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CRISES IN EMERGING MARKET ECONOMIES: A GLOBAL PERSPECTIVE

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ABSTRACT

The paper argues that global financial factors played an important role in the capital-inflow episode in Emerging Market economies (EMs), during the early part of the 1990s, and clearly in the Sudden Stop (of capital inflows) crises that took place after the 1998 Russian crisis. Moreover, the paper shows that recovery after crises that exhibit large output loss (more than 5 percent of GDP from peak to trough) occurs in a Phoenix-like fashion: little credit or investment is required. These results strongly suggest that: (1) deep financial crises can be prevented or at least largely alleviated and (2) global institutions and arrangements should be high on the policy agenda. The paper then discusses an Emerging Market Fund (EMF) charged with the task of lowering the incidence of contagion in EM bond prices. In addition, the paper analyzes domestic policies and concludes that they are critical and important in making EMs less vulnerable to shocks but are unlikely to succeed in fully shielding these economies from global financial shocks if not supported by arrangements like the EMF. Finally, two sections of the paper are devoted to discussing some current issues regarding applicable theory and econometrics.

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I. Introduction

This year (2005) marks the tenth anniversary of the "First Crisis of the Twenty-First Century," as Michel Camdessus, the former managing director of the IMF, called Mexico's 1994/5 Tequila crisis. The event is important not because it signaled a new environment (the Tequila was not that different from Mexico's 1982 crisis), but because it was the beginning of a long series of financial crises in Emerging Market economies (EMs). Their frequency and global span (Latin America, Asia, the Middle East and Russia) set them apart from anything else that we have seen—at least since World War Two. The key question that arises in this respect is as follows: Is higher frequency an indication that EMs have become sharply less creditworthy (e.g., by running unsustainably large fiscal deficits), or rather, does the higher frequency of EM crises show that greater access to the global capital market has made those economies more vulnerable to shocks coming from the capital market itself? In Calvo (2002) I referred to these capital market shocks as Globalization Hazard. The central point of this lecture is that empirical evidence strongly supports the view that EM crises exhibit an important degree of globalization hazard; consequently, policies aimed at attenuating the incidence and seriousness of these crises should contain significant global or systemic components. Specifically, one is prompted to think of ways in which the international financial community can help to lower globalization hazard. Without new and effective global instruments, the old modus operandi in which IMF missions are sent to nurse the wounds of economies hit by crisis may still alleviate the pain, but it is unlikely to wipe out the plague.

I begin my presentation in Section II by discussing a remarkable fact that has received little attention in the literature, namely, the persistent slowdown in EMs' growth (if not outright output collapse) and investment in the aftermath of the 1997 Asian and 1998 Russian crises, especially the latter.[1] The negative shock cuts across various EMs, strongly suggesting the existence of *systemic* or *global* factors. This is further confirmed by evidence pointing to the fact that the capital inflow episode in EMs in the first half of the 1990s may also have global roots such as the rapid development of the US bond market and the creation of Brady Bonds. Finally, adding a touch of hope to global instability, the section closes by noting that these crises may have been *preventable* or significantly alleviated, albeit with new policies and institutions (some of which are later discussed in Section V).

Sections III and IV are relatively more technical and could be skipped on a first reading without loss of continuity. Section III outlines a model explaining shocks that emanate from a malfunctioning of capital markets. The section further explains why a shock in the international capital market could spread to EMs and how domestic vulnerabilities could help to magnify the external shock and give rise to higher domestic volatility and financial disorder. Section IV summarizes recent empirical and econometric findings, which further confirm the relevance of external factors and identify domestic vulnerabilities that might aggravate the impact of negative external shocks. In particular, empirical papers focus on Domestic Liability Dollarization or DLD (i.e., domestic banks' loans denominated in foreign exchange as a share of GDP) and the

[1] For a discussion of the Russian crisis in the context of Latin American economies, see Calvo and Talvi (2005).

Current Account deficit (as a share of the absorption of tradables). Finally, Section V discusses policy issues, emphasizing the global perspective.

II. The Asia/Russia Crisis and Its Aftermath

It always happens after a big crisis: people happily reveal their inchoate views. Thus, for instance, after the 1982 Mexican crisis that inaugurated the so-called Debt Crisis period, enemies of government intervention immediately concluded that the crisis was due to the failure of Import Substitution. This conclusion stuck for many years, and still does, as few bothered to question it.[2] Likewise, after the Asia/Russia crisis, it has become fashionable in Latin America to blame the reform process inspired by the Washington Consensus (see Williamson (1994)), even though there is no thread of evidence connecting reforms to crises in the region. However, if left unchallenged, this view will soon become conventional wisdom (and an army of protection-hungry firms and politicians will have good reason to celebrate!)

In this section, I will challenge that view in a somewhat indirect way. I will show that there exists evidence strongly suggesting that what recently happened in EMs may have a great deal to do with the global capital market. This does not deny, I hasten to add, that local factors are relevant. Rather, it suggests that, without the existence of external disturbances, EMs would not have ridden the dizzying rollercoaster of recent years.[3]

[2] For a different view stressing the catalytic role of the sharp rise in U.S. interest rates, see Borensztein and Calvo (1989), and Stiglitz (2003). Panagariya (2003) even shows that it is incorrect to characterize the 1960s and 1970s in Latin America as a period of Import Substitution.

[3] See, for example, Calvo and Talvi (2005) where the sharp differences between Argentina and Chile after the Russian crisis are attributed to factors like Domestic Liability Dollarization and Openness to Trade.

Before starting, I should warn the reader that the discussion in this section is highly impressionistic and would not pass a rigorous scientific test. The latter will have to wait until Section IV. Instead, the main objective in this section is to show some key stylized facts strongly suggesting that the 1997/1998 Asia/Russia crisis[4] appears to have had an inordinately strong impact on EMs, thus challenging the opponents of reform while at the same time motivating the theoretical discussion in the next section.

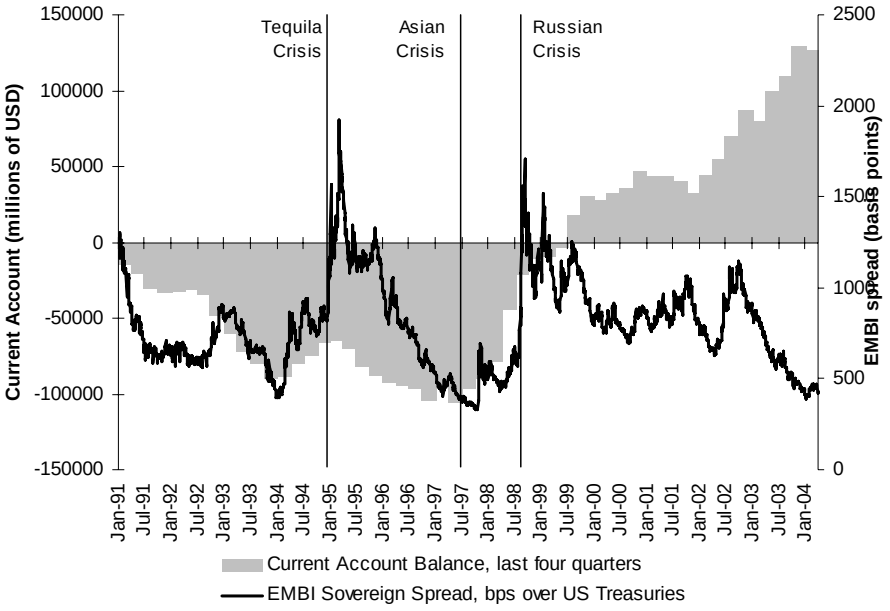
The Asia/Russia Crisis

Let me begin by referring to Figure 1. Figure 1 plots monthly observations of J. P. Morgan's EMBI and EMs' current account from January 1991 until the present. The EMBI shows two episodes where this index sharply rises above 1,500 basis points (i.e., 15 percent above U.S. treasuries), namely, shortly after the onset of (1) Mexico's Tequila crisis in December 1994 and (2) the Russian crisis in August 1998. However, the impact on current account adjustment is quite different in the two episodes. While it is difficult to see much of an adjustment around the Tequila crisis (actually shortly after the Tequila crisis the EM current account deficit widens until the Asian crisis in 1997), the combination of Asia and Russia set in motion an enormous current account adjustment that completely reversed earlier current account deficits; large EM current account surpluses are still the norm at present. Evidently, something very dramatic happened around the Asia/Russia crisis.[5] The impact of these crises on the real economy can be seen in Figures 2 and 3.[6] Again, the difference between the Tequila and Asia/Russia

[4] I bunch them together because they happened in the span of about one year, but later I will argue that the Russian crisis likely was the most damaging.
[5] Indeed, the drama or, rather, the tragedy also visited the *North* as LTCM (Long-Term Capital Management) collapsed on September 2, 1998 (see Kaminsky and Reinhart (2001)).
[6] Quarterly data. Investment and output are unweighted averages across the corresponding regions. A similar pattern emerges if countries' data are weighted by their relative GDPs.

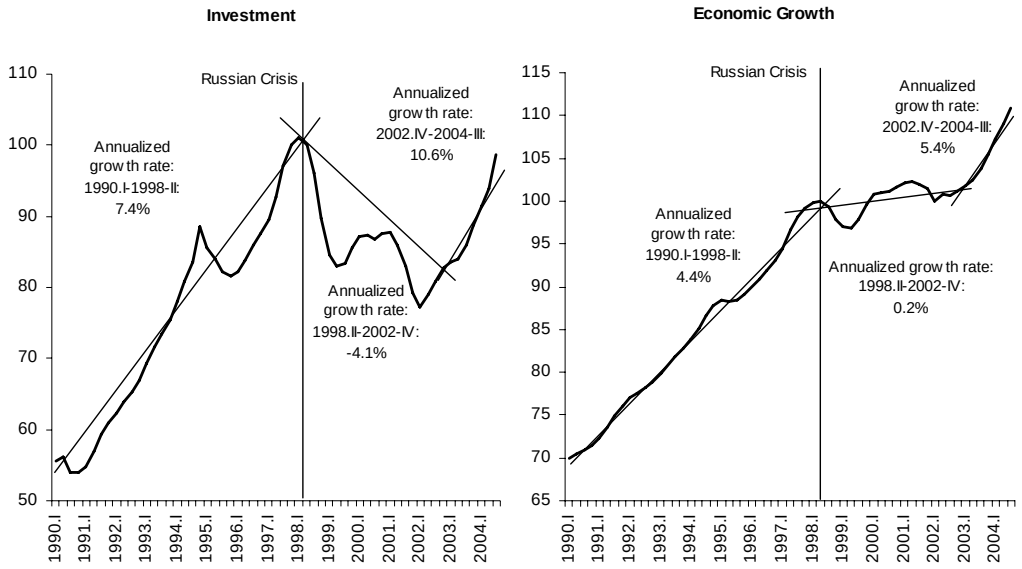
crises is quite striking. While the Tequila crisis represents a minor bump in the road, even for Latin America, the Asia/Russia crisis is associated with major collapses in growth and investment. Even in Asia, where recovery begins immediately after the Russian crisis, output does not return to its peak (prior to the Asian crisis) until 2002, and investment is still about 15 percent below its peak. Incidentally, notice that the Asia/Russia crisis was much more benign in Latin America than in Asia, since in the former it brought about a slowdown in the growth rate, while in Asia output shows a precipitous decline.

Figure 1. The Asia/Russia 1997/8 Crisis: Effects on EMs.



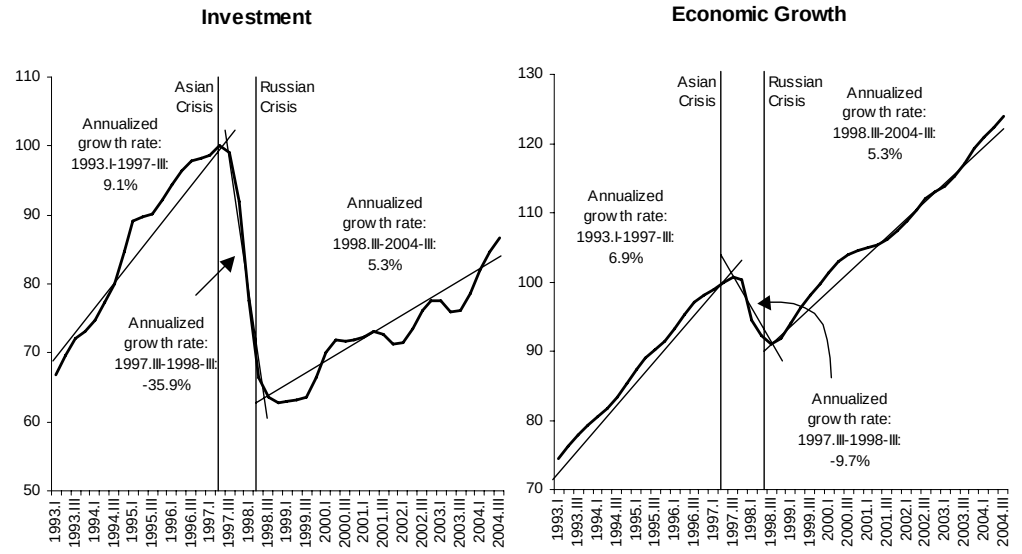
Note: Includes Argentina, Brazil, Chile, China, Colombia, Czech Republic, Egypt, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Poland, Slovak Republic, South Africa, Thailand, Turkey and Venezuela. Source: J.P. Morgan and IMF Balance of Payments Statistics.

Figure 2. The Asia/Russia 1997/8 Crisis: Latin American Investment and Output.



Note: s.a. Investment and s.a. GDP, 1998.II=100. Includes Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela. Source: Corresponding Central Banks.

Figure 3. The Asia/Russia 1997/8 Crisis: Asian Investment and Output.



Note: s.a. Investment and s.a. GDP, 1997.II=100. Includes Indonesia, Korea, Malaysia, Philippines and Thailand. Source: Corresponding Central Banks.

Why was the Tequila crisis so mild, and the Asia/Russia crisis so severe? My conjecture is that the Tequila crisis was mild because the timely and large Mexican bailout orchestrated by the Fund succeeded in insulating the global capital market (particularly Wall Street) from this crisis.[7] The Asian crisis could have also been mild (notice that the EMBI hardly budged during this episode), but it turned virulent when combined with the Russian crisis. The latter showed investors that the EM asset class was much more risky than they had originally believed in the early 1990s.

Capital Inflows in the Early 1990s

Thus far, the discussion has focused on crises, completely ignoring the capital inflow period in the first part of the 1990s. While a full account of that period is outside the purview of this lecture, it is nonetheless worth noting that explanations run the gamut from domestic to external factors. During the capital inflow period, the official sector was quick to conclude that the surge in capital inflows reflected the end of the Debt Problem (the debt crisis that involved several EMs and started with Mexico's August 1982 financial crisis) and the onset of a pro-market reform period. This fit the facts in Latin America, but not in Asia. By and large, Emerging Asia did not suffer from the Debt Problem, and the 1990s was not a particularly active reform period (unless one counts as pro-market reform the opening up of Asian capital market). Thus, the domestic factors explanation is not terribly convincing.

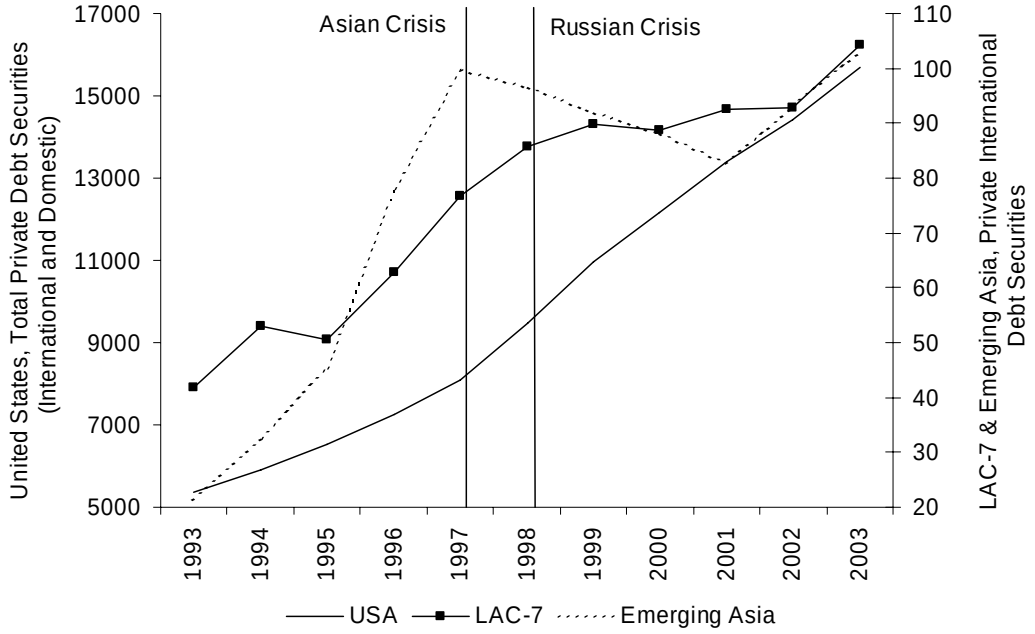
In my opinion the external factors view has, once again, a better chance of hitting the bull's eye. As shown in Figure 4, the U.S. private sector bond market exhibited

[7] Some observers claim that the Mexican bailout is responsible for the Asian crisis, because it sent the signal that the public sector would bail them out in case of trouble. I do not find this *moral hazard* argument very persuasive. See Calvo (2002) and discussion in Section V.

almost a 211 percent expansion in the period from 1993 to 1997 as firms shifted from bank loans to tapping the bond market. This represented a major technical change in global financial markets, and the growth of the U.S. fixed-income market created an expertise that could arguably be applied to other bond issuers. Moreover, the onset of this expansion coincided with the creation of the so-called Brady Bonds, which essentially meant taking sovereign loans out of banks' balance sheets and placing them on the bond market. This, combined with the large expansion of the U.S. bond market, may have laid the groundwork for the EM bond market. These factors may have additionally provided a platform for the initial wave of capital inflows in the 1990s, especially for countries afflicted by the Debt Problem. Some evidence in that direction is presented in Figure 4, which shows that in the 1993-1997 period private international bonds[8] in LAC increased by 84 percent, while in Emerging Asia they did so by an impressive 365 percent. Notice, incidentally, that while the U.S. private sector bond market keeps growing at full steam after the Asia/Russia crisis, Emerging Asia shows a sharp retrenchment, while Latin America exhibits a marked slowdown (especially after the Russian crisis). Interestingly, the different nature of the Asian and Latin American private sector international bond stocks after the Asia/Russia crisis mirrors their output counterparts (recall Figures 2 and 3).

[8] I focus on international debt for EMs because domestic debt is subject to tricky valuation problems, and considering them would unduly extend the discussion. However, tentative estimates including domestic EM debt provide a similar picture.

Figure 4. Private Debt



Note: Amounts Outstanding in billions of USD. Source: BIS.

An across-the-board increase in the supply of EM bonds may contain the seeds of its own destruction, or at least of instability. This is argued in Calvo and Mendoza (2000) by showing that such an expansion of the bond market may diminish investors' incentives to collect information specific to each economy and induce them to make portfolio decisions on the basis of general information (like ex ante first and second moments).[9] However, a slight change in expectations may bring about a sharp portfolio repositioning. Thus, this theory helps to explain the occurrence of a single country's Sudden Stop episode, which, to the unsuspecting observer, would appear to have come from nowhere. As will be discussed in Section III, this type of shock may create confusion and make investors (especially the unsuspecting or uninformed ones) think that

[9] A key assumption is that short sales are bounded (e.g., there are margin constraints).

most EMs are subject to a negative shock, giving rise to an across-the-board increase in interest-rate spreads, such as occurred during the 1998 Russian crisis.

The Phoenix Miracle

Another topic that deserves mention here is the nature of recovery after a Sudden Stop (of capital inflows).[10] In ongoing work with Alejandro Izquierdo and Ernesto Talvi we examine the recovery process in all EM Sudden Stop episodes from 1980 to the present, including all of those cases in which output fell by more than 5 percent from peak to trough and exhibited a *systemic* nature. Economies in the sample underwent Sudden Stops around the times of the 1982 and 1994/5 Mexican crises and the 1997/8 Asia/Russia crisis. In total we examined 14 cases. Among many interesting features, some of which will not be reported at this time (such as the remarkably similar V-shaped pattern of these crises), we find that the recovery took place under conditions in which (1) domestic bank credit, (2) current account deficit and (3) investment were *only a fraction* of the corresponding levels prior to Sudden Stop. This *Phoenix Miracle* or *Rising from the Ashes* phenomenon suggests that systemic Sudden Stops are *preventable accidents*.[11] How to avoid them depends on how one interprets the reasons behind Sudden Stops. If the triggering factor is external to EMs, then global solutions are called for. Our previous discussion shows that the Asia/Russia crisis could be a case in point. However, as the theoretical and econometric sections below will argue, domestic factors are also likely to play a critical role. Thus, policies to prevent Sudden Stops and attenuate their effects

[10] These are episodes in which the flow of new international credit is sharply curtailed, and are central to recent financial crises in EMs. For a more formal definition, see Section IV below.
[11] For an update of these results and formal empirical tests that confirm and extend them, see Calvo, Izquierdo and Talvi (2006).

must encompass both domestic and global components. This will be addressed in Section V below.

The discussion above shows very clearly that the Asia/Russia crisis was associated with a major and persistent collapse in EM growth and investment. This empirical evidence should give pause to opponents of reform and at least make them reconsider their dogmas. However, that is unlikely to happen unless they are faced with well-structured theory and scientific empirical analysis. A summary of the first steps in that direction will occupy us in the next two sections.[12] However, readers less interested in technical details are prompted to proceed directly to the policy discussion in Section V.

III. Insights from Theory

The first step is to rationalize the existence of a Sudden Stop stemming from a malfunctioning of international capital markets. Let the EM production function be given by $f(k,\theta)$, where k is capital per unit of a fixed factor (which one might interpret as entrepreneurial services, or home goods), and θ is a random shock.[13]

The representative firm is risk neutral and chooses k so as to maximize its quasi-rent, i.e.,

$$\underset{i\in\mathcal{I}}{Max}\, E\left(\underset{k}{Max}\, E\{[f(k,\theta)-rk]/i\}-N(i)\right), \tag{1}$$

where r is the international rate of interest or capital rental *faced by the firm*, E is the expectations operator, $\mathcal{I}$ is the set of information schemes (or σ-fields) available to the

[12] The following discussion is heavily biased towards my own work, since I assume the objective of these lectures is to showcase different views rather than to offer a balanced survey of the literature.

[13] As usual, I assume that function f is increasing and strictly concave with respect to k. A fixed factor is assumed, instead of allowing for a variable factor like labor, because at one point I will introduce a fixed

firm, the forward slash stands for "conditional upon," information scheme $\boldsymbol{i}$ is a member of $\mathcal{I}$, and $N(\boldsymbol{i})$ is the cost of information scheme $\boldsymbol{i}$. Thus, given information scheme $\boldsymbol{i}$, the firm is assumed to maximize its expected quasi-rent with respect to k, conditional upon information scheme $\boldsymbol{i}$. The firm then chooses the information scheme $\boldsymbol{i} \in \mathcal{I}$ that maximizes ex ante expected profits.

International shocks are transmitted through the interest rate faced by the firm, r. Investors are risk neutral, but there are states of nature in which EM governments may impose a tax τ on interest income (in response to, for instance, a negative common real shock).[14] Thus, letting R stand for the pure international interest rate, the no-arbitrage condition implies that

$$r = E\left(\frac{R}{1-\tau}\right). \tag{2}$$

Consider now a capital market mishap similar to the one that allegedly occurred during the Russian crisis, in which a set of key investors are subject to margin calls and therefore sharply lower their participation or dump a considerable share of their EM portfolios in the market.[15] Upon observing such strange behavior on the part of margin-constrained but high-profile investors and firms, the non-margin-constrained agents would face a classical signal-extraction problem. What prompted margin-constrained investors to withdraw from the market? Was it because they are margin-constrained, or because they learned that EMs have been hit by a negative shock and, say, governments

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cost and, as is well known, under those conditions variable factors and linear homogeneity are inconsistent with the existence of a competitive equilibrium.

[14] The tax story is chosen for its simplicity. There is nothing especially "realistic" about it.

will increase the tax τ on capital flows? Under those circumstances, unless there is a totally credible leak signaling that all is due to margin calls, rational non-margin-constrained agents (the only ones that would be able to extend fresh loans to EMs) will infer that EMs have been hit by a common negative shock. Consequently, expected interest income taxes will rise, leading to an increase in interest rates faced by firms, r.[16] Therefore, a mishap in the international capital market that has nothing to do with EMs may result in an increase in r and have a negative impact on output.[17]

However, some degree of skepticism would be warranted here, because the argument above could apply to developed economies as well. Why, then, are EMs more likely to suffer devastating effects from capital market accidents? In my view, the key element that differentiates developed economies from EMs is in the very labeling of EMs, namely, the adjective *Emerging*, especially if by *Emerging* one means that these economies operate under highly incomplete information due to, for example: (1) lack of a sufficiently long track record, and (2) weak economic and political institutions. These conditions make it more likely that, faced with a shock stemming from the international capital market, uninformed economic agents give more weight to the conjecture that the shock has a large EM component, and less weight to the alternative, i.e., that the shock comes from the international capital market.

Calvo (1999) discusses an example along these lines in which margin-call shocks and EM shocks are log-normally distributed and are mutually stochastically independent; in that context it is well known that the weight rational individuals give to domestic

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[15] Some investors buy financial securities by borrowing the attendant funds from a bank. Thus, upon a sharp fall in securities' market values, the bank may decide that the original loan is too risky and demand a swift (partial) repayment. This is a salient characteristic of "margin calls."

[16] For a more rigorous discussion of this issue, see Calvo (1999).

factors increases with the variance of domestic shocks relative to that of margin-call shocks. Thus, the larger the volatility of information about an economy, the bigger the weight uninformed (but rational) investors will put on domestic factors, which helps to explain why the same accident in the world capital market may have a bigger negative impact in EMs than in developed economies.

As argued in Calvo (1999), however, a Sudden Stop in capital inflows (provoked in this case by a sharp rise in r) may have negative effects that go beyond the decline in capital or investment. The existence of additionally negative effects is a standard feature in current macro models, and it goes by the name of *adjustment costs*. Typically, it is assumed that the larger the change in the rate of investment, the larger its associated adjustment cost. However, the standard assumption is that such costs result in lower net output but have no direct effect on marginal productivities and that, equally important, they are temporary. Relevant as the standard assumption may be for regular business-cycle shocks, it does not seem to capture the great disarray that follows a Sudden Stop in EMs, in which shocks are so large and widespread that they radically change the business environment. Therefore, a more appropriate assumption seems to be that adjustment costs impinge on the marginal productivity of capital, θ, in our model and, in a dynamic extension, that the shocks are highly persistent (especially in the absence of sufficiently large and timely bailouts). Thus, at the very least one should assume that a Sudden Stop temporarily lowers the unconditional expectation of θ. Since the Sudden

[17] See Neumeyer and Perri (2005) for an analysis of the impact of international interest rates faced by EMs and their business cycle.

Stop lowers the marginal productivity of capital, output will remain depressed even though interest rates go back to pre-crisis levels.[18]

The effect of a Sudden Stop on marginal productivities is likely to depend on the depth of the ensuing *domestic* financial turmoil. In some extreme cases, such as in Argentina in 2002, even the domestic payments system may come to a sudden stop. In recent research with my collaborators, which will be summarized in Section IV, we have identified two factors that may contribute to deepening domestic crisis and, as a result, increase the probability of a Sudden Stop. These factors are *Domestic Liability Dollarization* (DLD) and a large current account (of the balance of payments) deficit as a share of output of tradables. DLD is defined as domestic banks' foreign exchange-denominated loans as a share of GDP, and it is a risk factor because Sudden Stops are associated with large real devaluations, increasing the chances that foreign exchange denominated loans will be defaulted on. On the other hand, the current account deficit (as a share of the domestic production of tradables) is also a risk factor because a Sudden Stop typically leads to a sharp current account adjustment which is likely to bring about large changes in relative prices (never a good omen in financial markets) when output of tradables is small. (If the economy produces only tradables, however, the current account adjustment would take place with hardly any change in the real exchange rate.)

As will be discussed in Section IV, empirical analyses also show that the volatility of relative prices sharply goes up during Sudden Stops, thus suggesting that Sudden Stops are also likely to lead to a higher variance of θ. This may stem from the fact that a

[18] Mendoza (2004) studies a dynamic general equilibrium model in which Sudden Stops emerge exogenously, and when they occur the economy exhibits productivity effects on value added of the type discussed here. These effects are caused by changes in capacity utilization and demand for intermediate goods triggered by frictions in world credit markets.

Sudden Stop increases the share of systemic as opposed to firm-specific shocks on individual θ_j, where *j* stands for firm *j*. Greater volatility, in turn, may increase firms' incentives to learn more about the state of nature. Thus, as firms divert resources to *knowledge activities*, output in the short run is likely to fall further. Moreover, better knowledge about the state of nature may be reflected in even larger price volatility, as will be shown in the following example.

Relative-Price Volatility

To simplify the exposition, I will assume that there are only two polar information schemes: (a) No Information, *NI*, i.e., firms know the distribution of random variable θ, but not its realization, and (b) Full Information, *FI*, i.e., firms know the realization of θ. Moreover, following Calvo, Izquierdo and Loo-Kung (2006), I will assume that function *f* can be approximated by the following quadratic form:

$$f(k,\theta) = \theta k - \frac{1}{2}k^2. \tag{3}$$

Thus, in the no-information case, the maximization problem stated inside expression (1) (i.e., after choosing the information scheme) yields, assuming interior solutions,

$$k^{NI} = \overline{\theta} - r, \tag{4}$$

where k^{NI} is the quasi-rent-maximizing capital stock under no information, and $\overline{\theta}$ is the unconditional expectation of θ. Thus,

$$\pi^{NI} = \underset{k}{Max}\, \underset{\theta}{E}[f(k,\theta) - rk] = \frac{1}{2}(\overline{\theta} - r)^2, \tag{5}$$

where π^{NI} stands for expected maximum quasi-rent in the no-information case. Moreover, the ex post return to the fixed factor, w^{NI}, is given by

$$w^{NI} = f(k^{NI}, \theta) - rk^{NI} = (\theta - r)(\bar{\theta} - r) - \frac{1}{2}(\bar{\theta} - r)^2. \tag{6}$$

Similarly, the quasi-rent-maximizing k in the full information case satisfies

$$k^{FI} = \theta - r, \tag{7}$$

and, expected quasi-rents associated with full information, denoted by π^{FI}, satisfy

$$\pi^{FI} = \underset{\theta}{E}\, \underset{k}{Max}[f(k, \theta) - rk] = \frac{1}{2}\underset{\theta}{E}(\theta - r)^2 = \frac{1}{2}\text{var}\,\theta + \pi^{NI} \tag{8}$$

Equation (8) shows that expected quasi-rents under full information are larger than under no information, the difference being proportional to the volatility of θ. Clearly, given information cost, the higher the volatility of θ, the larger will be the incentives to acquire full information.

Furthermore, denoting the ex post return to the fixed factor under full information by w^{FI}, we have

$$w^{FI} = f(k^{FI}, \theta) - rk^{FI} = \frac{1}{2}(\theta - r)^2. \tag{9}$$

Does more information entail higher relative-price volatility, as measured by w? To answer this question in the present context, we could compute *RVol* defined as follows:

$$RVol = \sqrt{\frac{\text{var } w^{FI}}{\text{var } w^{NI}}} = \frac{1}{2(\bar{\theta} - r)} \sqrt{\frac{\text{var}[(\theta - r)^2]}{\text{var } \theta}}, \tag{10}$$

where the rightmost expression in (10) follows from equations (6) and (9). To obtain an explicit expression for *RVol* let us consider the case in which θ is log-normally distributed with natural log mean μ and natural log standard deviation σ, and assume $r = 0$. Then, one can show (see Appendix),

$$RVol = \frac{1}{2} e^{\sigma^2} \sqrt{\frac{e^{4\sigma^2} - 1}{e^{\sigma^2} - 1}} > 1. \tag{11}$$

Therefore, this example confirms the intuition that better information will result in higher relative-price volatility.[19] This may not be welfare-reducing if its only effect is to generate an economy operating under better information. However, if firms are debt-ridden (as is likely to be the case after a capital-inflow episode), then the resulting higher relative-price volatility may bring about financial difficulties, which could more than offset the beneficial effects of better information.[20]

IV. Sudden Stop Probability and Price Volatility: Empirical Evidence

In this section I will summarize the main empirical findings on the Sudden Stop phenomenon based on Calvo and Reinhart (2000a), Kaminsky and Reinhart (2001), Calvo, Izquierdo and Talvi (2004), Calvo, Izquierdo and Mejía (2004) and Calvo,

[19] In Calvo, Izquierdo and Loo-Kung (2005) a similar result is shown in the case in which θ is uniformly distributed. However, we have not been able to establish the generality of this result for arbitrary distribution functions.

[20] Notice that DLD is not a problem in the present context because firms are implicitly assumed to produce tradable goods.

Izquierdo and Loo-Kung (2006). In these papers we employ various definitions of Sudden Stop. However, much of the systematic empirical analysis defines Sudden Stop along the following lines:

- First, we define capital flows as of month *t*, as the accumulated capital flows in the previous *t* – 11 months.

- We say that there is a *Sudden Stop Episode* at month *t* if capital flows in month *t* are lower than its mean by more than 2 standard deviations, where mean and standard deviation are computed from prior history.

- We define a *Candidate Interval for Sudden Stop*, as a time interval that contains a Sudden Stop Episode, and for each month of the interval, capital flows are at least 1 standard deviation below the mean.

- Finally, we define a *Sudden Stop Interval* as a Candidate Interval for Sudden Stop in which, in addition, output falls (see Calvo, Izquierdo and Mejía (2004)) or there is at least 1 month in the interval in which the regional international interest-rate spread exceeds its mean by at least 2 standard deviations (see Calvo, Izquierdo and Loo-Kung (2006)).

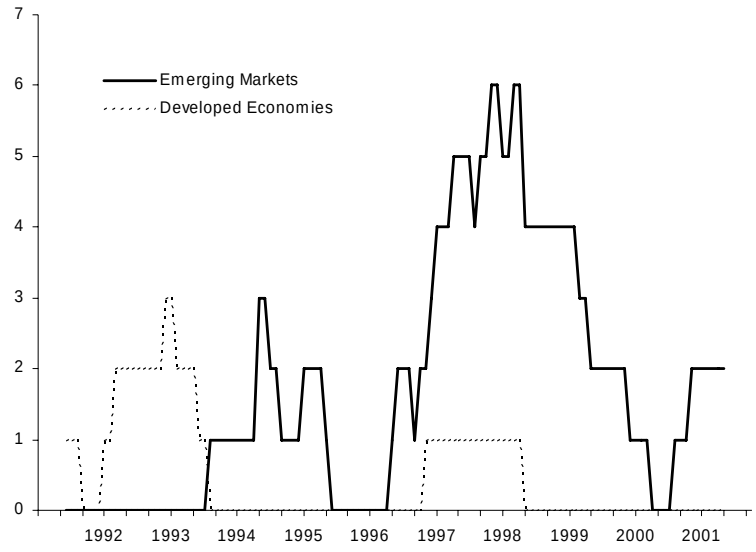
These definitions of Sudden Stop try to capture situations in which the contraction of capital flows has a large "surprise" element, and is either associated with an output fall[21] or takes place in an environment in which all EMs are undergoing financial stress.

[21] The output contraction condition was assumed in order to exclude cases in which capital flows drop as a result of large terms of trade improvement, a phenomenon that has no connection to capital market difficulties, which is the focus of our analysis. Criticism of this criterion led us to the alternative definition in which the requirement is that global capital markets for EMs show signs of trouble.

This definition is in line with the following setup. Sudden Stops stem mostly from a malfunctioning of the global capital market. A mishap in the latter leads investors to *test* all EMs. Thus, each EM is subject to an *Incipient Sudden Stop*. If the economy bounces back from this test, no (*Full-Fledged*) *Sudden Stop* takes place; otherwise, a Sudden Stop (Interval) will take place. As discussed in Section III, whether or not a Sudden Stop will occur is likely a function of domestic vulnerabilities. However, before turning to that issue, I would like to discuss two interesting features of Sudden Stops.

In the first place, Figure 5 shows that, for the case in which the definition of Sudden Stops requires output contraction, Sudden Stops tend to bunch together, especially in EMs. This suggests that there is a systemic element in Sudden Stops (which is one reason why we changed the definition in Calvo, Izquierdo and Loo-Kung (2006), and required that Sudden Stops have a systemic characteristic), reinforcing the conjecture that Sudden Stops could have external roots.

Figure 5. Bunching of Sudden Stop Episodes in Emerging Market Economies.



Source: Calvo, Izquierdo and Mejía (2004).

Second, as shown in Chart 1, more than 60 percent of large devaluations (which are typically associated with balance-of-payments, BOP, crises) in EMs are accompanied by a Sudden Stop, while for developed economies less than 20 percent exhibit that feature. This reveals a central difference between EMs and developed economies: BOP crises in EMs are more likely to be associated with a *credit crisis* than in developed economies. Thus, while purely monetary models like Krugman (1979) could be relevant for developed economies, Chart 1 suggests that for EMs one has to look deeper into the roots of credit disruptions.[22] An implication of these facts is that, while simple policy actions like currency devaluation could be very effective in restoring equilibrium for developed economies, they may be ineffective or even counterproductive in EMs.[23]

Chart 1. Sudden Stop and Large Currency Depreciation

In % of total

	Emerging Markets	Developed Economies
Devaluations associated with Sudden Stop	63	17
Of which: First Sudden Stop, then devaluation	42	9
First devaluation, then Sudden Stop	21	9
Devaluations not associated with Sudden Stop	37	83

Note: The total number of large devaluations is 19 in emerging markets and 23 in developed economies. Source: Calvo, Izquierdo and Mejía (2004).

Third, in Calvo, Izquierdo and Mejía (2004), and Calvo, Izquierdo and Loo-Kung (2006), we tested the hypothesis that the probability of a Sudden Stop increased with DLD (defined as local banks' foreign-exchange denominated loans as a share of GDP and current account deficit as a share of output of tradables (denoted by $1 - \omega$). The

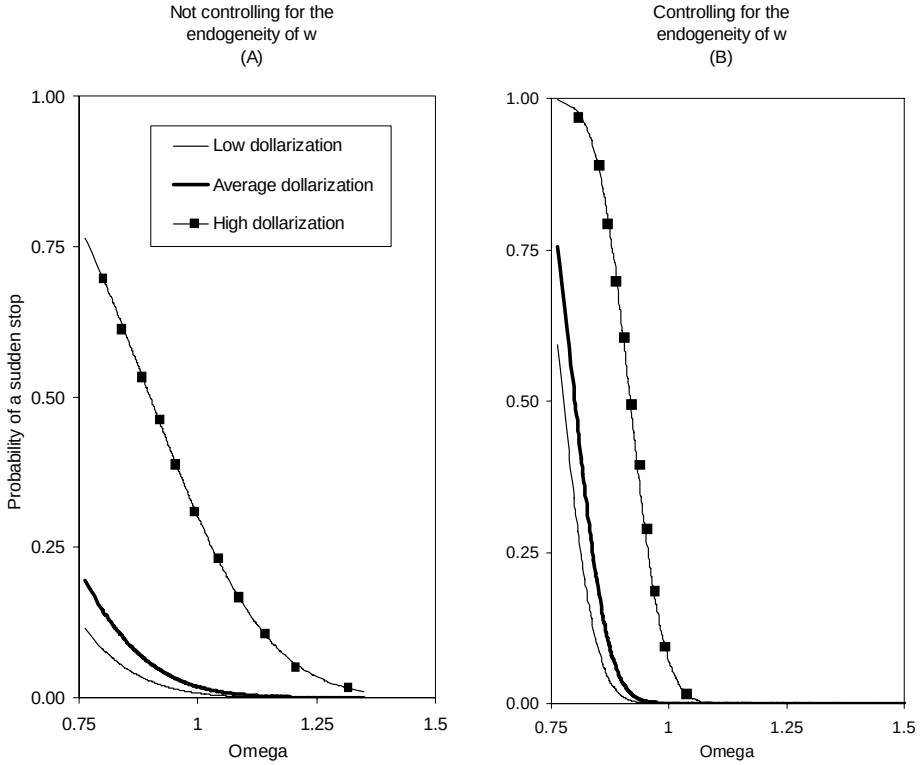
[22] This establishes a connection with Section III, since credit disruptions are at the heart of the theoretical framework discussed there.

rationale for these variables was discussed in the previous section. In all cases we find that DLD and ω are significant at conventional levels. Terms of Trade come out significant and with the right sign (i.e., negative) in some cases but, by far, not in all. Moreover, other a priori relevant macro variables like fiscal deficit and total debt are not significant. It is worth noting that in our interpretation this does not imply that the probability of a Sudden Stop is independent of past "bad" policy but, rather, that the *conditional* probability of a Sudden Stop may exclusively depend on DLD and ω. DLD, in particular, could reflect past monetary and fiscal mismanagement, driving individuals to protect themselves by adopting a more stable foreign currency. Once DLD is placed on the right-hand side of the estimation equation, however, past history becomes irrelevant.

Figure 6 is based on panel probit estimates in Calvo, Izquierdo and Mejía (2004). The left-hand side in Figure 6 corresponds to the standard random effects probit estimation, while the right-hand side corresponds to estimates that adjust for endogeneity à la Rivers and Vuong (1988). Clearly, the probability of Sudden Stop falls with 1 - ω and rises with DLD. It is worth noting that the probability of a Sudden Stop is highly sensitive to DLD values in the sample. This sensitivity is even greater when we adjust for endogeneity.

[23] This issue will be further discussed in the next section.

Figure 6. Probability of Sudden Stop.



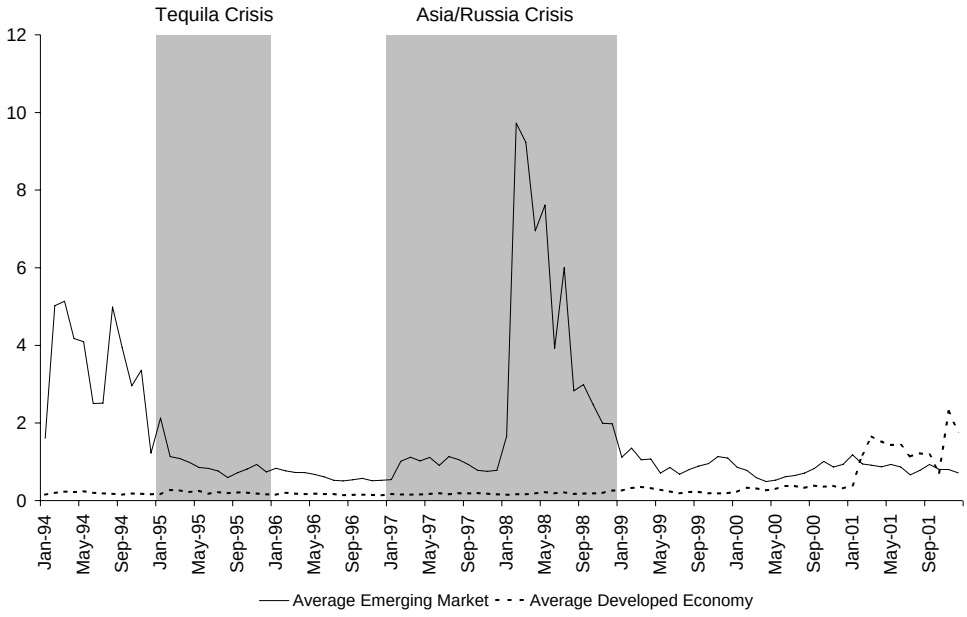
Source: Calvo, Izquierdo and Mejía (2004).

Relative-Price Volatility

Another issue worth exploring is volatility. The theoretical model in Section III suggests that volatility may change during Sudden Stops. That is precisely what we find in Calvo, Izquierdo and Loo-Kung (2006).[24] In our sample, the ratio of the variance of relative prices (measured by the ratio: Wholesale/Consumer prices indexes) is around 3 times larger during Sudden Stop than during Tranquil (i.e., non-Sudden Stop) periods for EMs, while for developed economies that ratio is around 2. This suggests that the variance of random shocks like θ in the model of Section III increases during a Sudden

Stop, possibly leading to further volatility and output costs as a result of firms' investment in information. Furthermore, Figure 7 shows that *conditional* volatility can also exhibit large changes, especially for EMs. Notice that the two big spikes there occur around the Tequila and Asia/Russia crises but, once again, the Asia/Russia crisis dominates the scene. In Calvo, Izquierdo and Loo-Kung (2006) we estimate ARCH models with DLD, 1 - ω, and a dummy for Sudden Stop as independent variables, given that arguments similar to those suggesting that they may have a role in determining expected changes in relative prices could be utilized to justify their possible effect on relative-price volatility.

Figure 7. WPI/CPI Conditional Variance for the Average Emerging and Developed economy.



Source: Own calculations based on estimations from Calvo, Izquierdo and Loo-Kung (2006).

[24] See also Kaminsky and Reinhart (2001).

Our conjecture was confirmed. We found that the coefficient for Sudden Stop and DLD are always significant (at conventional levels) and positive, showing that conditional relative-price volatility increases with DLD and during Sudden Stop. On the other hand, the significance of 1 - ω does not always hold, although it does so in a good number of cases, and its point estimate is always negative, i.e., relative-price conditional volatility is an increasing function of the current account deficit (as a share of output of tradables). Thus, variables that help to enhance the probability of a Sudden Stop also seem to contribute to higher relative-price volatility. Volatility is not necessarily a negative factor, especially if it reflects better information, but it could be dangerous in a context of, for example, high DLD.

In sum, econometric studies do not reject the hypothesis that Sudden Stops are largely prompted by external factors but, at the same time, strongly suggest that the probability of Sudden Stops reflects domestic characteristics. Moreover, Sudden Stops are periods of higher conditional volatility, which may cause financial disorder if contracts are not made state-conditional.

V. Policy Issues

The evidence discussed in Section II strongly suggests that EMs could be subject to external shocks that combined with domestic vulnerabilities, result in major crises. Moreover, the *Phoenix Miracle* reported at the end of that section suggests, in addition, that one may be dealing with *preventable accidents*. Therefore, one is left with the feeling that there must be room for policies and institutions that help to reduce the incidence of Sudden Stops and attenuate their consequences. In this section I will discuss

domestic and global policies that relate to the previous sections, although no attempt is made to provide comprehensive coverage of the many issues involved here.[25]

Domestic Policies

Sudden Stops happen in the best of families (see Calvo and Talvi (2005)). In order to avoid Sudden Stops and/or attenuate their effects, the empirical research summarized in Section IV suggests that it is essential to reduce financial vulnerabilities. Among them, it is particularly important to maintain low exposure to foreign-denominated debt, especially DLD. Since DLD involves the domestic payments system, financial crises under high DLD may entail serious systemic consequences. It should be noticed that these concerns involve both public and private sectors; this is so because experience shows that the government is likely to be called upon as lender of last resort if the private sector runs into financial trouble. Thus, for example, public debt in Korea was around 10 percent before the July 1997 crisis and quickly rose to about 40 percent as a result of the mechanisms put in place to ameliorate the effects of the crisis in the private sector. Contingent public debt is hard to control, precisely because government bailouts are effective instruments for attenuating the impact of financial crises. Thus, stern statements to the effect that the government will not be a lender of last resort will enjoy little credibility.

An alternative policy would be to discourage large private debt in terms of foreign exchange by levying a tax on total borrowing (not just international borrowing) denominated in foreign exchange. This is not easy to implement, however, and it may have a negative impact on growth.

[25] For a complementary policy discussion, see Calvo (2002) and Calvo and Talvi (2005).

Another way to discourage foreign-exchange-denominated borrowing is allowing the exchange rate to undergo large fluctuations. However, this policy is likely to result in a highly volatile *real* exchange rate, which may have negative effects on trade and output (see Calvo and Reinhart (2000b)). Moreover, if the economy initially exhibits large DLD, real exchange rate volatility may cause serious financial distress, as noted above. Incidentally, *forcing* de-dollarization has proven not to be very effective, since there are many examples where dollarization returns with a vengeance. On the other hand, spontaneous de-dollarization cases are few and far between (see Reinhart, Rogoff and Savastano (2003)). At present, however, a small window of opportunity may be opening up. The U.S. dollar, the currency of choice for denominating financial transactions in EMs (until now), is undergoing persistent devaluation vis-à-vis several currencies, including EM currencies. This appears to have increased the appetite of international investors for debts denominated in terms of EM currencies. Countries like Colombia, Mexico and Peru are taking advantage of the situation and issuing public debt denominated in their own currencies, which is being acquired by both domestic and foreign investors.

The previous discussion was heavily colored by my conjecture that global crises entail major financial difficulties that prevent the effective use of standard countercyclical monetary and fiscal policies. There are exceptions, though, and Chile in 1998 is possibly one of them. Chile was hit by the largest Sudden Stop in Latin America (equivalent to more than 7 percent of GDP; see Calvo and Talvi (2005), and Cowan and De Gregorio (2005)).[26] However, Chile did not display a high level of Liability

[26] Chile never lost access to credit markets. However, this is not incompatible with suffering an externally-driven Sudden Stop. To be sure, Chile's spread was low compared to the rest of Latin America. However,

Dollarization, its current account deficit (relative to output of tradables) was not large, and public debt was tiny. Why, then, did Chile experience such a large Sudden Stop? An interesting conjecture is that, in response to the 1998 Russian crisis shock wave, Chile chose the wrong policy mix, sending the wrong signal to the market. As this view goes, Chile, like every other EM, was tested by the markets after the Russian crisis. In response, Chile narrowed the exchange-rate band (the previously large headroom of the exchange rate was virtually eliminated) and sharply tightened monetary policy, sending interest rates to record-high levels. This policy response revealed to the market that the monetary authority was worried about balance-sheet currency-denomination mismatch (i.e., Liability Dollarization). This signal was wrong because Liability Dollarization was apparently a problem only for firms providing public services, involving multinationals who most likely would have been bailed out by their headquarters. Thus, this argument that that this type of policy could have put Chile, in the eyes of investors, in the same basket as Argentina and other Liability Dollarized economies—helping to explain the full-fledged Sudden Stop that followed. Expansive monetary and fiscal policy may have been a better policy response.[27]

It should be noted, however, that expansionary policy may be counterproductive if the government is also subject to Sudden Stop. Clearly, under those circumstances, lowering taxes or raising public expenditure is out of the question unless the government resorts to some kind of capital levy, like debt repudiation or a higher inflation tax. Although one can think of costless capital levies, in practice costs could be quite high.

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it increased by a factor of three in 1998 like the rest of the region. A large *relative* increase in interest rates could provoke sizable contraction in the value of loan collaterals, even though the increase is small in absolute terms. For a discussion of this and related topics, see Calvo and Talvi (2005).

[27] This view was put forward by my IADB colleague and frequent collaborator Alejandro Izquierdo.

Necessary conditions for a capital levy to be costless are that (1) it is largely unanticipated and (2) it does not seriously affect the credit or payments system. These conditions are unlikely to be satisfied in practice. Condition (1) generally does not hold, unless capital levies are *automatically* triggered by Sudden Stop.[28] On the other hand, condition (2) is also hard to satisfy in practice, as collateral constraints play a key role in credit markets.[29] Thus, capital levies would lower collateral values, bringing about a sudden contraction of bank loans, for example, unless the levy falls entirely on nonresidents. The latter is unlikely because bonds are subject to legal clauses that prevent unequal treatment of bondholders, thus making it difficult to discriminate in favor of domestic residents.[30]

Could lowering domestic interest rates help after a Sudden Stop that dries up credit to both private and public sectors? Under fixed exchange rates, lower interest rates are possible only if effective controls on capital outflows can be implemented (as in Malaysia in 1997). This is not easy, especially in economies in which there is a long history of capital flight: underground institutions and fake transactions (e.g., underinvoicing of exports) are quickly put in place. On the other hand, under floating exchange rates, the low-interest-rate policy may be helpful if price/wage downward inflexibility delays reaching "full employment" equilibrium. However, since easy money results in a large devaluation, such policy may wreak financial havoc in Liability

[28] Automatic mechanisms are interesting policy options but will not be explored in this paper.
[29] For a discussion in the context of EMs, see Caballero and Krishnamurthy (2002), and Izquierdo (2000).
[30] Moreover, it is hard to *know* who is a resident and, finally, even if that were possible and there were no clauses explicitly protecting bondholders from discrimination, the international financial institutions are much against unequal treatment of creditors in case of default (as recently revealed in the context of Argentina's debt-default negotiations).

Dollarized economies; or sharply raise inflationary expectations in economies that have a long history of high inflation.[31]

In closing this section, I would like to say a few words about *Full Dollarization*, i.e., the adoption of a foreign or regional currency for all financial and commercial transactions (except, possibly, for "small change" like the *balboa* in an otherwise fully dollarized economy like Panama). It is not an ideal system if the economy is subject to large fluctuations in relative prices and financial contracts are very rigid (e.g., non-state contingent). However, in economies *addicted to dollars*, to use the expression in Reinhart, Rogoff and Savastano (2003), Full Dollarization may dominate a system that stubbornly sticks to high Domestic Liability Dollarization. Moreover, Full Dollarization considerably lowers the complexity of macroeconomic assessment, given that an easily manipulable variable like the nominal exchange rate will no longer be subject to policy decisions (or, at least, the exchange rate would be much more difficult to manipulate because it would involve a radical change in the policy regime).[32]

Global Policies

The above discussion shows that EMs have a very limited set of policies for preventing Sudden Stops and attenuating their effects, especially when they originate in a malfunctioning of the global capital market. This prompts us to think about policies that are directly aimed at the global capital market. In Calvo (2002) I proposed the creation of an Emerging Market Fund (EMF) whose main activity would be to stabilize an EM bond price or spread index, like J. P. Morgan's EMBI, whenever it is judged that

[31] For a complementary discussion about domestic policies, including controls on capital inflows, see Calvo and Talvi (2005).
[32] See Calvo (2001) and Mendoza (2005).

the latter undergoes unduly large fluctuations. A motivation for the EMF was the large and persistent increase in the EMBI following the 1998 Russian crisis (see Figure 1). Russia traded little with the other EMs, and its output and debt were minuscule on a global scale. Therefore, its large impact on the EMBI was arguably evidence of shocks coming from the global capital market, as discussed in Section II. The two leading conjectures in this respect are that the large impact on the EMBI were due to: (1) margin calls triggered by the Russian crisis (a conjecture discussed in Sections II and III above), and (2) *Reverse Moral Hazard*, caused by Russia not being bailed out by the IMF. The latter may have sent a signal that other large EMs, like Brazil, would receive the same treatment—thus decreasing the expected return on EM bonds.[33] Whatever explanation one finds most persuasive, the point remains that the shock had a global origin.

Institutions like the EMF play the role of Lenders of Last Resort and would thus, be close relatives of national central banks. A salient characteristic of central banks is that they are able to relieve the symptoms at the source, which in this case is the global capital market, not the individual countries. Thus, it appears that something like the EMF is needed to attenuate globalization hazards. The question that naturally arises in this connection, however, is why the EMF would have better information than the capital market which, after all, is in the business of finding arbitrage opportunities. There are two types of answers to this question. The first one is institutional. The capital market is subject to regulations, such as collateral constraints, that prevent it from taking full advantage of arbitrage opportunities. Mendoza (2004) discusses a dynamic general equilibrium example along these lines. The second type of answer goes to the heart of

[33] I am not very enthusiastic about the Reverse Moral Hazard conjecture, because soon after the Russian crisis Brazil got a generous package from the IMF (in January 1999). However, it took several years for

how the capital market is supposed to operate, even if there were no institutional or principal-agent constraints. As noted in Grossman and Stiglitz (1980), for example, asset market prices convey information about other market participants' information, and the authors provide an example in which prices *costlessly* transmit *all* relevant information across the market. This is, of course, an extreme case, but it sharply illustrates the fact that market participants can benefit from costly information collected by others without having to pay for it. Thus, capital market information has features in common with *externalities* or *public goods* and, consequently, capital market information is likely to be undersupplied in equilibrium. This market failure implies that a Lender of Last Resort put in charge of collecting better EMs' information may result in a Pareto-enhancing equilibrium. Why, then, should there be an EMF and not just a Global Bureau of Economic Research (GBER) that freely provides information to the market? This is an important question, and a valid objection to setting up a Fund that may possibly result in large losses for the international community.[34] My favorite answer is that one advantage of the EMF over the GBER is that the former would "put its money where its mouth is," thus better aligning incentives with public pronouncements.[35] In addition, if market failure is partly due to institutional constraints, the EMF would help to relieve those constraints by infusing the market with a larger liquidity chest.

A word of caution is in order, however, as international arrangements like the EMF require full and *credible* support by the involved *sovereign* countries. This is not a

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the EMBI to get back to the levels prevailing prior to the Russian crisis. See Figure 1.

[34] Durdu and Mendoza (2005) examine the possible moral hazard implications of asset price guarantees, a close relative of the EMF. It should be noted, however, that the EMF is supposed to "lean against the wind" in order to lower contagion, not to give price guarantees. See Calvo (2002).

[35] In fact, experience at the IMF and other multilaterals shows that the information that these institutions make available to the public is heavily tinted by political opportunism. Do they put their money where

minor complication, and may represent an impassable roadblock. Nevertheless, even if the EMF and similar global financial institutions are not feasible at present, a thorough understanding of why and how these institutions would operate is useful, because we would be much better prepared to set them up when the time comes.

The discussion above was biased in favor of stabilizing and expanding the EM bond market. However, an entirely different conclusion emerges if Reverse Moral Hazard is seen as the main driving force behind the 1997/1998 events, particularly the Russian crisis. Reverse Moral Hazard implies that *too much* money was flowing to EMs. Thus, if anything, one should devise policies that make it more difficult for EMs to borrow in international markets. Interestingly, therefore, even though the margin call and Reverse Moral Hazard views both imply that external shocks are relevant, their policy implications are diametrically opposed. However, Reverse Moral Hazard is just one possible story of how the market read the news that the Fund left Russia twisting in the wind. Another interpretation is that, as the Fund jettisoned its role as Lender of Last Resort, the market became more apprehensive about lending to EMs. There is nothing optimal about this retrenchment if, on the basis of prior discussion, one concludes that informational/frictional considerations call for the existence of a Lender of Last Resort.

In summary, both domestic and global policies are called for to increase the stability of EMs while allowing them to reap the benefits of financial globalization. Success in this area would likely rely on improving both the domestic and global fronts. Traditional fiscal and monetary stabilization policies do not seem very effective and need to be complemented with structural policies that help to lower domestic financial

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their mouths are? Yes, but to a limited extent, because those institutions are senior creditors: they are supposed to be paid back before everyone else! This would not be the case with the EMF.

vulnerability, especially in economies suffering from a high incidence of foreign-exchange denominated domestic bank loans.

APPENDIX

I will derive equation (11) in the text. Variable θ is log-normally distributed with natural log mean μ and natural log standard deviation σ. Thus (see Maddala (1977)),

$$\overline{\theta} = e^{\mu+(1/2)\sigma^2}, \text{ and } \operatorname{var}\theta = e^{2\mu+\sigma^2}(e^{\sigma^2}-1). \tag{A1}$$

Moreover, it follows that θ^2 is log-normally distributed with natural log mean 2μ and natural log standard deviation 4σ. Thus,

$$\operatorname{var}\theta^2 = e^{4(\mu+\sigma^2)}(e^{4\sigma^2}-1). \tag{A2}$$

By equation (6) in the text and (A1), setting $r = 0$,

$$\operatorname{var} w^{NI} = \overline{\theta}^2 \operatorname{var}\theta = e^{4\mu+2\sigma^2}(e^{\sigma^2}-1). \tag{A3}$$

Moreover, from equation (9) in the text, and setting $r = 0$,

$$\operatorname{var} w^{FI} = \frac{1}{4}e^{4(\mu+\sigma^2)}(e^{4\sigma^2}-1). \tag{A4}$$

Equation (11) in the text follows from equation (10) in the text, (A3) and (A4).

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