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CAPITAL MARKETS AND THE EXCHANGE RATE

With Special Reference to the Dollarization Debate in Latin America

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I. Introduction

The central focus of this paper is the optimal choice of a foreign exchange system for Emerging Market economies, EMs, taking into account the conditions under which these countries operate, and that have been revealed to us as a byproduct of recent financial crises. I believe this discussion is necessary because there is a yawning gap between available theories and the concepts and issues that surfaced in the current policy debate. The risk of not subjecting this issue to professional analysis is that exceedingly bad and incomplete policy advice can pass for serious opinion. A shocking example is the emerging consensus that most EMs should adopt *flexible* exchange rates. You sense a spontaneous nod of approval as the issue is raised in policy circles, even though most of the time flexibility remains largely undefined. Thus, I am afraid that flexibility is becoming a code word for what we used to call "discretion."

I do not claim this paper will fill the gap between theory and practice. The issues involved are very complex, and cannot be dealt in a purely analytical fashion. They require, in addition, serious and massive empirical analysis, much of which is still missing. However, I will try to pull the two sides (i.e., theory and practice) closer together by, first, in Section II examining the "initial conditions" (a "where do we stand" exercise). Then, in Section III, I will take a cursory look at received theory and try to identify the lessons that are still valid, while at the same time pinpoint areas for future research. One key observation in Section II will be that several EMs are already partially dollarized, a fact that seems to escape flexibility devotees. In that respect, *liability dollarization*, i.e., sizable dollar-denominated debts, is especially worrisome, because exchange rate flexibility in that context could bring about massive bankruptcy. The theory and implications of liability dollarization are analyzed in Section IV. The objective is to gain a better

understanding of the phenomenon. Does it arise spontaneously, or is it a result of government policy (maybe dollarization of public debt, as the famous Mexican Tesobonos)? I find good reasons for both.

Section V analyzes an extreme case of fixing: full dollarization (i.e., adoption of a foreign currency for all transactions). This is followed in Section VI by a discussion of what many analysts think is the Achilles' heel of dollarization, namely, lack of a lender of last resort. The bottom line of the analysis in Sections V and VI is that although dollarization is a serious commitment that calls for hard preconditions to work, it could be advantageous once unsurmountable as one might have thought before taking into considerations the "initial conditions" which are relevant to many EMs are taken into account.

If dollarization is not good enough, then what? This is the topic of Section VII. The alternative is a system of flexible exchange rates. The analysis reiterates and expands on the issue that in practice flexibility is subject to narrow bounds, especially if credibility is at stake. Moreover, the section discusses Inflation Targeting, a system that is gaining the serious consideration of academics and policymakers worldwide.

The main thrust of the paper is that there are compelling reasons for EMs to stay away from exchange rate flexibility. Dollarization may be costly, but it may put the EMs on the fast track toward monetary and financial stability which, otherwise, may take years to achieve.

The paper is closed with conclusions in Section VIII. The more technical material is relegated to two Appendixes.

II. Initial Conditions: Financial Globalization and Partial Dollarization

This section will present evidence that EMs have been operating under sharply different

global financial conditions than those prevailing before 1989. The central conjecture is that the surge of capital flows to EMs partly resulted from new market structures and conditions, combined with imperfect policy and policymakers credibility. Moreover, these very structures could have set the stage for the ensuing financial turmoil that took place after 1994. Understanding these conditions is essential for the design of the optimal foreign exchange system. To organize the discussion, I will subdivide the discussion between external and domestic factors.

External Factors. The integration of EMs into the world (private) financial markets could be dated to 1989. Figure 1 shows a sharp increase in capital inflows to emerging markets around 1989, accompanied by an also sharp rise in net portfolio flows (especially to Latin America, see Figure 2, where Asia refers to countries in the region that recently underwent financial turmoil, except Japan). I would conjecture that these phenomena are linked to the development of the Brady bonds market, and the launching of a major US campaign to push open the Asian capital market.

The Brady bond market developed as a result of securitizing nonperforming sovereign debt. This meant taking debt entries in banks' books and placing them on the capital market to be traded. The amounts were significant (their market value was around US$ 25 billion in 1990 and reached almost US$ 100 billion in 1996/7). Trading fixed-income sovereigns requires knowledge about fundamentals such as macroeconomic performance, political trends and, especially, willingness to pay. This type of information is not easy to acquire but, once acquired, can be utilized to assess other securities emanating from the same country, because the return to private sector investment also depends on those variables. Thus, for instance, the imposition of controls on capital flows (as in Malaysia, recently) could drastically change a project's 'dollar' rate of

return.[1]

The above observation supports a key conjecture, namely, that issuers of Brady bonds opened up the market for other types of bonds and securities originating from their countries.[2] Moreover, if this view is accepted, other important implications follow. As noted, information about sovereigns' fundamentals is subject to (possibly large) economies of scale. Under those conditions, a likely capital market configuration is one in which there are just a few *specialists* (informed investors) surrounded by a sea of (mostly) uninformed investors. The latter, will be clients of the specialists, mimicking their behavior, or investing on the basis of their own priors, market rumors, etc., which do not involve the use of first-hand information.

This type of market structure is consistent with the models in Grossman and Stiglitz (1980), Gennotte and Leland (1990), Kodres and Pritsker (1998), Calvo and Mendoza (1998), and Calvo (1999 a). Under these circumstances, rational herding is possible and market prices could be highly sensitive to the actions of specialists. In particular, if specialists are subject to a liquidity crunch (as presumably was the case during the August 1998 Russian crisis, see Calvo (1998 a)), EMs security prices could collapse. Thus, as specialists are forced to download their positions in EMs securities (or, more simply, are unable to acquire the flow of securities coming from EMs to finance their current account deficits), uninformed investors mistakenly (but rationally) interpret it as a negative signal on those securities' expected return.

It could be claimed that in an advanced country like the U.S., domestic capital markets

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[1] In what follows the dollar will be identified with foreign exchange. Thus, "dollarization" stands for the adoption of a foreign currency, not necessarily the U.S. dollar.

[2] As shown in Figure 2, portfolio flows went mostly to Latin America. This supports the conjecture in the text, since Latin America is a major issuer of Brady Bonds.

also display the same asymmetric information feature. However, the U.S. is a dollar economy and, thus, the Fed has "unlimited" funds to prevent a serious collapse in stock market prices (because it can expand dollar liquidity without bound; see Section VI for further discussion on lender of last resort). This is less likely to happen in EMs because some of their domestic debt and virtually all of their external debt is denominated in foreign exchange (see next subsection for further discussion of this issue). To be true, the Fed eventually lowered interest rates, partially relieving the liquidity crunch after the Russian crisis, but this came only after the LTCM (Long Term Capital Management) scandal threatened to develop into a major U.S. market meltdown. Moreover, as Figure 3 illustrates, the share of official capital flows to EMs exhibited a sizable decline after 1989 (even during crises), which is another indication that the international safety net for EMs has considerably shrunk in size.

In sum, the above remarks support the view that the recent surge of capital flows to EMs was partly a result of better information about those countries, induced by external factors (e.g., the creation of the market for Brady bonds).[3] This came about in a context of asymmetric information that left ample room for rumors, contagion and mistakes. In contrast to capital markets in advanced economies, the global financial system lacks an effective safety net to prevent those phenomena from creating a major market meltdown and output loss (on the issue of output collapse, see Calvo (1998) where the link between financial turmoil and output collapse is discussed). Therefore, *the factors behind the strong surge in capital flows in the early 90s, may have created the conditions for the increased EMs' financial vulnerability in the second part of*

[3] Lower U.S. interest rates in the 1989-1993 period also appears to have played a key role, especially in Latin America. See, Calvo, Leiderman and Reinhart (1996).

the decade.

Domestic Factors: Credibility and Partial Dollarization. Financial globalization has not hit all EMs to the same degree. Africa, for example, has been largely spared (Calvo and Reinhart (1998)). Pull factors are, thus, also relevant. However, pull factors are not always beneficial. There is an extensive literature showing that under incomplete policy or policymakers' credibility, capital inflows could lower social welfare (see, e.g., Calvo (1986 and 1996)). This literature is especially relevant during periods in which EMs' access to capital markets shows a sizeable increase (due to lower international interest rates or better country-specific information). This is so, because no matter how well an EM was run in the past, the sudden access to substantial additional funds will likely raise serious questions about the policymakers' ability to handle the boom. These questions range from ability to keep fiscal discipline, to effectiveness of bank supervision, to maintenance of political stability. Assessment of those risks is not easy. For example, during a capital-inflow episode there is a surge in fiscal revenue (Talvi effect) and international reserves, helping to give a semblance of improved financial conditions. In most cases, economic advisors are unable to control the politician's drive to spend and, as a result, large fiscal deficits materialize when the capital-inflow episode comes to an end (see Talvi (1997)). Thus, as rational agents become aware that, eventually, present policies may have to be abandoned, they engage in intertemporal speculation which, as a general rule, have led to higher present private sector expenditure and current account deficit. These imbalances are unsustainable, because higher expenditure occurs as a reaction to perceived *policy* unsustainability

(or temporariness, see Calvo (1986)).[4]

I will now turn to discuss the phenomenon of *partial dollarization*. There exists a large number of EMs in which foreign-exchange-denominated deposits, FXDs, exceeds 30 percent of the total (IMF (1999)). In those countries bank loans are also heavily dollarized (a phenomenon that is associated with what I will call *Liability Dollarization*, LD, i.e., sizable dollar debts) due to the standard regulation that requires banks to match the currency denomination of their assets and liabilities in order to avoid currency risk.

LD has sprung into prominence since the recent financial crisis in Indonesia. On all accounts, Indonesia passed the traditional tests of sustainability (e.g., low current account and fiscal deficits, stable and not overappreciated currency, etc.) with flying colors. However, Indonesia's Achilles' heel was private sector exposure to short-term foreign-exchange-denominated debt. Since those loans were largely invested in nontradables, and exceeded the country's stock of international reserves, the inability to refinance them during the Asian crisis, faced Indonesia with a serious balance-of-payments problem. Why would firms expose themselves to bankruptcy by engaging in LD? This is a question that has scarcely received any attention in the literature (however, see Calvo (1999 b)). Some discussion about the issue will be provided in Section IV.

In summary, imperfect policy or policymakers' credibility could magnify the effect of external factors. I conjecture that the interaction between external factors and imperfect policy

[4] It should be noted, however, that for the mechanism of intertemporal substitution to operate, agents must feel that current policies will be maintained for a reasonable span of time. Thus the theory is not contradicted by the fact that capital has not flowed to some countries in which policymakers have no credibility at all.

and policymakers' credibility could help to explain a large share of the surge of capital flows to EMs in the early 1990s. In addition, domestic reforms that enjoyed less than full credibility–like several of the financial liberalizations that took place during the capital-inflow episode (e.g., Mexico)–may have exacerbated the 'pull' force (possibly at the expense of welfare). Finally, partial dollarization makes the economy more vulnerable to sharp changes in the real exchange rate.

III. Choosing a Foreign Exchange System: The Traditional Approach

The traditional approach follows Mundell (1961), and has recently been reviewed and summarized in De Grauwe (1994). Development of the theory has relied heavily on Poole (1970) (see, for instance, Flood and Marion (1982) and Aizenman and Frenkel (1985)). The main thrust of the theory can be captured by a simple example.

Consider the following equilibrium conditions:

$$y = \alpha e + g + u, \tag{1}$$

and,

$$m = y + v. \tag{2}$$

Equation (1) represents equilibrium in the output market (the IS curve), while (2) denotes equilibrium in the money market (the LM curve), where *y*, *e*, *g*, and *m*, denote the logs of output, nominal exchange rate, autonomous demand (a shift parameters which could be interpreted as government expenditure or external demand factors) and money supply, respectively. The domestic and foreign price levels are assumed constant for the time being, and equal to 0 (in logs).

Variables *u* and *v* are random shocks, and α is a positive constant. For simplicity, I will not explicitly model interest rates. Aggregate demand is represented on the right-hand-side of equation (1) and is an increasing function of the real exchange rate. Moreover, without loss of generality, the demand for money is assumed to be unit elastic with respect to output.

For the present purposes it is enough to focus on two polar cases: fixed and (pure) flexible exchange rates. Under fixed (which I will call Fix), *e* = constant, and *m* is determined by the market. Under flexible exchange rates (which I will call Flex), *m* = constant, and *e* is determined by the market.

Solving for *y* in equations (1) and (2), we get under Fix

$$\text{var } y = \text{var}(u + g), \text{and var } e = 0. \qquad \textbf{(3)}$$

Moreover, under Flex

$$\text{var } y = \text{var } v, \text{ and var } e = \frac{1}{\alpha^2}\text{var}(u + g + v). \qquad \textbf{(4)}$$

Following Poole (1970), this literature focuses on output volatility, var *y*. Therefore, abstracting momentarily from *g*, the following familiar proposition follows immediately: Fix is better (alt. worse) than Flex, if the volatility of nominal shocks (i.e., var *v*) is larger (alt. smaller) than the volatility of real shocks (i.e., var *u*).

This setup helps to rationalize the often-heard concern that Fix may not be attractive if the country to which the currency is pegged (the U.S., say) exhibits shocks which are "asymmetric" with respect to those suffered by the pegging country. Although the word "asymmetric" is usually loosely defined, the focus is on shock *u*, and by "asymmetric" it is meant to say that there is a

negative covariance between the *u*'s of the two countries. Let variable *g* in equation (1) capture the effect of U.S. policy. Moreover, let us assume that the U.S. engages in countercyclical policy (i.e., *g* is negatively correlated with U.S. *u* shock). Thus, under asymmetric shocks, cov(*g*, *u*) > 0. Clearly, by equation (3), the larger is the latter, the larger will be var *y* = var(*u* + *g*) under Fix.

Variable Rules and Time Inconsistency. Given that capital flows are volatile and involve both real and nominal shocks, policymakers guided by the above model are not likely to choose either one of the two extremes, Fix or Flex. The choice is likely to fall somewhere in the middle, *and depend very much on current circumstances*. One day nominal shocks will dominate, another day real shocks will, and yet another day both shocks will share the limelight. Therefore, I am afraid that the traditional approach–which, it is worth saying, has still a strong influence on the profession–will lead policymakers to adopt *a highly discretionary foreign exchange system*. This kind of system may work reasonably well in advanced economies (see Blinder (1999)). However, I cannot be hopeful about its effectiveness in EMs, since I suspect that a discretionary foreign exchange system (dirty float, managed float, etc.) is likely to lead to serious credibility problems for countries that have not yet reached a *national accord* on the size and nature of the public sector. Let me elaborate on this.

A typical problem of EMs is tax evasion, which keeps the size of the public sector below target, and results in a lopsided tax burden across individuals. This creates a tension, a *political* fiscal gap, which politicians promise to close when campaigning for office, and fail to fulfill when they get elected. This sows the seeds for time inconsistency, since when honesty fails trickery's charms are hard to resist. That is the reason why a foreign exchange system that is constantly changing course could make people think that politicians are adopting time-inconsistent strategies.

EM governments are fully aware of their credibility difficulties. As a result, few dare to exploit the advantage granted by discretion (although oftentimes a misplaced sense of survival makes them unwilling to give up that degree of freedom). Thus, in practice exchange rates are not allowed to vary much (and policymakers pay only lip service to the above analytical framework). So, EMs that opt for discretion and have not closed the political fiscal gap–or any other gap that might tempt its policymakers to adopt time-inconsistent strategies–end up in the worst of all worlds: rigid exchange rates and high interest rates (for evidence about the "fear of floating" in EMs, see Calvo and Reinhart (forthcoming)). Moreover, lack of clear-cut rules may make the whole system more vulnerable to rumors and contagion.

Volatility of the Real Exchange Rate. Why the exclusive focus on var *y*? Why not also take into account var *e*, the volatility of the real exchange rate? The nominal exchange rate in the present context entails a relative price which volatility has effects on sensitive areas of the economy like income distribution and poverty. Moreover, as pointed out in the previous section, unexpected relative price changes could have devastating financial effects, especially when they are large and lead to lower relative prices for indebted sectors.[5]

Ranking systems by var *e* yields very different answers. In the first place, Fix wins hands down. Second, recalling equation (4), shock asymmetry increases the volatility of the real exchange rate under Flex.

Price Indexation. I will now extend the model in a conventional manner, in order to take explicit account of the domestic price level, *p* (in logs). Then, equations (1) and (2) become

[5] Irving Fisher (1933) was one of the first (Keynes (1931) apparently preceded him) in identifying this problem, which he somewhat imprecisely called Debt Deflation.

$$y = \alpha(e - p) + g + u, \quad \textbf{(5)}$$

and,

$$m - p = y + v. \quad \textbf{(6)}$$

This setup can be used to examine the role of indexation. In the limit when prices are perfectly indexed to the exchange rate, i.e., $e = p$ + a constant, either exchange-rate system will yield the same output volatility. This suggests that economies exhibiting high pass-through coefficients like Mexico (see Carstens and Werner (1999)), adoption of Fix may not much increase output variability. On the other hand, under both Fix and Flex the volatility of the real exchange rate is zero. Thus, perfect indexation makes the traditional approach useless.

Endogenous Random Shocks. A major omission of this approach lies in the assumption that random shocks are exogenous to the foreign exchange regime. According to this approach, for example, Fix with low international reserves is equivalent to full dollarization, or the intermediate system Currency Board. In contrast, for instance, those who see the advantages of dollarization focus on the *endogeneity* of random shocks (see Calvo (1999 a and b), Hausmann et al (1999)). This endogeneity is supported by the discussion in Section II, where it was argued that recent crises reflect the existence of imperfect and asymmetric information. Thus, systems that lower the need for information (as a fully dollarized system would) could help to alleviate the information problem, and lower the incidence of contagion (which would be reflected in lower volatility of

random shocks *u* and *v* in the above analytical framework).[6]

IV. Liability Dollarization

This section will present a discussion on liability dollarization, LD, and the effect that LD may have in the event that the currency suffers a large devaluation.

Theory. Some progress has been made in Calvo and Guidotti (1990) (see also Calvo (1996) Chapter 12) for public debt and in the context of time inconsistency. Let the public debt be denominated in *pesos* (the local currency) and, for the sake of simplicity, let us assume that PPP prevails. Under these conditions, a devaluation lowers the real value of outstanding debt. This gives rise to time inconsistency because a welfare-maximizing government will be tempted to devalue more than what would be optimal to announce the previous period. However, if individuals are rational and fully understand this situation, they will not be taken by surprise: in a perfect-foresight context, the ex post real interest rate will equal the international interest rate, but inflation will be too high. One solution to this problem is to dollarize the public debt (which in this case is equivalent to indexing the debt to the price level). By removing the incentive to devalue, authorities could keep inflation at its ex ante optimal level.[7]

I was not able to extend Calvo-Guidotti approach in a straightforward manner to account for LD in the *private sector* (which, for the sake of this discussion, I will assume to be completely

[6] It is interesting to note that the traditional literature abstracts from credibility and financial considerations. For example, in the subject index of De Grauwe's (1994) compendium there is no entry under Finance or Banking.

[7] It should be noted that Calvo and Guidotti (1990) show that full LD may not be optimal if there are shocks to government expenditure (a result that could easily be extended to any real shock in the sense of the model of Section III), and the government cannot issue bonds contingent on those shocks. However, the point remains that time inconsistency is one possible explanation for government's LD.

atomistic). Risk-averse individuals whose income is in pesos will have an incentive to borrow in pesos, not in dollars, unless their peso income is highly correlated with the exchange rate (see Appendix A for further discussion). However, if the latter correlation is high, sharp devaluations under LD need not provoke serious financial difficulties. Since it is the connection between LD and financial difficulties that motivates this discussion, I conclude that one must look elsewhere for an explanation.

Consider the case in which external private sector peso debt is positive. Then, the government will have incentives to devalue giving rise to excessive inflation, as in the previous case. However, this does not necessarily lead the private sector to change its debt currency denomination to dollars. The reason is that the private sector is atomistic and, therefore, does not internalize the government's reaction function. Thus, again, the model falls short of target.

An alternative hypothesis is that domestic firms have better information about the exchange rate than foreign investors (especially those foreign investors not operating within the country's confines on a regular basis). Why would domestic residents have superior information? First, learning about the exchange rate is a costly exercise because it involves keeping a close tab on monetary policy and relevant random shocks in a relatively unstable institutional environment. The cost will be paid by those that have an opportunity to apply that knowledge to various ends. A firm that operates in an EM is a candidate to incur in those costs because it normally will be buying tradable goods and, if subject to foreign ownership, it will be sending profit remittances abroad. Besides, to the extent that there exists Currency Substitution, CS (i.e., domestic and foreign currencies concurrently being used for transactions purposes, see Calvo (1996, Chapter 8) and IMF (1999)), it is imperative to have good information about the exchange rate. Thus, for this

kind of firm, the exchange rate plays a central role in its regular decisions. In contrast, for the pure foreign investor who just buys bonds issued by the EM firm, there will be little use for exchange rate information, aside from helping to evaluate the dollar return on those bonds. Thus, devaluation expectations between the local firm and the foreign lenders may differ. If lenders expect a higher devaluation rate than borrowers, LD may occur, despite borrowers' risk aversion. However, if the difference of opinion went in the opposite direction, no LD will be exhibited (except for the cases discussed in Appendix A). So the theory, as it stands, gives an ambiguous answer.

A way to extend the theory and, at the same time, focus on a relevant issue is to assume that the economy suffers from a *peso problem* stemming, for example, from several past episodes of surprise devaluations (e.g., the *sexenio* phenomenon in Mexico). If we assume that domestic firms can better assess the timing of the devaluation than the uninformed foreign investors, then it may be optimal for the former to borrow in foreign exchange, giving the desired result. Incentives for LD would be further enhanced if the private sector expects that, when devaluation looms, it can refinance its dollar debts in pesos at "low" nominal interest rates (i.e., interest rates that are far lower than expected rates of devaluation). This happened in several recent crisis episodes as central banks tried to keep nominal interest rates from skyrocketing, and expanded domestic credit (Mexico 1994 is an example).

A more straightforward explanation for LD is Currency Substitution, CS. Several countries that have undergone CS have eventually allowed their banks to issue dollar deposits (e.g., Argentina, Bolivia, Peru), since allowing for dollar deposits lowers banks' vulnerability to changes in currency composition. Notice that, if dollar deposits are not allowed, a sudden

expansion in the demand for foreign currency–for instance, as a result of an increase in the expected rate of devaluation–may bring about a bank run, as individuals try to buy foreign exchange with bank deposits. In contrast, if dollar deposits are allowed, the change in currency composition can be carried out simply by modifying the denomination of bank deposits without altering its total.[8]

Under standard regulations, banks have to match the denomination of assets and liabilities. Therefore, if in equilibrium there is a stock of dollar deposits, banks will have to invest those sums in dollar assets. Assuming that domestic banks have a comparative advantage in assessing domestic borrowers, LD might develop. However, the interest-rate differential between peso and dollar loans may be less than the expected rate of devaluation. Otherwise, nontradable sectors might not be willing to borrow in dollars (see Appendix A).[9]

Finally, public sector LD may induce private sector LD. For example, consider a government that is subject to time-inconsistency problems and, as pointed out above, engages in LD. This lowers incentives to devalue, inducing the private sector to increase LD even more, further reducing devaluation incentives.

I conjecture that large private sector LD occurs in response to (1) government's actions that generate substantial CS (e.g., high inflation), (2) public debt dollarization, or (3) the

[8] This shift in the composition of deposits may still create banking problems if reserve requirements have to kept in the currency in which deposits are denominated. It is worth noting, incidentally, that Argentina solved this problem by allowing banks to hold reserves in either pesos or dollars. This was facilitated by the fact that there is a fixed parity between the two currencies.

[9] In addition, similar regulations prevent foreign-located institutions (e.g., banks) to lend in pesos. Thus, foreign borrowing would necessarily involve LD.

expectation of peso refinancing of private sector dollar debt at attractive interest rates.

Large Devaluation and LD. As a general rule, large devaluations are associated with balance-of-payments crises–i.e., situations in which the government runs out of international reserves, or reckons that it is waging a losing battle to stop the hemorrhage and stops the bleeding by letting the exchange rate go–containing a large *unanticipated* component (i.e., individuals are mostly taken by surprise by, at least, the timing of the devaluation). In addition, large devaluations are usually accompanied by sizeable *exchange-rate overshooting* (i.e., a *temporary* rise in the exchange rate, as in the recent crisis episodes in Brazil, Indonesia, Korea and Mexico).[10] If nontradable goods prices are sticky, large devaluations would bring about large changes in the real exchange rate. Thus, if the nontradable sector exhibits LD, the resulting deterioration of the relative price of nontradables could bring about serious financial difficulties.

Sizable real currency depreciation can occur even under perfect price flexibility. As noted, large devaluations tend to occur in a crisis context. In the brave new world discussed in Section II, an EM may undergo a Sudden Stop (of capital inflows) simply because some other EM ran into BOP difficulties. A Sudden Stop, in turn, lowers aggregate demand and depresses the relative price of nontradables (i.e., brings about a *real* currency depreciation). Thus, if the nontradables sector is exposed to LD, financial trouble could ensue (for a theory of Sudden Stops, see Calvo (1998 b)). Notice that these financial difficulties could take place even in the context of fixed exchange rates. However, the combination of Flex and CS (plus the imperfect capital mobility implied by Sudden Stop) could exacerbate the financial problems by provoking large nominal

[10] On the theory of exchange-rate overshooting, see the seminal paper by Dornbusch (1976) and Calvo (1996, Chapters 9 and 10). These papers show that overshooting can occur as a result of price stickiness, or currency substitution (in the context of imperfect capital mobility).

devaluation and further exchange-rate overshooting.

V. Dollarization: General Remarks

I will define dollarization or full dollarization as a situation in which a country abandons its own currency and adopts another country's currency (generically called the dollar) as a means of payment (except perhaps for small change, as in Panama) and unit of account.[11] It is an extreme case of Fix and, by its nature, is fully shielded from BOP crises. However, banking and financial sector crises are still possible. Thus, to the extent that banks' money is used as means of payment, a banking crisis could break the equivalence of bank money with dollar currency, and the economy will effectively operate under a two-currency system. This is one reason, incidentally, why a dollarized system may have to ensure mechanisms that mimic the operation of a "lender of last resort," LOLR.[12]

I will return to the LOLR issue in the next section. For the time being I would like to discuss the basic economics of a dollarized economy abstracting from banking difficulties. There are three positive features of a dollarized system that I would like to highlight: (1) credibility, (2) lower information costs, and (3) providing a cushion for sharp relative price changes (in comparison with flexible exchange rates).

Point (1) is less trivial than it may at first look. Obviously, a dollarized system is immune

[11] For a recent policy discussion on dollarization, with special reference to Argentina, see Hanke and Schuler (1999).

[12] According to Eichengreen (1998) during the Gold Standard period, LOLR capabilities were limited, and banks were forced to declare inconvertibility of bank deposits. Interestingly, this phenomenon operated as an automatic stabilizer, because gold flowed in as a result of the liquidity crunch provoked by deposit inconvertibility.

to devaluation, so 'exchange rate' credibility is ensured.[13] But, from a policy perspective, an economy is much like a "pressure cooker" in which if one valve is obstructed (a policy variable is set at a fixed level, for example), pressure increases on the other valves (i.e., the other policies), fiscal policy, for example. Thus, dollarization removes the ability to raise seigniorage but, if push comes to shove, the inflation tax can be substituted by a wealth tax or a tax on bank checks. The main difference, however, is *predictability*. Collecting the inflation tax in the context of Flex, for example, may generate high volatility, because the exchange rate is highly sensitive to expectations and is subject to overshooting. Thus, the effective tax *rate* may turn out to be highly volatile.[14] In contrast, the same average tax revenue could be collected through a tax on wealth. Wealth is a relatively stable variable and, therefore, the fiscal authority can collect the desired amounts by setting a very stable tax *rate*. To be true, wealth taxes could change in the future to finance higher government expenditure, introducing some degree of uncertainty, but under normal circumstances, the hand of the legislator is noticeably steadier than that of inflation or devaluation, especially when there is no firm exchange rate commitment on the part of the monetary authority. Part of the reason for this hand-steadiness is that, as a general rule, regular taxes have to go through Congress, entailing time-consuming political compromise.

Point (2), lowering information costs, has been discussed before. It acquires special

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[13] I am assuming that it would be very costly, if not impossible, to de-dollarize once dollarization has been adopted. Treaties with the U.S., for example, would be one way to make the system virtually impermeable to de-dollarization attempts.

[14] As a point of some theoretical interest, I would like to note, however, that there are cases in which exchange rate volatility is totally harmless (see Calvo and Guidotti (1993) or Calvo (1996) Chapter 2). However, my sense is that inflation or exchange rate volatility is highly undesirable in EMs, given the fragility of their financial markets, an issue that is not accounted for in the Calvo-Guidotti paper.

significance when combined with point (3)–cushioning relative price changes–because relative price changes are a major factor behind financial vulnerability in EMs.

On the negative side of the ledger for dollarization, an often-mentioned issue is the costs associated with nominal price and wage rigidities. Critics claim that these rigidities make unemployment more likely to happen and to exhibit a high degree of hysteresis. The situation gets worse under downward public sector price/wage inflexibility, because it becomes more costly for the private sector to lower its own prices. Moreover, inflexibility of public sector wages switches the burden of fiscal adjustment during recessions mostly to the taxpayer.[15]

However, the above difficulties can be partially offset by appropriate fiscal policy. For example, one can increase labor subsidies financed by a higher income tax, or impose uniform export subsidies and import tariffs (which mimics devaluation without affecting the dollar value of peso-denominated assets and liabilities). These are *cyclical* policies and, therefore, they must be phased out accordingly. Otherwise, they are bound to be counterproductive as they remove incentives for price and wage adjustment.[16]

Thus far, I have accepted without qualification the view that price/wage stickiness is an undesirable feature in a dollarized economy. However, this is not necessarily so. There is a silver lining to nominal stickiness and it is related to financial considerations. With price/wage flexibility a shock that requires downward nominal adjustment will take place very quickly,

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[15] Argentina attempted to lower public sector wages in response to the Tequila crisis, but the decision was overturned by the labor courts. Moreover, some privatizations guarantee the dollar-equivalent price charged by utility enterprises.

[16] This represents a major practical difficulty for the implementation of this type of fiscal policy because tariffs and subsidies lead to the formation of lobbies that make their eventual removal politically hard to achieve.

implying that *nominal* profits will fall. This may generate financial difficulties to firms that have taken the typically rigid (non state contingent) loans. In contrast, if prices/wages are somewhat sticky, the nominal adjustment will be slower which, on that account, facilitates debt repayment. Of course, the final effect has to take into consideration the greater output contraction that price/wage rigidity may bring about. However, slow nominal adjustment may facilitate a more orderly debt recontracting. Moreover, in economies that undergo Keynesian-type recession, a rise in unemployment helps to give a clear signal that financial problems are not specific to a given firm. As a consequence, banks may become more willing to refinance loans under more lenient or longer-maturity terms.[17] At this juncture, however, it is no longer possible to ignore the role of LOLR (i.e., lender of last resort). Without it, a Keynesian-type recession may trigger fears of financial collapse, making it hard for banks to refinance debt in an orderly fashion as suggested above.

VI. Lender of Last Resort

First let me dispose of a common red herring. It is sometimes said that a dollarized economy lacks a LOLR because it cannot print its own money. This is false. A LOLR has just to be able to lend. In advanced countries, the LOLR does not issue money to finance the operation, it issues bonds, public debt. This may be more difficult to achieve for an EM but what this suggests is that EMs may have to engage in more LOLR planning than advanced economies.

[17] Banks have to solve a signal-extraction problem when faced with a nonperforming loan. Is the borrower a deadbeat, or a casualty of recession and macroeconomic malfunctioning? The rise of unemployment–a variable that is easily observable, in contrast to nonperforming loans in the banking sector, which banks keep hidden from the public's eye–leads banks to put more weight on the possibility that the borrower is an innocent bystander. One can think of several reasonable models in which unemployment makes banks more reluctant to sue the delinquent borrower and more willing to offer better terms on nonperforming loans.

Credit lines, for instance, may have to be negotiated in advance (the recent IMF CCL points in that direction). In addition, EMs will likely have to muster a relatively large stock of international reserves. All of this adds to the cost of running a dollarized system. But those costs should not be overdone, because under these conditions, restoring the powers of a LOLR via the printing press is also costly. If the central bank can freely turn the wheels of the money-printing machine, a Damocles' Sword will hang on the economy every time there is a slight suspicion that the LOLR is preparing for action. And the Sword is, of course, an inflationary explosion. Therefore, as soon as suspicion arises about the health of the banking system, interest rates will sharply rise, further weakening the banking system.

I will now turn to two strategies for enhancing LOLR capabilities. The first strategy has been proposed by Argentina and it involves the sharing of revenue from seigniorage, or "seigniorage sharing," for short. The second has been utilized by Panama–a country that has successfully operated under dollarization since 1904, see Chapman (1999)–and consists of relying on a banking system which is deeply integrated with the international financial centers.

Seigniorage Sharing. To present the central idea in simple terms, let me assume a scenario in which there is a constant demand for real monetary balances, PPP holds, there is no international inflation (international prices are normalized to unity), and the initial exchange rate is equal to 1. Let M stand for initial stock of high-powered money (i.e., monetary base). Dollarization in this context involves a swap of M for dollars D, such that $M = D$. Obviously, to be able to perform the dollar-for-peso swap, the government has either to possess those funds or to be able to borrow them. In both cases, however, there is a fiscal loss equivalent to the rate of interest on own or borrowed reserves. For the sake of simplicity, I will assume that the relevant interest rate is the

same, irrespective of whether reserves are owned or borrowed, and is constant over time. I will denote it by *r*. Thus, the fiscal cost of the swap would be *rD* per unit of time. However, the dollarizing country's loss is exactly matched by the U.S. gain, because the *D*-for-*M* currency swap involved in dollarization, implies an increase in the demand for dollar bills equal to *D*, which the U.S. Treasury can use to retire public debt and, thus, save *rD* dollars per unit of time. Dollarization is, thus, a fiscal boon for the U.S. Consequently, there is room for bargaining. In exchange for the EM dollarization, the U.S. could, for instance, make a stock transfer to the dollarizing country equal to θD, where $0 < \theta < 1$. Under these circumstances, the U.S. Treasury still gains a positive amount from the operation, and the dollarizing country saves θrD, per unit of time. Equally important, the dollarizing country now has an additional stock of international liquidity θD, which can be stashed away for LOLR operations.[18] In the case of Mexico, gross international reserves are around US$ 30 billion, while $M \cong$ US$ 20 billion. Thus, there are enough resources to conduct the swap without any further borrowing and–making the plausible assumption that Mexico and the U.S. share revenue from seigniorage on an equal basis–Mexico could set in place a LOLR fund of US$ 20 billion (representing about 20 percent of M2).

A problem with seigniorage sharing is that it likely requires Congress approval because it cannot be simply handled as an open market operation by the Fed. If the dollarizing country went ahead with the swap unilaterally, for example, there would be nothing to negotiate with the U.S. Negotiations have to take place *before* the currency swap. Another difficulty is that this

[18] For Argentina, a country that operates under a Currency Board, seigniorage sharing is especially attractive because, at present, *D* is held to back up the monetary base, while after dollarization and seigniorage sharing, θD would be available to support banks through LOLR operations.

arrangement is beneficial to the U.S. *if the dollarizing country does not revert to using its own or some other country's money* (e.g., the Euro). For that reason it may not be in U.S. best interest to transfer the stock θD in the above example. An alternative mechanism that addresses the incentive-compatibility problem is for the U.S. to commit to making a *flow* transfer θrD, conditional on the continued use of dollars as the national currency. There is an additional complication, though. Authorities of the dollarizing country could commit to keeping the dollar as the national currency, but cannot easily prevent individuals from switching to the Euro, for example. Thus, to implement the flow transfer requires close monitoring of the demand for dollar bills in the dollarizing country, calling for the development of and entirely new set of statistics which are likely to be costly to collect. Furthermore, since flow transfers are subject to market-driven de-dollarization risks, the present value of those flows may be considerably lower than θD.

International Banking. This is Panama's system. In Panama, banks are subject to minimal reserve requirements and there no institution in charge of LOLR operations. Seemingly, the de facto LOLR has been a large American bank (see Chapman (1999)). The country has suffered no tremors from Tequila and other recent financial crises.[19]

The presence of international banks–i.e., subsidiaries of world-class banking houses–allow local branches to draw liquidity from the head office in case of need. Therefore, it is hard to imagine that a system entirely composed of those types of banks could not successfully withstand a bank run. Actually, Latin America has been moving in that direction. Economies in which the international presence is large have suffered no bank runs since the Tequila crisis. In Argentina,

[19] Admittedly, the financial system in Panama went through a wrenching period during Noriega's war with the U.S., but it is hard to imagine any other currency arrangement that would not have creaked under those conditions.

for example, bank deposits have continued to grow even though the economy is going through its deepest postwar recessions. It should be pointed out, however, that elimination of bank runs does not shield the economy from Sudden Stops (of capital inflows). In fact, international banks in Latin America (except Panama) have been pro-cyclical (i.e., expanding credit during booms and contracting it during recessions).

However, we have to be careful and refrain from mechanically extrapolating this behavior to the future. International banks still have a short history in Latin America (again, with the notable exception of Panama where banks appear to have been countercyclical, see Chapman (1999)).[20] Therefore, their knowledge of the region is still limited, which, as argued above, is conducive to herding and seemingly irrational behavior. This situation may well change in the future as international banks become more knowledgeable about local conditions. Moreover, in several of these countries public banks–which are typically subject to political pressure–still represent a large share of the local financial market, and show the largest share of nonperforming loans. This suggests that the pro-cyclicality of international banks could partly be a reaction to unsound anti-cyclicality of state-owned banks.

VII. The Dollarization Debate: Summary and Realistic Alternatives

The opening of the capital market for EMs has brought about new complications for macroeconomic management. The paper has argued that at the heart of this problem may lie imperfect information, inexperience in handling suddenly larger capital inflows, flaky political equilibrium, etc., which lead to seriously questioning the credibility of policy and policymakers.

[20] It would be interesting to check if international banks' behavior in Panama became less pro-cyclical over time (abstracting from the Noriega crisis).

In some cases, this situation resulted in partial dollarization and, most worrisome, in liability dollarization. This is the background from which, I believe, any useful discussion of dollarization in EMs should start.

Against this background, it is not obvious that greater *policy* flexibility is a sound idea. While flexibility is welcome in a context in which policymakers can make credible policy announcements, it could magnify distortions otherwise. Not surprisingly, then, even though several EMs have opted for more flexible exchange rates, in practice their exchange rates are closely managed. In addition, since imperfect credibility detracts from the effectiveness of open market operations, EMs that opt for exchange rate flexibility usually carry (or aim to carry) a large stock of international reserves. In this fashion, if juggling with the domestic interest rate to stabilize the exchange rate proves ineffective, the monetary authorities can always intervene by 'issuing' advanced-country securities (e.g., U.S. Treasury Bills), i.e., running down international reserves.

Therefore, dollarization has to be compared, not with the textbook paradigm of pure floating (Flex as I called it in Section III), but with a closely managed flexible-rates system, in which explicit, implicit, or potential foreign exchange intervention play a central role. Thus, the range of realistic possibilities is not huge. The paper argues that the larger the degree of liability dollarization and lack of credibility, the greater will be the attractiveness of dollarization. On the other hand, the more adamant are nominal rigidities, the more attractive will be to have some degree of exchange rate flexibility.[21]

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[21] The Optimal Currency Area literature suggests that fixed exchange rates could still be attractive despite nominal rigidities if there is enough factor (especially labor) mobility across countries or regions (De Grauwe (1994)). However, factor mobility cannot realistically be a very

In the previous discussion, however, I took for granted the traditional open-economy model with tradables and nontradables. In that context, the exchange rate is a very powerful instrument because it can help to avoid exchange rate misalignment (again, assuming that the country has enough reserves to place the exchange rate where it wants it to be, and that exchange rate indexation is low). This 'nominal' solution to a real problem works only under price stickiness. However, it is worth recalling (theorist: pay attention) that we do not live in a world with a single nontradable good. Thus, if price stickiness is a relevant issue, we are bound to encounter misalignment in several directions. Not just between tradables and nontradables, but between, say, nontradables No. 173 and No. 18112. In other words, the exchange rate is not good enough to take care of misalignment across the prices of nontradables goods. This is obvious (although systematically forgotten). More interesting is the following question: If the exchange rate will be managed to minimize misalignment, which sectors will be privileged by the policymaker? The urban or the rural, skilled workers or unskilled workers, etc.? These are never easy issues for a politician, especially in EMs subject to the above-mentioned political fiscal gaps.

Inflation Targeting. This is badly defined monetary system that has caught the fancy of politicians and some academic economists (see Bernanke et al (1999)). In Latin America, Chile has taken the lead years ago, followed, more recently, by Brazil and Colombia (or so it seems at the time of writing). Inflation targeting is equivalent to pegging the currency to a basket of goods. If the basket is composed of tradable goods, inflation targeting is essentially equivalent to fixed

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relevant issue, because exchange rate flexibility helps to deal with high-frequency imbalances, while labor mobility decisions are dictated by relatively low frequency considerations. Even in the U.S. it is hard to imagine that labor will move massively across States in response to a temporary real wage disparity, making exchange rate flexibility totally unnecessary.

exchange rates. Naturally, if a basket containing nontradables is targeted, then the exchange rate will be flexible–or, more precisely, it will move. A very common conceptual error, however, is to identify inflation targeting with flexible exchange rates. True, the exchange rate is flexible, but the situation is very far from the Flex case discussed in Section III. And it is very different from the exchange-rate flexibility envisaged by the Optimal Currency Area literature (see De Grauwe (1994)). Moreover, pegging to a basket does not shield the economy from large fluctuations in the real exchange rate, or insulate the EM from U.S. monetary policy, for example. As shown in Appendix B, inflation targeting is also subject to distortions generated by imperfect credibility, much like it happens under not-fully-credible pegged exchange rates.

A possible advantage of inflation targeting (assuming that the target rate is positive or zero) is that it prevents *deflation* of the basket's price index, which, as a general rule, includes nontradable goods. Thus, under price stickiness, this policy may give rise to a smaller rate of Keynesian-type unemployment.[22] However, compared to dollarization, this advantage could be minimal in countries exhibiting a high pass-through coefficient (as seems to be the case in Mexico).[23] Moreover, inflation targeting does not shield the economy from sharp relative-price changes, like a collapse in real-estate prices and, thus, may give rise to major financial difficulties.

The credibility problem under inflation targeting may be quite serious because authorities are allowed to use a whole battery of instruments to achieve their inflation objectives. Since instruments come first and inflation later, the public will have to infer whether authorities are

[22] As argued above, however, unemployment may have a silver lining in terms of improved information.

[23] Reader be warned: pass-through coefficients could be endogenous to monetary policy.

committed to the targets from the instruments they utilize. Thus, I am afraid that this will add a new reason for "fear of floating." Exchange rates are easily observable variables and a devaluation is usually taken as a harbinger of higher inflation. As a result, fear of floating is likely to be exhibited, especially during periods of global financial turmoil (e.g., Chile narrowed the exchange-rate band right after the Russian default in August 1998). Since high-frequency changes in fiscal policy are hard to implement, the instrument of choice (or, *instrument of last resort*) will likely be the interest rate.

This discussion leads me to conjecture that, under normal circumstances, credibility-riddled EMs that adopt inflation targeting are likely to place a lot of weight on interest-rate policy and exchange rate stability. These two policies are, in principle, inconsistent unless there are controls on capital mobility, like in Chile (presently discontinued). But controls on capital mobility have been shown, by and large, to be ineffective in changing aggregate flows (see @). They can at best be claimed to have an effect on maturity composition of capital inflows (see @). Thus, this somewhat tortuous policy mix (inflation targeting cum controls on capital mobility) may have the desired effects only in the short run. Eventually, inflation targets may have to be changed or, at least, momentarily broken–enhancing the persistence of the credibility problems.

VIII. Conclusions

The paper highlights the importance of credibility issues for the design of optimal macroeconomic policy in EMs, particularly for the choice of the foreign exchange regime. Credibility is a highly country-specific characteristic. A credible policymaker can steer the economy by a subtle turn of phrase (witness Alan Greenspan), and change the course of policy at midway without creating confusion. In contrast, a non credible policymaker may have to tie himself firmly to the mast to get any results. In my opinion, most policymakers in Latin America are, unfortunately, of the second type because they are faced with what the paper calls "a political fiscal gap." This explains why without strong monetary commitments, interest rates remain high and highly volatile (actually, orders of magnitude higher than in the U.S., for example).

In addition, the paper argues that the subtle arithmetic of the traditional approach for the choice of the optimal exchange rate system could still be useful, but it ignores key relevant features for EMs. In particular, it assumes that random shocks are independent of the foreign exchange regime, and the institutions that support them. Moreover, there is scant or no reference to the role of the financial sector and currency substitution or liability dollarization, and most of the papers take policy credibility for granted.

When those missing aspects are incorporated into the analysis, totally different implications arise. Thus, dollarization, an extreme form of fixed exchange rates, begins to look as a plausible choice. True, dollarized systems must meet stringent conditions, but they hold the promise of putting EMs on a fast track to much greater policy credibility.

Appendix A: Notes on the Microeconomics of Liability Dollarization

I will conduct the analysis in terms of a mean-variance framework. The objective is to study incentives for LD when the price faced by the firm is not highly correlated with the exchange rate, because it is under those conditions that a sharp change in the exchange rate can provoke serious financial disruption.

Consider a risk-averse firm. Peso Revenue (net of operating costs), accruing "next" period, is proportional to its price P, in pesos. The firm has a stock of debt $B > 0$ in pesos which has to be refinanced today. The problem is to choose between exchange rate indexation, or no indexation at all. Without indexation, next-period peso profit will be

$$\beta P - (1+i)B, \ \beta > 0, \qquad \textbf{(A1)}$$

where i is the one-period peso interest rate. On the other hand, if debt is denominated in dollars, peso profit will be

$$\beta P - XB, \ \beta > 0, \qquad \textbf{(A2)}$$

where the present exchange rate is set equal to unity, X denotes next-period peso-dollar exchange rate and, without loss of generality, I assume that the international dollar interest rate is zero.

Since the country is small, it is reasonable to assume that lenders are risk neutral (in dollars).[24] Therefore, at equilibrium

[24] Departure from risk neutrality by lenders may contribute to LD because lenders would welcome the opportunity of risk diversification provided by peso loans. However, I believe that the information and time-inconsistency arguments in the text ought to play a bigger role for LD. Thus, the risk-neutrality case emphasized here appears to be a useful benchmark for the discussion in the text, irrespective of its factual accuracy.

$$\mathcal{E}\frac{1+i}{X}=1, \tag{A3}$$

where $\mathcal{E}$ denotes the mathematical expectation operator conditional on present information.

By Jensen's Inequality,

$$\mathcal{E}\frac{1}{X}\geq\frac{1}{\mathcal{E}X}, \tag{A4}$$

with strict inequality is *X* displays any volatility. Thus, by (A3) and (A4),

$$1+i\leq\mathcal{E}X. \tag{A5}$$

Therefore, by (A1), (A2) and (A5), expected profit is smaller under LD. The ranking of variances is ambiguous if *P* and *X* are positively correlated. In all other cases LD displays higher variance. Therefore, for LD to dominate, the correlation between *P* and *X* must be sufficiently high.

The situation is somewhat different if the dollar is also the relevant unit of account for the domestic firm.[25] Under those circumstances, expressions (A1) and (A2) become, respectively,

$$\beta\frac{P}{X}-\frac{1+i}{X}B, \tag{A6}$$

and

$$\beta\frac{P}{X}-B. \tag{A7}$$

Clearly, by (A3), (A6) and (A7), expected dollar profit is the same in the two cases.

[25] The reader should recall that the unit of account matters in incomplete-markets models like the one we are discussing here.

Unfortunately, I could not obtain general analytical results for ranking profit variances, but examination of two polar cases makes me confident that in this case also adoption of LD requires sufficiently high correlation between X and P. First, suppose P is nonstochastic (hence, the correlation between P and X is zero). Thus, if expected profit and i are positive (the normal case), then profit variance is larger under LD. Second, suppose P is proportional to X (hence, the correlation between P and X is one). Thus, LD exhibits the lowest profit variance.

To check intuition and to get some sense for the conditions under which LD dominates, I used Mathcad random number generators under the assumption that $P = \theta X$, where $0 \leq \theta \leq 1$ is the pass-through coefficient. Figure 4 shows results for 10000 trials in the case in which X is 1 + exponentially distributed variable, where the exponent is set equal to 0.1. In the simulation, the equilibrium interest rate $i = 0.093$. Variables *peso*(θ) and *dollar*(θ) are the profit variances for peso and dollar loans, respectively, when the pass-through coefficient is equal to θ. Clearly, peso loans dominate dollar loans for most θs, except for very high θ (more specifically, $\theta > 0.935$). All cases examined shared this feature, i.e., LD dominates only for very high pass-through coefficients.

Appendix B: Inflation Targeting and Credibility Problems

In this section I will show that inflation targeting under imperfect credibility could produce distortionary effects similar to those encountered in non-fully-credible fixed exchange rate regimes. The model utilized follows closely on Calvo (1986).

To simplify, I will assume a representative (price-taker) individual whose utility function from the perspective of time 0 (identified as "the present") satisfies:

$$\int_0^\infty [u(c_t) + v(z_t)]e^{-\rho t}dt, \qquad \textbf{(B1)}$$

where *c* and *z* stand for consumption of tradable and nontradable goods, respectively, and ρ is a positive subjective discount rate. Instant utility indexes *u* and *v* are increasing, strictly concave and twice-continuously differentiable.

The individual is subject to a cash-in-advance constraint

$$m_t = c_t + p_t z_t, \qquad \textbf{(B2)}$$

where *p* is the relative price of nontradables with respect to tradables, and *m* is the stock of money held by the individual expressed in terms of tradables. The assumption behind (B2) is that individuals are constrained to hold monetary balances for their planned consumption.[26] In what follows, I will assume that the international price of tradables is constant and equal to unity. Therefore, *m* also stands for the ratio of nominal money balances to the exchange rate (the foreign

[26] This constraint has a more natural interpretation in discrete time, but its use in continuous time makes the analysis more elegant without distorting the implications of the model.

exchange market is totally free and there are no controls on capital mobility). Moreover, the total number of individuals is normalized to one and, hence, individual variables also stand for their corresponding aggregates.

Following Calvo (1986), the representative individual's budget constraint can be written as follows:

$$\int_0^\infty [y + p_t h + g_t - (c_t + p_t z_t)(1+i_t)]e^{-rt}dt = 0, \qquad \textbf{(B3)}$$

where, to save on notation, I assume that initial financial wealth is zero, and y, h, g, r, and i stand for endowment flow of tradables and nontradables (assumed constant, for simplicity), government lump-sum transfers, and the instantaneous international and nominal interest rates, respectively. For simplicity and to stay away from uninteresting dynamics, the international interest rate r is assumed constant through time and equal to the subjective rate of discount ρ.

Maximization of utility (B1) subject to budget constraint (B3) with respect to the paths of c and z, yields the following familiar first-order conditions (interior solutions are assumed throughout):

$$u'(c_t) = \lambda(1+i_t), \qquad \textbf{(B4)}$$

and

$$v'(z_t) = \lambda p_t(1+i_t), \qquad \textbf{(B5)}$$

where λ is the time-invariant Lagrange multiplier.

Suppose the government targets the price level P (identified with the price of nontradables in terms of domestic currency), such that $P_t = 1$, for all times t.[27]

Given the assumption of perfect capital mobility, we get

$$i_t = r + \frac{\dot{E}_t}{E_t}, \qquad \textbf{(B6)}$$

where E is the nominal exchange rate (i.e., the price of foreign in term of domestic currency). Under these circumstances, one can show that along a perfect-foresight equilibrium E is not expected to jump after $t = 0$. It can also be shown that differentiability of E also holds on open intervals where the target is fully credible.

At equilibrium, we have, for all t,

$$z_t = h. \qquad \textbf{(B7)}$$

Thus, by (B4), (B5) and (B7), we have

$$p_t = \frac{v'(h)}{u'(c_t)}, \qquad \textbf{(B8)}$$

and, moreover, by (B5), (B6), and (B7), on open intervals where the target is credible, we have (recalling that $p = P/E$, and that target $P = 1$)

[27] Alternatively, one could assume that authorities only set a target for the rate of inflation (zero in this case). To anchor the system, however, one would have to make some assumption about initial money supply. The results are unchanged, and I chose the present formulation for its directness.

$$i_t = \frac{\dot{E}_t}{E_t} + r = v'(h)\frac{E_t}{\lambda} - 1. \qquad \textbf{(B9)}$$

This defines an ordinary differential equation for *E*.

Assuming that the government's consumption is nil and that revenue from seigniorage is given back to the public as lump-sum transfers, the overall budget constraint takes the following form:

$$\int_0^{\infty} c_t e^{-rt} dt = \frac{y}{r}. \qquad \textbf{(B10)}$$

In words, equation (B10) simply states that present discounted value of the economy's consumption of tradables must be equal to the present discounted value of the endowment flow of tradables (recall that the economy is assumed to start with no initial financial wealth).

The steady state of equation (B9) is unstable. Hence, if the target is credible at all points in time, equilibrium nominal exchange rate *E* must be constant over time, implying that $p \equiv 1/E$ is constant through time. Thus, by (B8) and (B10), at equilibrium $c_t = y$, for all *t*.

Consider now the standard paradigm of non-credible targeting in which individuals expect that the target will be satisfied for an initial interval, but that it will be followed by higher inflation afterwards. More precisely, I will assume that individuals expect

$$\begin{aligned} &P_t = 1, \text{ for } 0 \le t < T, \text{and} \\ &\frac{\dot{M}_t}{M_t} = \mu, \text{ a positive constant, for } t \ge T, \end{aligned} \qquad \textbf{(B11)}$$

where M is nominal monetary balances and the credibility horizon $T > 0$. To anchor the system, I will assume that M is continuous with respect to t at $t = T$, which rules out a jump of M at T.

By (B2) and (B7), we have

$$M_t = E_t c_t + P_t h. \tag{B12}$$

Question: Can the price level P jump at T, in spite of the nominal exchange rate E and money supply M being continuous at T? I will show that the answer is "no". Suppose, for instance, that P jumps up at T, then since M and E are continuous, c has to jump down, contradicting (B8). The contradiction is intuitive because when P jumps up, nontradable goods become more expensive, and satisfaction of (B12) would require that the individual consumes *less* tradable goods, while keeping constant the consumption of nontradables.

Furthermore, one can show that from T on, the rate of inflation is constant and equal to μ (the proof is omitted). Therefore, recalling (B6),

$$i_t = r + \mu, \text{for all } t \geq T. \tag{B13}$$

Continuity of P implies that equation (B9) holds at T. Hence, by (B9) and (B13), initial conditions in (B9) must be such that i converges to $r + \mu$ at T. Furthermore, by (B9), it is easy to see that there exists a unique E_0/λ that ensures that condition, and that E will rise over the credibility interval $[0,T)$. Since over that period P is constant, equilibrium condition (B8) implies that the consumption of tradables will be falling over time. For this to be consistent with the overall budget constraint (B10), there must exist some t_0, such that $0 < t_0 < T$, and

$$c_t > y, 0 < t_0, \text{ and}$$
$$c_t < y, t > t_0. \qquad \textbf{(B14)}$$

As in Calvo (1986), one can show that this consumption fluctuation is not optimal. Moreover, compared to the full-credibility case in which $c \equiv y$, the currency exhibits real appreciation in the first stages of the program (more specifically, on the interval $[0,t_0)$), and depreciation beyond t_0. Finally, it can be shown that there will be a current account deficit over all the interval $[0,T)$.

Consequently, non credible inflation-target programs may suffer from much the same maladies that afflict non-credible currency pegs. Moreover, readers familiar with the earlier literature will notice that non credible inflation target programs give rise to richer consumption and real exchange rate dynamics than non credible currency pegs.

It will be interesting to study the implications of imperfect credibility in richer scenarios displaying price stickiness, for example, and also to get a better sense of the costs of non-credible inflation-target programs compared to non credible currency pegs (Michael Kumhof is working on these issues).

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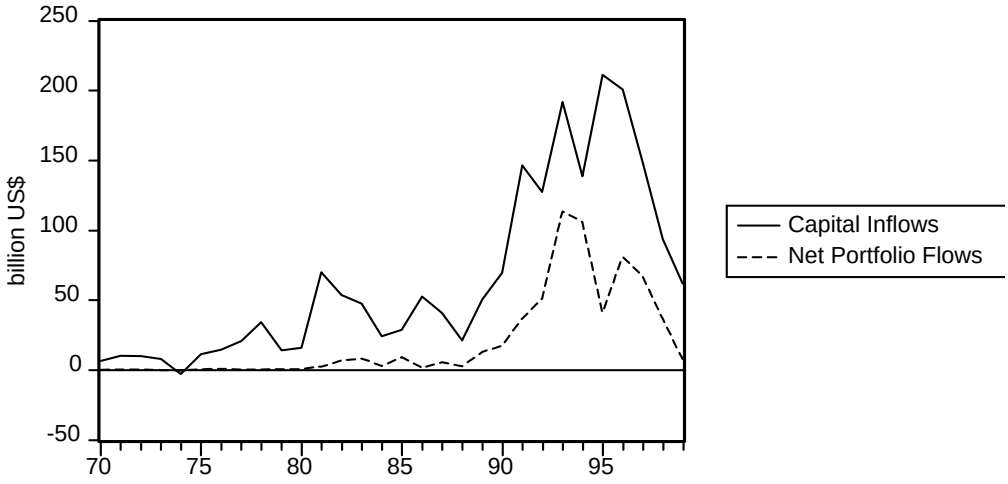
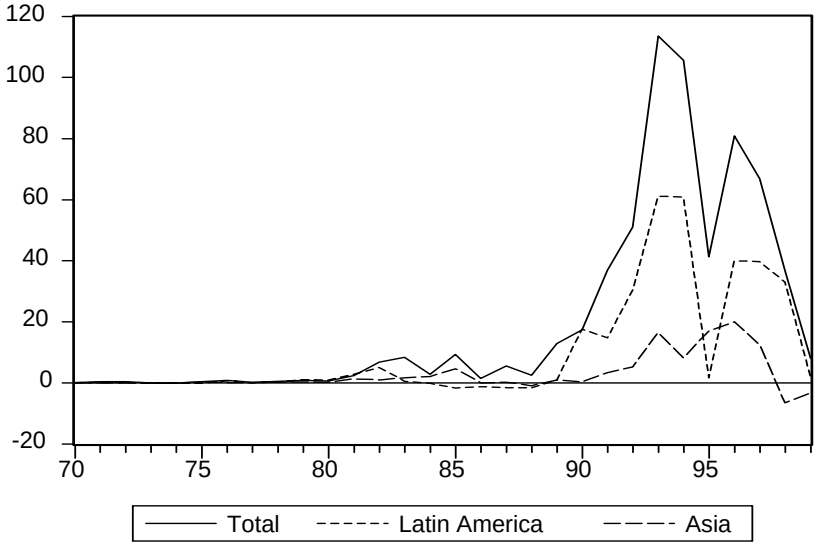
Figure 1. Capital Flows to Emerging Markets



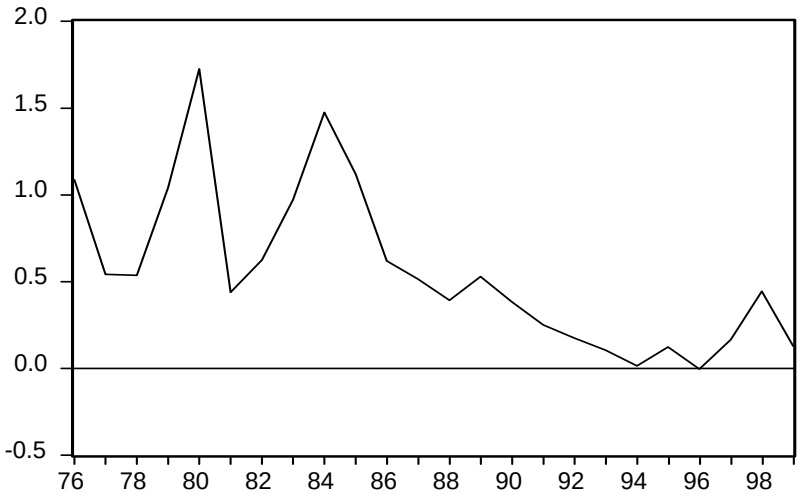
Source: IMF, World Economic Outlook, April 1999.

Figure 2. Portfolio Flows to EMs



Source: IMF, World Economic Outlook, April 1999

Figure 3. Share of Official Capital in Total Flows to Emerging Markets



Source: IMF, World Economic Outlook, April 1999

Figure 4. Profit Variance (exponential distribution)