for determining how much consumption-smoothing is achievable through international borrowing and lending is the surplus gained through borrowing itself. The greater the cost of a cut-off from access to international credit, the more that can be lent under the threat of potential repudiation or default.

Using this logic, with long-term loans the short-run cost to a default in period t is the foregone output

from new investments undertaken in period t. This loss equals

$$k_t E_t \left[\left(\frac{1+R}{(1+i^*)^2} \right) - 1 \right], \tag{A-4}$$

where k_t is equilibrium foreign lending in period t in the equilibrium constrained by sovereign risk. There is no default on loans due in period $t+1$.

Suppose that an input of capital is needed in the second period of a project to bring the project to completion. In this case, the project yields the uncertain net output R in period $t+2$ if investments equal to $1/2$ are made in each of periods t and $t+1$. If no investment is made in period $t+1$, then net output is r. In this situation, assume that a long-term loan commits foreign capital for both periods even if the country defaults on other debts coming due. The additional output loss that can be imposed on the country using short-term loans equals

$$k^S_{t-1} E_t \left[\left(\frac{1+R}{(1+i^*)} \right) - (1+r/2) \right], \tag{A-5}$$

where k^S_{t-1} is short-term debt contracted in period $t-1$.

Using only short-term debt increases capital flows in a simple extension of the Eaton and Gersovitz [1981] model by the proportion,

$$\frac{\Delta k}{k} = \frac{1}{(1+i^*)^2} E_t \left[\left(\frac{1+R}{(1+i^*)} \right) - (1+r/2) \right].$$

As in all models of sovereign debt in which punishment does not actually occur in equilibrium, there is an incentive to increase the penalties for default. This is because a larger penalty sustains higher levels of lending which are more efficient whenever the constraints imposed by sovereign immunity are binding. Short-term lending increases the costs of default in the time-to-build model.

Another issue involving sovereignty is the desire to influence policy choices that might adversely affect foreign creditors. The ability to keep a short-leash is essentially the same as increasing the penalties that can be imposed in the short run. Typical changes in fiscal and regulatory policies do not constitute default, but can impair the value of long-term loans. Short-term lending allows a run on banks that may be optimal conditional on an expected policy change. The cost of run given in equation (17) can increase the cost of such a policy change discouraging its adoption. The prospects of a bailout also can generate a bias towards short-term debt as noted by others. Other reasons for short-term lending despite a potentially troublesome maturity mismatch include regulatory and tax treatment that favors short-term borrowing.

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