Will Self-protection Policies Safeguard Emerging Markets from Crises? [1]

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1. Introduction

Alternative mechanisms to contain financial crises include international rescue packages, "the bail-in" of international creditors, and domestic safeguards. International rescue packages create moral hazard and efforts to "bail-in" the international lenders have so far proved intractable. To complement these international measures—and, perhaps, render them more effective—enhanced self-protection by governments against readily reversible capital flows has been proposed. Unlike international rescue packages and "bail-in" initiatives, which come into play mainly after a crisis is imminent, domestic safeguards are directed primarily towards crisis prevention.

The domestic proposals that we examine in this paper arise from three premises. First, financial crises are not always the consequence of fundamental inconsistencies in macroeconomic management and may be the by-product of ongoing, but incomplete, domestic financial reform and integration with international capital markets. Although liberalization is expected in the long run to foster the efficient working of financial markets, the short-run effect has often been a greater susceptibility to crises for developing country financial sectors. Deregulation of the domestic financial sector is sometimes accompanied by imprudent lending practices, creating booms and busts, which may be amplified by highly responsive short-term international capital flows—international and domestic factors in combination create a "combustible mix," as noted by Eichengreen [1999]. Second, freely floating exchange rates—and the consequent insulation of domestic policy actions—are difficult to achieve in practice. And finally, while long-term fiscal

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prudence, sustainable public debt management, and a sound banking system are the most effective safeguards against crises, near-term measures are required to augment the capacity of governments to deal with capital flow volatility and thus reduce a country's exposure to crises.

As such, these new proposals go beyond traditional macroeconomic policies and include raising foreign currency reserves, establishing contingent lines of international credit, taxing short-term foreign capital flows, and instituting prudential capital controls. Martin Feldstein [1999] proposed the general concept of self-protection. Pablo Guidotti [1999] and Alan Greenspan [1999] have suggested that it may be prudent for countries to hold foreign currency reserves in the amount of total external debt maturing within one year. This proposal revises the traditional rule of thumb that foreign reserves should cover three to four months of imports to a rule based on short-term debt amortization. An alternative to holding reserves is for countries to arrange contingent lines of credit, effectively purchasing an option to borrow reserves if and when needed to avoid illiquidity during a crisis. These lines of credit could be arranged with private creditors or provided by the international financial institutions. Others have suggested restricting short-term capital inflows, drawing on the apparent success of Chilean controls in changing the composition of inflows towards those with longer maturities (see Eichengreen [1999] for a review and an endorsement). Prudential capital controls have been advocated by, among others, the World Bank [1998] and the International Monetary Fund [2000].

We deal in this paper principally with liquidity enhancing measures, followed by a brief discussion of capital controls, and reach three main conclusions:

- Safeguards impose costs on the domestic economy either by raising the cost of capital or by reducing the flow of international capital and hence limiting the potential benefits from international integration. However, the rising frequency of crises—and the new coincidence of currency collapse and domestic financial distress—has been associated with high social costs (severe output losses in which the poor have borne a disproportionate burden). Safeguards are, therefore, appropriate. The adoption of policy safeguards is desirable particularly if they complement the transition from closed or repressed financial systems to efficiently functioning financial markets.
- A higher level of liquidity is most appropriate when a crisis is one possibility among "multiple equilibria," i.e., when unfavorable outcomes are not a necessary consequence of government policies and actions. Access to liquidity can prevent an unwarranted crisis or contain the amplification of one where weak "fundamentals" create vulnerability. Contingent credit lines are superior to the holding of international reserves, since reserves create higher fiscal costs, which, in turn, can further weaken fundamentals and contribute to crises rather than alleviating them.

Governments can, however, lower their costs of reserves by requiring banks to hold high quality foreign assets. In contrast to higher liquidity, capital controls more directly address concerns arising from weak banking or corporate governance systems.

- The design of the safeguards is likely to highly country specific taking into account both cyclical and structural country characteristics.

The next section (section 2) discusses the motivation for the proposals considered. It notes the growing importance of "twin" currency and banking crises, which typically reflect fundamental weaknesses in the domestic financial sector but which may be amplified by short-term capital flows. Section 3 discusses the role of reserves both in the context of weak fundamentals and liquidity crises. Section 4 discusses the uses and limits of contingent credit lines and the recent experience with such facilities. Capital controls are briefly discussed in section 5 followed by some concluding remarks in section 6.

2. Sources of crises

The frequency of emerging market crises has risen progressively over the last 120 years. During the Bretton Woods era, crises resulted mainly from speculative attacks on exchange rates that had become increasingly inconsistent with macroeconomic policies. The frequency of pure currency crises has declined as countries have chosen more flexible exchange rate regimes. However, banking crises, which were relatively rare between 1945 and 1971 because of capital controls and tight banking regulations, have reemerged as companions to currency crises in the large majority of cases since 1973 (Kaminsky and Reinhart 1999). Problems in the domestic financial sector appear to be largely responsible for the sudden capital flow reversals that precipitated the Asian financial crisis.

Any argument for safeguards should be based on the substantive social costs of crises. Though the share of annual foreign capital inflows to GDP in emerging market economies falls in the range of 3-5 percent of GDP, the turnaround in flows following a crisis is much larger. Moreover, since this capital is leveraged by the domestic system, the withdrawal of funds contributes to systemic disruption with large and persistent impact on the crisis economies. World Bank [1998, box 3-1 p. 127] estimates place the average cost of an emerging market currency crisis at 8 percent of GDP, rising to 18 percent when a banking crisis occurs simultaneously. For the 5 crisis countries of East

Asia, the costs of crises range from 7.8% of pre-crisis year GDP for the Philippines to 30.2% for Indonesia. These costs are comparable to the benefits of capital account openness estimated by Obstfeld [1986]. The costs of crises may be even worse when their impact on the poor is recognized (Lustig [1999]).

The analysis of policy safeguards depends on the causes of financial crises. If a mismatch of macroeconomic policies with an exchange rate peg is the proximate cause of a crisis, then a reasonable approach might be to reform fiscal or monetary management or allow greater exchange rate flexibility. However, if crises are endemic to the process of financial liberalization and development, then safeguards may play a critical role. Two competing views of how domestic financial markets and foreign capital inflows interact to create 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). One view is based on the conventional speculative attack model of currency crises due to Krugman [1979]. In this view, economic fundamentals are the source of a currency crisis and its consequent financial crisis, but the inconsistency between fiscal policies and a pegged exchange rate regime arise endogenously with external capital inflows to the domestic financial sector. 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. The government accumulates implicit liabilities that must be financed through domestic credit expansion after a crisis. An ultimate government bailout is expected and, along with a surge in capital inflows, creates the environment that makes 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 lack of liquid resources available to the government to meet the sudden reversal of international credit has been highlighted the role played by short-term capital flows in the Mexican crisis of 1994 and Asian crises of 1997. These experiences have also stimulated theoretical work on explanations of currency and financial crises that do not rely on a mismatch of an exchange rate peg and other macroeconomic policies. The extension of currency crisis models by Obstfeld [1986] demonstrates the possibility of multiple

equilibria 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. The traditional model (also known as the first-generation model) can yield either an inevitable, fundamentals driven crisis or a crisis that occurs as one possible but not inevitable equilibrium. The role of short-term lending for generating a liquidity crisis is discussed second.

2.1 Financial liberalization: long-term benefits and short-term costs

Financial sector liberalization has proceeded in parallel with capital account liberalization. Though such liberalization is necessary—and inevitable—in the long-run, recent events in Mexico, East Asia, and Russia show that in the early stages of liberalization banking systems remain fragile and such fragility can be powerfully amplified by volatile international capital flows. In each of these countries, but especially in East Asia, the depth of the crisis reflected the withdrawal of foreign funds from the distressed domestic banking system. Implicit government guarantees of the liabilities of the banking system can generate “twin” currency and banking crises.

The long-term benefits—and short-term costs— of financial liberalization. The deregulation of domestic financial sectors is an important and key element for achieving long-term economic growth. However, liberalization of domestic financial systems in emerging markets has been accompanied by an increased incidence of financial crises. A substantial number of countries deregulated their interest rates from 1985 to 1995. This coincided with an impressive expansion in bank lending to the private sector (as a share of GDP). However, Demirguc-Kunt and Detragiache

[1998] show that the probability of a banking crisis increases and remains high for three or four years following interest rate deregulation.

Regulatory failure enables banks to invest in excessively risky projects, knowing that if they fail the public will absorb the cost. McKinnon and Pill [1996], Krugman [1998] and others argue that elements of moral hazard and weak supervision combine to produce speculative asset price bubbles and crashes. Demirguc-Kunt and Detragiache [1998] find that when the domestic institutional environment is weak, financial liberalization is especially prone to banking crises.

The potential benefits of capital account openness are also well known. These include the efficient allocation of world savings to the most productive investment opportunities (often in capital-poor regions), the ability to smooth consumption against fluctuations of national income and the diversification of risk for savers (see Obstfeld [1999] for a summary). Among the many benefits that international investors acting in their self-interest bring to recipient countries is a market imposed discipline on governments and domestic businesses. Ultimately, Klein and Olivei [1999] argue, one of the main benefits of capital account openness is the development of the financial sector itself as international capital brings skills and discipline that help long-term financial sector discipline.

However, foreign capital can amplify the weaknesses of an unsophisticated or inadequately regulated financial sector. Private capital inflows are subject to surges and sudden reversals, both of which cause severe stress. During periods of inflows, weak domestic regulatory frameworks and distorted incentives allow lenders to build up poor quality loan portfolios and channel investment to low yielding, speculative projects. When inflows are reversed, the resulting credit contraction causes widespread defaults in the banking, corporate and real estate sectors. Both Klein and Olivei [1999] and Rodrik [1998] find that capital account openness has not been beneficial for developing countries contrary to theoretical analysis. One problem with both the Klein and Olivei and the Rodrik studies is that they measure capital account openness as a binary variable (open or not) when, in practice, the measure is much more nuanced. As a result of the measurement error, the estimated benefit from openness is biased downwards. Nonetheless, these results suggest that developing countries are unable to fully exploit the benefits of financial openness to the rest of the world.

Government contingent liabilities and 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 conventional 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):

$$m_t - p_t = \varphi y_t - \delta i_t, \tag{1}$$

$$p_t = s_t + p_t^* \tag{2}$$

and

$$i_t = i_t^* + E_t s_{t+1} - s_t, \tag{3}$$

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

$$\widetilde{s}_t = (1+\delta)^{-1} \left[\widetilde{m}_t - p_t^* - \varphi y_t + \delta i_t^* + \delta E_t \widetilde{s}_{t+1}\right]. \tag{4}$$

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

$$S_t\left(B_{t+1} - B_t\right) = i_t^* S_t B_t + D_t + S_t\left(R_{t+1} - R_t\right) - r_t^* S_t R_t - \left(M_{t+1} - M_t\right), \tag{5}$$

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,

$$\left(M_{t+1} - S_t R_{t+1}\right) - \left(M_t - S_t R_t\right) = i_t^* S_t B_t + D_t - r_t^* S_t R_t - S_t\left(B_{t+1} - B_t\right), \tag{6}$$

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 a one-time event. 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.

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].

2.2 Short-term lending and crises

Short-term lending by commercial banks to the domestic financial sectors of emerging markets appears to have accentuated crises in recent years. A strong trend toward shorter maturity lending by commercial banks to developing countries occurred between 1989 and 1997. This pattern is especially pronounced for the Asian crisis countries where the share of bank lending composed of short-term debt rose from around 40 percent in the late 1980s to over 65 percent by the mid-1990s. The share of short-term debt was approximately level between 1992 and the end of 1996. Thus, while the East Asian economies enjoyed rapid growth, the accumulation of short-term debt was treated as relatively benign by the markets (Eichengreen and Mody [1999]). However, the positive

interaction of short-term debt with growth also generated the basis of instability. Short-term borrowing, in other words, created a vulnerability that made the crises more severe than would otherwise have been the case.

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 significantly less than the riskless rate. Such time-to-build models demonstrate that the withdrawal of funding can strand incomplete projects and hence cause a sharp downturn in output.

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

$$\frac{(1+i^*)\,xk}{(1+r)} \tag{7}$$

The present value net return to a domestic investor equals

$$E_t\left[\left(\frac{1+R}{(1+i^*)^2}\right)\left(1-\frac{(1+i^*)\,x}{(1+r)}\right)-(1-x)\right] \tag{8}$$

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

$$E_t\left(\frac{1+R}{(1+r)(1+i^*)}\right) > 1 \tag{9}$$

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

$$(1+r)(1+i^*)\,(1-x) > E_t\,(1+R)\left(1-\frac{(1+i^*)\,x}{(1+r)}\right), \tag{10}$$

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

$$E_t \left(\frac{(1+R) - (1+i^*)^2}{\left(\frac{1+i^*}{1+r}\right)(1+R) - (1+i^*)^2} \right) = \overline{x} < x, \tag{11}$$

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 short-maturity foreign debt may dominate capital inflows from the private sector.

2.3 Why exchange rate flexibility may not be enough

The adoption of more flexible exchange rate regimes can work to reduce crisis vulnerability because it reduces the likelihood of speculative attacks against domestic currencies. The cost of capital to the borrowing country is higher because greater uncertainty is associated with foreign lending in domestic currency. *Ceteris parabis*, this reduces the flow of capital into the country. Flexibility also reduces the incentives for speculation and the taking of unhedged positions. Both

factors lower the likelihood of a pure currency crisis, and a true float should eliminate externally triggered crises.

Since 1973, there has been a trend towards greater exchange rate flexibility and the incidence of pure currency crises has simultaneously declined. However, susceptibility to externally generated crises has not disappeared because, in part, under flexible exchange rates, international borrowing is often contracted directly in foreign currency. The currency risk is thereby transferred to domestic borrowers, such as banks and others in non-tradable sectors, and takes the form of credit risk.

Moreover, most currencies are flexible only to a limited extent. As Calvo and Reinhart [1999] note, countries appear to fear floating, and central banks tend to maintain nominal exchange rates within bands while still seeking to achieve domestic policy independence. Frenkel and Mussa (1981) and Frenkel (1983) point out freely floating exchange rates do not necessarily increase policy autonomy and that the true limitation to achieving domestic policy goals arises inherently from the openness of the economy. They distinguish between the ability to achieve monetary targets and the ability to achieve real economic effects. Under a fixed exchange rate, the domestic money supply is endogenous, i.e., domestic interest rates equal foreign rates. In contrast, money supply and interest rate targets may be achieved in a floating exchange rate regime. However, real effects may still be illusory if optimal nominal contracts respond to exchange rate variability. If exchange rate variability is associated with more nominal flexibility, then real balances adjust more quickly, so monetary policy is less effective. Thus, to achieve production and income goals—as distinct from merely money supply and interest rate targets—policymakers may wish to contain nominal exchange rate movements, requiring safeguards such as sufficient international reserves. Frenkel (1983) finds that the demand for international reserves remained unchanged after the shift from the Bretton Woods period of fixed to more flexible exchange rates.

3. Reserves accumulation

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, as discussed above, 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. The recent approaches to understanding how financial crises arise sketched above are useful for analyzing two important proposed safeguards: reserve accumulations 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]). The Guidotti and Greenspan proposals call for the accumulation of reserves equal to the amount of debt maturing within one year. Lines of credit could be provided by official sources, private financial institutions, or a combination of the two.

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.

These proposals for higher liquidity should be viewed in the context of a more general government borrowing strategy that takes into account not only the short-term costs but also refunding risk.[2] Since governments need to be sensitive to potential contingent liabilities on account of private sector actions, a consolidated asset and liability management strategy is necessary. Policymakers can use traditional tools to limit risk, including the amount, maturity, and currency composition of the country's liabilities and reserves. Modern tools to hedge risk can provide

[2] Personal communication from Vincent Reinhart.

useful complements through the purchase of insurance by buying or selling options, arranging contingent lines of credit, including call provisions in its debt, and using regulatory and tax policies to encourage equity, as opposed to debt, financing. Modern financial engineering also suggests that authorities should perform stress tests to gauge residual exposure to risk. Continued work is required to determine if simple rules provide useful benchmarks for good debt and reserve management.

3.1 Reserve adequacy in practice

Though the simple short-term debt rule proposed by Guidotti and Greenspan may serve as a benchmark, countries will be best served by maintaining the level of reserves that meets their particular requirements. In addition to short-term debt, the factors to be considered in determining reserve adequacy include: the current account deficit, the variability of the balance of payments, and the uncertainty associated with the measurement of the country's short-term debt and its reserves. It is important, moreover, that the traditional concern with reserve adequacy in relation to imports also be a consideration, though the analysis below shows that when reserves are adequate from a short-term debt point of view they also provide sufficient cover for imports. For some countries, the costs of holding adequate reserves may be high and will require innovative approaches to reserves management plus a shift in the burden of holding reserves to banks.

Reserves and current account deficits. Reserves may be required not just to repay debt but also to meet the obligations due to the current account deficit. In an empirical analysis, Bussiere and Mulder [1999] show that the Greenspan-Guidotti rule of reserves equal to short-term debt will work best to limit crisis when the country also runs a current account surplus of about 2 percent of GDP. However, where the current account is just balanced, the required reserves for containing crises rise to about twice the level of short-term debt. With higher current account deficits, the required reserves may rise non-linearly to large levels.

Reserves and variability in the balance of payments. A traditional reason for holding reserves is to deal with the variability in the balance of payments. Empirical studies (for example, Frenkel [1983] and Frenkel and Jovanovic [1981]) find that higher the variability, the greater the observed level of reserves. In these empirical studies, the past variability in reserves is used as a proxy for the variability in the balance of payments. Figure 1 shows the level (right hand side) and standard

deviation (left hand side) of Reserves/Short term debt. The levels are those from June 1999. The standard deviations are calculated over the period June 1994-June 1999. Note, as earlier studies suggested, the two measures are highly correlated across this sample of countries, with a correlation coefficient of 0.85.

The ambiguity in the measurement of reserves and short-term debt. There are other some reasons why reserves may need to be higher than proposed under the Greenspan-Guidotti rule. First, adequate measures of debt that has to be repaid in the coming year are not always readily available. Short-term debt reported by the Bank of International Settlements refers to debt owed to specified banks and hence does not cover other short-term repayment obligations, such as supplier credits, bonded debt, and equity outflows, that create demands on the country's foreign exchange earnings and reserves. Second, short-term debt can fluctuate sharply. For example, Ukrainian debt repayments fluctuate significantly because it has borrowed using bullet bonds. The rule would require either large maintained reserves, which is costly, or a rapid increase in reserves just prior to the time of repayment, which may not be feasible. Third, the level of reserves can be depleted rapidly. For example, the level of Korean reserves were relatively low in the early part of 1997 and began to fall sharply just before the crisis in November when the Korean Central Bank began using its foreign exchange reserves to provide liquidity to the foreign branches of Korean banks. Similarly, the level of Thai reserves was lower than appeared since the Thai authorities had undertaken to buy the baht at a fixed exchange rate.

Other indicators of reserve adequacy. Traditional rules for reserve adequacy look to import coverage. Figure 2 compares the reserves to import ratio to the reserves to short-term debt ratio and reveals a strong association. The axes in the figure intersect at reserve/imports = 4 months, and reserves = short-term debt. Thus, any point to the right of the vertical axis represents reserves in excess of a year's repayment of outstanding short-term debt. Any point above the horizontal axis represents import coverage greater than four months. Using these two widely accepted benchmarks as a reference, any point in the upper right quadrant represents adequate reserves and any point in the lower left quadrant represents inadequate reserves. Of the 36 countries represented in the figure, 27 are in either the upper right or lower left quadrants. This is not surprising: a country's short-term debt and imports tend to be highly correlated. In other words, while the new focus on

short-term debt is appropriate, for many countries conventional reserve management to cover 3 or 4 months of imports appears to be a relevant rule. Moreover, since estimates of imports are likely to be more accurate than short-term debt and be available sooner than short-term debt measures, the reserves-to-import ratio could be a leading proxy for the reserves/short-term debt ratio.

Also relevant is the ratio of reserves to money supply (M2). Country rankings along this measure often vary significantly from rankings on reserves/short-term debt and reserves/imports. For example, prior to the crisis Malaysia had relatively high reserves in relation to short-term debt but the level of reserves were more modest in comparison with M2. The controls on capital outflows instituted in September 1998 were motivated by the concern that international reserves would be inadequate if domestic residents chose to convert large sums of domestic currency assets into foreign currency assets.

3.2 The costs of holding reserves

There is a cost to holding central bank reserves. 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 (5) and (6). 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, begin by adding an increase in reserves in the amount ΔR_t to the flow budget identity of the government:

$$(M_{t+1} - S_t R_{t+1}) - (M_t - S_t R_t) = i_t^* S_t (B_t + \Delta R) + D_t - r_t^* S_t (R_t + \Delta R) - S_t (B_{t+1} - B_t). \tag{12}$$

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

$$E_t \sum_{s=t}^{\infty} \left(\prod_{j=t}^{s} \frac{1}{1+i_j^*} \right) \Delta (M_{s+1} - M_s) = E_t \sum_{s=t}^{\infty} \left(\prod_{j=t}^{s} \frac{1}{1+i_j^*} \right) (i_s^* - r_s^*) S_s \Delta R. \tag{13}$$

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 dominant effect.

Feldstein [1999] proposes that these costs could be reduced by investing reserves in higher return and higher risk securities than government debt issued by the United States or similar countries. While this generates some risk, he argues that the risk is much less than of being caught with inadequate reserves.

Another way to reduce the government's costs of holding reserves is by requiring the private sector (including banking sector) to hold more reserves. Increasing reserve requirements for banks during periods of rapid capital inflows could achieve this. The burden of holding reserves is then shifted to depositors and borrowers from the banking system. Reinhart and Reinhart [1999] find that deposit rates fall and lending rates rise when reserve requirements are increased, thereby creating incentives to bypass the banking system in favor of other means of financial intermediation. However, where banks hold high quality foreign assets as part of their liquidity portfolio, they may be perceived as safer and hence may be able to increase their level of intermediation.

4. Contingent credit lines

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,

$$\widetilde{s}_t = (1+\delta)^{-1}\left[\widetilde{m}_t - p_t^* - \varphi y_t + \delta i_t^* + \delta E_t \widetilde{s}_{t+1}\right], \tag{14}$$

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 contracted by Argentina, Indonesia, and Mexico and can be less costly than borrowed foreign reserves although there are offsetting factors. When contracted, a contingent credit line incurs a commitment fee, which is the fee for the right to borrow under specified circumstances. This commitment fee is typically less than one percent of the contracted amount and, as such, is much smaller than the cost of holding reserves, which is approximated by the sovereign risk spread on the borrowed reserves. This large difference reflects an efficiency gain. By holding the money on behalf of the potential borrower, the international lender does not incur sovereign risk during the holding period; also, the money can be invested in a diversified portfolio that can be optimized continuously. When a borrower draws against the contingent credit, the precontracted interest rate is used, which, in practice, has had a lower spread (over the relevant risk-free rate) than sovereign bond borrowings. However, contingent credit lines have been arranged by commercial banks, who may charge a lower rate than bondholders.

Argentina established a $6.1 billion contingent credit line with 13 banks in December 1996. This was a substantial amount since Argentina held $18.1 billion in foreign exchange reserves and $23.0 short-term debt to BIS reporting banks. Thus, the contingent line took Argentina over the Greenspan-Guidotti threshold, at least in terms of commercial bank debt. The line of credit has not been utilized, and has subsequently been rolled over once with an increase in the commitment fee from around 30 to 60 basis points during a period of heightened risk perception following the Asian crisis. The line of credit backstops liquidity to the domestic banking sector in the event of a liquidity crisis. In effect, the Argentine Government can act as an intermediary, channeling reserves into the banking system, with the timing, extent of usage and cost determined by need.

The other significant benefit of a contingent credit is that it only specifies a maximum amount that would be borrowed in the event of an emergency. An emergency may be averted by borrowing only a fraction of the contracted amount. This suggests that if the maximum amount is set to be large enough (against which only a commitment fee is paid), the additivity problem may be reduced. To allow dynamic hedging in the contingency that the credit line is used, the same creditors to the country should choose a level of lending that can be reversed to offset the increase in exposure in the emergency. This level should be based on the expected use of the contingent facility and not necessarily chosen to cover its maximum. This could reduce the risk of a liquidity crisis, although it implies that the contingency fund would exceed short-term debt exposure.

Contingent credit lines 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. Dynamic hedging has already appeared as a threat to the usefulness of contingent credit lines. In the case of Mexico, participating banks warned against exercising the credit because bank lending to Mexican corporations would contract as a result (IMF [1999a], p. 33). As such, it is possible that contingent lines of credit will 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. If, however, the offsetting positions less than match the full maximum amount of the credit or if they are taken as a crisis approaches (in which case, lenders incur significant costs), then the lines could add net resources to provide liquidity to avert a crisis.

While contingent credit lines may not provide additional resources during a crisis in the presence of dynamic hedging, they may still help to protect countries against a liquidity crisis. Under dynamic hedging, a lender avoids increasing the total credit it extends to the country when the contingent credit is drawn against. However, if the lender seeks to reduce its short-term lending to the country in the event of a crisis, the contingent credit is invoked, thereby replacing that short term debt. The contingent credit line is effectively a contingent maturity extension. They can be used to replace short-term debt when the lender is unwilling to rollover existing short-term debts during a liquidity crisis. For example, if a country has short-term external debt of $10 million, it can face an outflow

of capital up to this amount in a crisis. By arranging $5 million of contingent credits, one half of its short-term debt exposure can be automatically rolled over by invoking the credits in the event of a liquidity run, halving the short-term capital outflow. If dynamic hedging is to unravel this effect, then lenders need to increase their short-term exposure by $5 million to raise the maximal liquidity shortfall to $10 million. Thus, in equilibrium, contingent credits do not have a beneficial effect if they induce lenders as a whole to increase their total exposure to the countries by the amount of the contingent credits. The purpose of contingent credit lines is to create a portion of the debt that cannot be subtracted in a crisis by allowing for a pre-arranged conditional maturity extension.

A second, related, issue is that collateral has been required to back credit lines. This has the effect of precommitting resources for the repayment of the debt. The Argentine agreement commits the participating banks to purchase Argentine government securities from the central bank as collateral; the value of the collateral, which is marked to market, has to be maintained above the level of the contingent credit line. Since the collateral held by the beneficiary banks is the form of Argentine Government debt, Argentina is under an obligation to repay following the triggering of the credit. The risk of this obligation led the Argentine Government to arrange backstop funding from the World Bank.

The IMF also created a contingent credit facility in April, 1999 (IMF, [1999c]), known as Contingent Credit Lines. These lines are intended to provide protection against adverse developments in international capital that pose a risk to member countries not of their own making. As of writing, these have not been used. The commitments would normally be in the range of 300 to 500 percent of the member's quota. Countries would be expected to repay each tranche within 12-18 months.

5. 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]). The Chilean approach has received the most attention since it seeks directly to restrict short-term capital flows.

Consider, first, the implications of restricting short-term capital on aggregate capital flows. 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. Longer term lending is associated with countries whose policy regimes are perceived to be more stable and pose a lower risk of sovereign default. The consensus for Chilean 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], Gallego, Hernandez, and Schmidt-Hebbel [1999]). In countries with greater political risk, capital flows may decline—and such a decline may also be perceived as desirable.

As observed by Rodrik and Velasco, 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 also beneficial. Thus the models of financial crises do imply that there are 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 paribus*.

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. However, it seems more appropriate to argue that the change in the maturity structure of capital inflows and interest rate volatility are evidence that the controls worked as intended.

The controls appear to have reduced short-term debt exposure without eliminating integration with international capital markets. The interest rate responses are consistent with maintaining integration of the domestic economy with international capital markets. This may a desirable, rather than undesirable, aspect of short-term restrictions relative to other forms of capital controls. The appendix discusses the impact and potential costs of this type of capital control when effective.

6. Conclusion

This paper provides a preliminary and partial assessment of the costs and benefits of policy interventions aimed at reducing the impact of crisis generated by (implicit or explicit) government commitments to honor the liabilities of their domestic banking systems and by short-term capital mobility. Reserve accumulations and contingency funds can guard against unexpected and limited shocks leading to the realization of government contingent liabilities and can also protect against the sharp downturns that result from the inability to rollover short-term debt. However, they cannot protect from endemic and unsustainable vulnerabilities. Reserve accumulations suffer from the further limitation that by creating a significant fiscal cost, they may bring about the very currency collapse they are intended to protect against. In this respect, contingent credits are superior. They serve as a mechanism to enforce a rollover of funds when private capital seeks to leave in the midst of a crisis. Taxation of short-term capital inflows raise the costs of investment, especially to small and medium firms, but may allow countries to limit short-term debt accumulation without significantly interfering with capital market integration. The limits on short-term debt thus achieved reduce government contingent liabilities and hence lower the costs of a crisis.

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 penalities 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.

Appendix B. Controls on short-term capital inflows

Chilean-style capital controls can be represented by 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

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

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

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

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

$$1+i^S=\left(\frac{1}{1-\tau}\right)\frac{1}{1-p}\left[(1+i^*)-p\frac{(1+r)}{x}\right], \tag{B-3}$$

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

$$\left(1+i^L\right)^2=(1+i^*)\left(\frac{1+i^*}{1-\tau}\right), \tag{B-4}$$

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

$$\frac{(1+i^*)^2}{1-\tau}=\left(\frac{1+R}{1-\overline{x}'}\right)\left(\frac{(1+i^*)\,\overline{x}'}{(1-\tau)(1+r)}-1\right). \tag{B-5}$$

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

$$p(1+R)\left(1-\frac{\left(1+i^S\right)x}{(1+r)}\right)\frac{1}{1-x}+(1-p)(1-\tau)\left(1+i^L\right)^2=(1+i^*)^2, \tag{B-6}$$

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

$$\left(1+i^L\right)^2=\frac{1}{1-p}(1+i^*)\left(\frac{1+i^*}{1-\tau}\right). \tag{B-7}$$

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..

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Figure 1: The level and variability of reserves/short-term debt

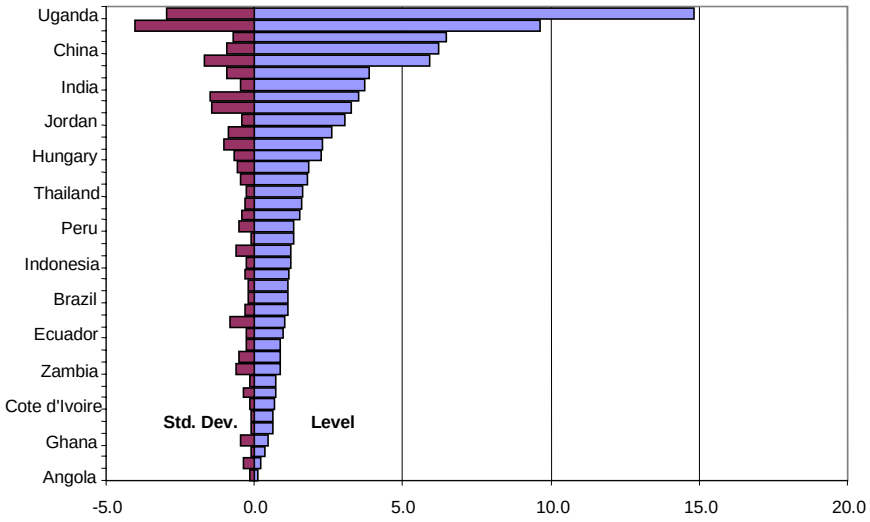
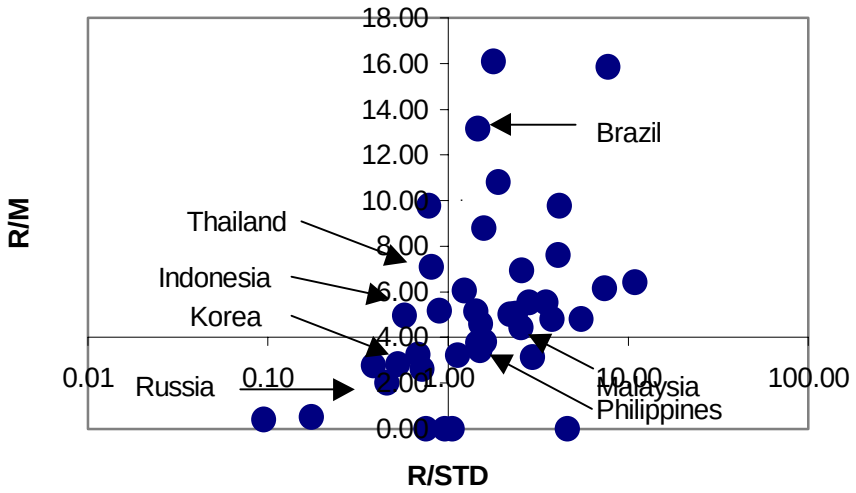


Figure 2: Reserves to short-term debt (R/STD) vs. reserves to imports (R/M), 1996



Source: BIS, IMF