

DOLLARIZATION OF ASSETS AND LIABILITIES: PROBLEM OR SOLUTION? THE CASE OF BOLIVIA*

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ABSTRACT

Financial dollarization in Bolivia is near complete (over 90% of total deposits and loans). The paper gives an inventory of the problems caused by *de facto* dollarization to actual policy making. The phenomenon has deep roots and was engendered by high inflation that reached hyperinflationary proportions in the first half of the 1980s. Yet, controlling inflation has not been sufficient to reverse dollarization. Despite the declining trend of inflation since 1985, dollarization has increased. The policy of the Central Bank of Bolivia of increasing the rate of crawl of the exchange rate, in a crawling peg system, to deal with exogenous shocks, while inflation was relatively unstable even if low, may be an explanatory factor. However, the data seem to support the view that the lingering *peso problem* was more important. Indeed, the reduction in the pace of dollarization is still waiting for clearer signals that low inflation is to stay. Also, the liquidation policies of failing banks, policies that are currency-blind, and the lender-of-last-resort functions of the central bank, have further pushed dollarization. With dollarization, even partial, the nature of the central bank changes in fundamental ways and is reduced to a large extent to the role of liquidity insurer in dollars to the banking system, losing more traditional functions. Also credit crunches and the implosion of the financial system are more likely in a (partially) dollarized economy. The gradual reduction of dollarization- through market-friendly mechanisms- would produce gains in total welfare by allowing a more independent monetary policy (and a more flexible exchange rate) to cope with exogenous shocks and to reduce the vulnerabilities of banks.

Clasificación JEL: E59, F31, F41

Keywords: dollarization, exchange rate regimes, real exchange rates, inflation

1. INTRODUCTION

The purpose of this paper is to present the experience of a highly dollarized economy, from the viewpoint of a policy maker. There is a growing literature (see *inter alia* the paper of De Nicoló, Ize and Honohan (2003) and the references therein, and the book by Levy Yeyati and Sturzenegger (2003a), providing a mix of highbrow theory and careful empirical work, to which I will refer on occasion. The paper is not on theory, nor is it a comparative study on the causes and effects of dollarization, but rather an inventory of the problems caused by *de facto* dollarization to actual policy making, without ignoring its benefits, which can be substantial.

I refer mainly to my Bolivian experience. According to the data set of De Nicolo, Honohan and Ize (2003), Bolivia ranked second in year 2001 in terms of the ratio of foreign currency deposits to total deposits. Only Cambodia had a higher rate among the partially dollarized countries. I would like to place the *caveat* that I believe that dollarization is path dependent and country specific in its extent and shape. Initial conditions do matter.

Dollarization has a long history in Bolivia and has deep roots, which can be traced to the aftermath of the Chaco War (1932-1936). Although inflation was moderate most of the time, there were some short outbursts of very high and variable inflation. Since 1985, after a noxious hyperinflation was controlled, inflation has followed a declining trend. In the past five years, the Bolivian inflation was only slightly above the United States' inflation. Despite the declining trend of inflation, dollarization increased, an outcome observed elsewhere. It remains however true that dollarization was engendered by high inflation, and that de-dollarization is still waiting for clearer signals that low inflation is to stay.

There is real, payments, and financial dollarization in Bolivia. It is very widespread in the three forms but it is partial. While real dollarization is limited, the dollarization of assets and liabilities of the financial system is close to complete (over 90% of total deposits and loans).

Dollarization received a push with the increasing dependency of Bolivia on foreign savings, that started in the 1960's. Dollarization was part and parcel of globalization. Moreover, after the end of the dramatic

hyperinflation of 1982-1985, it is fair to assume that the reconstitution of the financial sector would have been impossible without the recourse to dollars.

Over time a dual monetary system emerged, and the central bank had the illusion that it could conduct a monetary policy in domestic currency as well as in dollars, with the standard instruments and the standard IMF type of monetary programming. Only after a while did we realize the modesty of our results.

The cohabitation of two monies was accepted by the public and no major problem seemed to be posed by dollarization, except the loss of seigniorage, that after a hyperinflation was going to be small anyway or very slow to reconstruct.

When the crisis hit the region around 1998, and our neighbors started to devalue rapidly, the bi-monetary architecture started to show its weakness. It is important to note that the shocks were idiosyncratic to the region. The central bank responded to the shocks by increasing the rate of crawl of the Bolivian exchange rate peg. This presumably increased the default risk of the loans granted by the banks to non-traded sectors of the economy. The question is open whether the more active crawl was the right policy and whether this policy was not contractionary, given the high indebtedness in dollars of the non-traded sector.

The policy of maintaining a stable RER in face of exogenous shocks through the crawling peg probably increased dollarization as predicted by the Ize-Levy Yeyati (1998) model of minimum variance portfolio (henceforth the ILY model). We believe however that the lingering peso problem had more importance, and the data seem to show this. This, together with the liquidation policies, that are currency-blind, and the lender-of-last-resort functions of the central bank, as shown in a more general context by Broda and Levy-Yeyati (2003a), further promoted dollarization.

Dollarization, even partial, changes the nature of the central bank in fundamental ways. The central bank is reduced to the role of liquidity insurer in dollars to the banking system and keeping its financing of the government's deficit (and the deficit itself) under control. Its stated goal of price stability will depend more on the fiscal situation and the soundness of the banks, than of its own actions. In most states, monetary policy

cannot be employed as a shock absorber and to stabilize output and employment.

Credit crunches are more likely in a (partially) dollarized economy, than in an economy with more monetary autonomy. Since exchange rate devaluations lower the dollar value of non-traded collateral and increase the risks of default of dollarized loans, banks reduce their lending. Also, in times of financial stress, banks hold to their liquid assets in dollars and there is a high liquidity premium. In the current recession, dollarization is among the causes of the implosion of the financial system. In addition, maintaining high levels of international reserves is costly both to central bank and the banks.

If partial dollarization is the cause of the problem, then why not resort to a full dollarization? Many problems will not disappear with full dollarization and new problems, related mainly, but not exclusively, to long term international competitiveness, would appear. The move would be, at best, risky. Then, why not go to the other extreme, to strict inflation targeting? We argue in the text that this solution is not realistic and probably riskier than full dollarization. Then, what is left? The tentative answer is a middle of the road solution, consisting of a gradual reduction of dollarization, through market-friendly mechanisms.

Given the dramatic experience with forced de-dollarization in the early 1980's, any increased use of domestic currency has to be fully voluntary. A difficult fine-tuning of policy measures and announcements needs to take place. Doubts on the integrity of the current bi-monetary arrangement, that heavily favors dollar holders, may scare depositors. Yet, given that the situation is of unstable equilibrium, changes of sufficient impact are required. The problem is then of both timeliness and sequencing.

The public has to perceive that there are gains in total welfare with a more independent monetary policy (and a more flexible exchange rate). Yet, a full recognition has to be given to the fact that domestic currencies cannot easily compete in terms of quality and scope of services with solid, internationally accepted currencies. The most important point is that de-dollarization requires a credible commitment to maintain inflation low, not only now but in the future, even the distant future. Actual and expected inflation have to be very low.

The paper is organized as follows. In section 2 we review the origins of dollarization, by highlighting the main economic developments of Bolivian history, and based on this case study, some conclusions are suggested. Section 3 is devoted to the examination of the alternative (or rather, complementary) hypothesis of the presence of a peso problem and of different volatilities between inflation and the RER. Section 4 examines with more detail public policies, as a major factor behind dollarization. Section 5 highlights the diminished role of central banks in dollarized economies and how they stand with regard to the objectives set for modern central banking. In section 6 the issue of the benefits and costs of going either to full dollarization or to a fully flexible exchange rate (the bipolar option) is examined. Section 7 proposes concluding remarks.

2. THE ORIGINS OF DOLLARIZATION

The common thread in the dollarization of the economies, real and financial, is the legacy of distrust in their domestic currencies, because of prolonged periods of high and unstable inflations. The perception remains that the same forces that continuously led to the depreciation of exchange rates, also pushed prices up. For a vast majority of the public, inflation and depreciation of the currency are synonymous.¹

The origin of dollarization in Bolivia can be traced back to the abandonment of the convertibility to gold for domestic transactions in the early 1930's, and to the Chaco War against our neighbor Paraguay.² After controlling the high inflation of the 1950's (more than 100 % per year), dollarization continued with even more impetus, notwithstanding that during the whole decade of the sixties, inflation was low.³ As early as then, virtually all long-term contracts, loans and others, were agreed in dollars. The increasing dependence of Bolivia on foreign savings, either under the form of loans from the international development banks, or foreign direct investment was another factor. The loans were contracted in dollars and had to be serviced in the same currency; the same was true for profit remittances of the

¹ Despite the fact that, in the context of both recession and depreciating currencies in our trade partners, the pass-through effects to inflation from bilateral depreciation of the domestic currency vis-à-vis the dollar have been greatly reduced.

² Méndez (1987) gives data on dollarized deposits since 1940. The data show a spike in dollarized deposits after the high inflation of the 1950's ended, and immediately after the Bolivian hyperinflation of 1985 was over.

³ For a short overview of the Bolivian economy between 1952 and 1986, see Sachs and Morales (1998).

multinational companies. This form of opening the economy to foreign capital became a major explanatory factor of dollarization.

In the seventies, inflation increased again. Then wealthy Bolivians did not limit themselves to hoarding dollar bills and pricing big items, like houses and cars in dollars as they did before, and begun to open accounts off-shore. To impede capital flight and to attract back the off-shore deposits of Bolivians, the government allowed banks in the mid seventies to offer time-deposits. They rapidly took off as Bolivians switched their domestic currency deposits to domestic dollar deposits. Also, some repatriation took place. Deposit dollarization increased, and this was coincidental, and not independent of, a rapid accumulation of public external debt. By the mid-1970's, payments, financial and real dollarization were already important.

In November 1982, after the international debt crisis had started, the government took the unwise and dramatic decision to de-dollarize all financial contracts, forcing moreover the conversion of dollarized assets to domestic currency-denominated assets, at an exchange rate lower than the free-market rate. Simultaneously, it imposed foreign exchange controls. These decisions in the eve of accelerating inflation produced huge transfers of wealth and income from creditors to debtors. Private savings were wiped out and the financial system shrunk to a dismally small size.

The exchange controls led to a black market for dollars, with incredible high premia. Forced de-dollarization, in turn, sent underground the operations in dollars, that despite the prohibition continued on, frequently undertaken by the domestic banks themselves, that created off-shore branches to continue working in foreign currency.

The shrinking of financial intermediation had very negative consequences on real GDP. In addition to these visible real effects, the opposition parties blamed de-dollarization as a direct cause of the hyperinflation that afflicted Bolivia in 1984-1985. This accusation cannot be justified on economic grounds, but we must acknowledge that de-dollarization caused high real costs. In addition, since de-dollarization affected the rich and the middle classes, their press and the opinion-makers related to them, as well as the opposition parties of that time, took due care of presenting de-dollarization itself, and not only the forced conversion of dollars to domestic currency at an unfair rate, as a confiscatory measure (as indeed it was). As important, the public resented not being allowed to operate freely with a trusted money or, in other words, not having an anchor. Afterwards, the slightest hint at de-

dollarization would evoke tremors in the population that translated into capital flight.

The hyperinflation was controlled by end-1985 with a drastic, orthodox, stabilization plan. Exchange rate unification was central to the success of the stabilization plan.⁴ To reconstruct the financial system, deposits in dollars and onlending them in the domestic market were allowed again. The banking system and, beyond, the whole financial system, is now almost completely dollarized. It is observed in figure 1 that loan dollarization has a smoother trend than deposit dollarization, probably because banks financed part of their loans by borrowing abroad. Also in 1992, the crucial, but largely unnoticed, decision was taken to allow banks to settle their dollar positions in the books of the central bank.

Re-dollarization returned after 1985 with a vengeance; no restriction, however small, to the right to possess dollarized assets and to move freely and at no cost between dollars and the domestic currency was politically admitted.⁵ Operations in dollars, on both sides of the balance sheet of the banks, rapidly increased during the 1990's, as shown in figure 1.

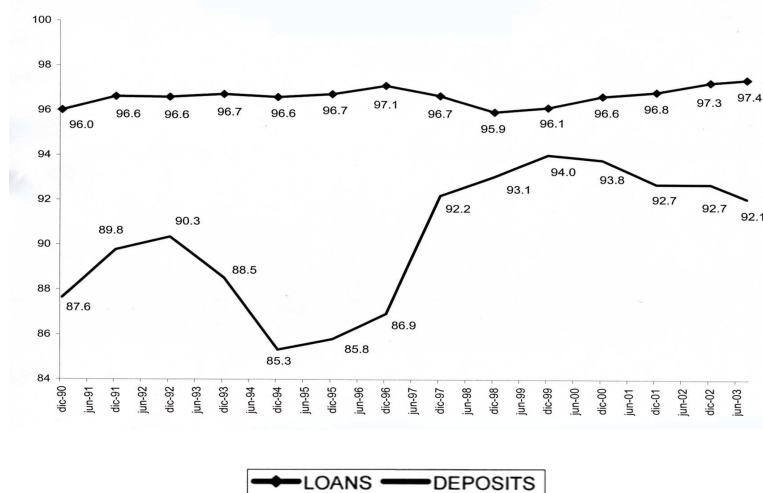
In the aftermath of the stabilization plan, when there was a dire need of international reserves, there were no minimum reserve requirements for dollar or dollar-indexed deposits. Regulations on open foreign exchange positions were issued at the same time, but with ample tolerance granted for positions of excess assets over liabilities in dollars.⁶

⁴ The Bolivian hyperinflation has received considerable attention. See e.g., Sachs (1987), Morales (1987), Morales (1988a), Morales (1988b).

⁵ For instance, the technical measure taken by the central bank in October 2002, to widen the bid/ask spread for the exchange rate of its own operations from 2 cents of Boliviano to 6 cents (a change of about half a cent of a dollar) met such a strong opposition in the public, that the measure had to be reverted.

⁶ Technically: oversold positions in dollars.

Figure 1
Domestic dollarized deposits and loans as percent
of total deposits and total loans 1990-August 2003



As a consequence of the actions taken, not only financial dollarization took off with great impulse, but a whole monetary system in dollars developed. Claims in dollars were created inside Bolivia very extensively. Banks received deposits in dollars from residents in Bolivia and borrowed abroad, always in US currency. More important for our purposes, they onlent the dollars received, more often than not, to firms in the non-tradable sector and to households.

On a closer look, the monetary system in local dollars is a “hard peg” system, with an irrevocable parity, except in the case of collapse. The local dollars are backed with dollars held abroad as international reserves by the central bank and by the banks, and under the form of notes held in their vaults. The vision of a hard peg acquires further relevance when it is realized that only a fraction of the dollar denominated deposits is covered by the (consolidated) foreign exchange reserves of the central bank and of the banking system. The uncovered dollarized deposits are “local dollars” or “inside money”. Table 1 gives some estimates of the money multipliers. The

narrow money multipliers (m1) do not seem large; on the other hand the broad money multipliers (m3) are indeed important.⁷

Table 1
Monetary base in U\$ and money multipliers

Year	Base	FE M1 U\$m	FE M3 U\$m	Multipliers	
				m1	M3
1990	215	160	810	0.7417	3.7586
1995	428	527	2,308	1.2303	5.3913
1997	635	729	3,683	1.1487	5.8050
1999	650	675	3,917	1.0382	6.0278
2001	686	773	3,862	1.1270	5.6333
2002	634	777	3,432	1.2267	5.4163

Monetary base = Cash reserves at the central bank and in vault + liquid assets abroad to meet central bank reserve requirements + estimate of currency in U\$.

Deposits in the Bolivian banking system exhibit a high degree of concentration, reflecting the very uneven distribution of income and wealth. This concentration of wealth, income and deposits may be another explanatory factor of dollarization and the low demand for financial instruments indexed to prices. The financial savings of the rich are in dollars to protect their consumption levels.⁸

In incipient banking systems like the Bolivian one, loans are frequently collateralized by real estate. While real estate is a non tradable asset, it has however been priced in dollars for decades. So we can make the conjecture that this form of previous real dollarization paved the way for financial dollarization.⁹

The government developed a market for its domestic debt. Practically all government paper is issued in dollars, except for very short maturities. Note

⁷ M3 is largely constituted by time deposits, which are not used for transaction purposes; hence, financial dollarization may be analytically separated from the features of a monetary system in dollars. The causes and effects may be different, although the implications of this disentanglement are not very important.

⁸ Dollarization of deposits goes now well beyond the rich. The quasi-banks (saving and loans associations and credit unions) and the micro-finance institutions are the most dollarized institutions in the country, while their customers are mostly street vendors, small traders and family-owned, small-scale enterprises, heavily exposed to foreign exchange risk. Why this dollarization? A tentative answer lies in that they bet on their political power.

⁹ Real estate prices, that should be affected by real depreciation, have shown significant downward rigidity, with the results varying across cities.

that on the asset side of their balance sheet, banks have, by and large, credits lent to non-tradable sectors, collateralized with non-tradable assets, and government paper.

This rapid overview of Bolivian economic and monetary history allows us to draw some conclusions: 1) the public has always sought a monetary anchor, preferably from abroad, because of the lack of credibility of the domestic institutions; 2) Bolivia confirms very clearly the finding of De Nicoló, Honohan and Ize (2001), that dollarization is more likely to appear in countries having suffered high inflation, as a way to make progress in inflation stabilization and as a rational response to weak monetary policies; 3) that inflationary environments are very destructive of financial systems, and that their reconstruction, once inflation ends, requires a credible money like dollars; 4) that financial dollarization and the development of a monetary system in (local) dollars are intertwined; 5) that globalization and the access to foreign savings needed for the development of the country could not (and cannot) be done in local currency, and; 6) that forced de-dollarization, especially when undertaken, as is likely to be the case, in a context of high inflation, only destroys financial intermediation but does not de-dollarize the economy.

3. VOLATILITIES OR PESO PROBLEM

Before proceeding, a short presentation of the current exchange regime is needed. The exchange rate regime, after the stabilization of 1985, started as a managed float, with the auctioning of foreign exchange by the central bank in a Dutch auction with a reservation price, as the main (and sole) intervention mechanism. Since the beginning of 1986, two things happened: a) almost imperceptibly at first, inflation was anchored to the exchange rate; b) to use the exchange rate as an anchor, without formally changing the system, the supply of dollars for the auction was increased several times, which reinforced the convergence effect of the bids of the public to the reservation price of the central bank. The central bank could readjust the exchange rate by changing within short periods its reservation price.¹⁰ Hence the system has evolved from a managed float to an incomplete crawling peg, whose objective is to maintain a stable RER. The stability of the RER is however subordinated to keeping domestic inflation low. This system, which is over 17 years old, is *sui generis* but it has worked reasonably well. More important, the system enjoys high credibility.

¹⁰ The issues in the aftermath of the stabilization of 1985, are examined in Morales (1991).

The current crawling peg system has reduced the volatility of the RER. Both the level and the volatility of domestic inflation have also experienced a significant reduction. Over a long-term span, the variance of inflation has been larger than the variance of the RER, but somewhat surprisingly, the variance of the RER is larger than the variance of inflation in the more recent period. In the terms of the ILY model, the difference in volatility (valid for long samples in Bolivia) is behind the high degree of dollarization. The ILY model uses interest rate parity as a starting point but focuses on the hedging decisions against inflation and foreign exchange risk of depositors and borrowers. The authors look at the second moments of the distribution of real yields in dollars and local currency. Portfolio equilibria gravitate around interest rate parity and minimum variance allocations.

The minimum variance portfolio allocations (MPV) provide a natural benchmark for actual allocations on both sides of a bank's balance sheet. Thus, the explanation for financial dollarization must essentially be based on volatilities rather than levels. An interesting implication of the model is that deviations from MPV can be explained by a mismatch between the supply and demand of loanable funds; and public policies, like monetary policy, currency denomination of public domestic debt and of bank reserves in the central bank, and regulatory restrictions. If the variance of the RER is smaller than the variance of inflation, this would explain "core" or underlying dollarization. This result is the more affecting, the more attention is paid by the authorities to the stability of the RER.

What do the data tell us? In Appendix A, a very high underlying dollarization coefficient (0.88) can be observed for the large sample there considered. This confirms the result of Ize and Levy Yeyati (1998) of a MPV allocation. This number is slightly lower than the estimate in ILY (p.23), obtained with a sample of quarterly observations for the period 1990:I- 1996:IV.

Our sub-sample 1992.02-2003.07 yields a negative underlying dollarization coefficient, introducing doubts on the MVP theory.¹¹ In this smaller sample, the more active depreciation policy between 1999 and 2002 is less diluted than in the larger sample. In addition, between 1999 and 2002, inflation was

¹¹ While λ^* , the underlying dollarization coefficient is bounded from above by 1, it may not be bounded by 0 from below, if the correlation coefficient between inflation and the RER is negative, and the standard deviation of the RER is sufficiently larger than the standard deviation of inflation. A negative correlation coefficient is not abnormal, if there is the policy of keeping the bilateral RER constant, even if some real appreciation is temporarily allowed when inflation is high. What is more annoying is the variance of real depreciation being significantly larger than the one of inflation.

low, as was its variance. There was real depreciation on average, but the variance of the RER was larger than the variance of inflation.

The failure of MVP allocations to explain the increasing dollarization of the past few years send us back to our explanations based on the difficult predictability of the path of the RER. It can be conjectured, that around 1999, a regime change occurred with the eruption of the regional crisis. The MVP theory remains valid for more "normal" times.

In addition, the results of the ILY model fit well when expectations on the exchange rate (and inflation) are both continuous and bounded. Yet without dismissing the model, I think that we have to focus more on the inherent difficulty to find the equivalence of returns (on an ex-ante basis) in, say, pesos and dollars.

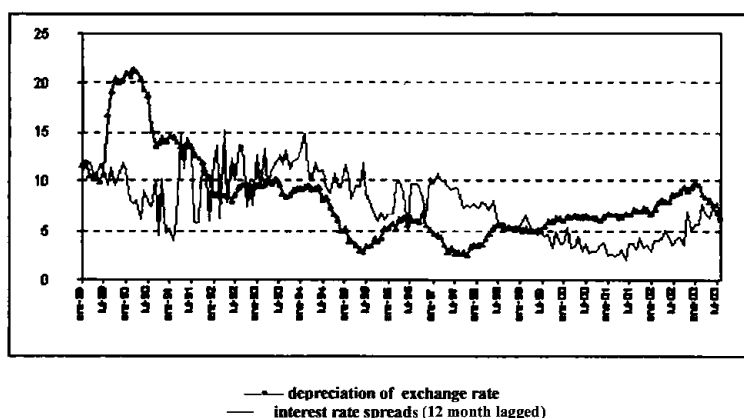
Dollarization may arise from the market rational forecasts of discrete events, which drives to very high levels the spread between dollar and domestic currency interest rates, perceived conventionally as risk premia. The uncovered interest rate parity may not hold in the long run because the public assigns a positive probability (even if small) to its future collapse, although the exact timing is not known.¹² Especially in countries like Bolivia, that have gone through dramatic periods of high inflation, doubts on the stability of the exchange rate and of inflation are likely to remain, no matter how much time has elapsed since the last inflation. The public continues anticipating a discrete change in the distribution of the economic determinants of the current exchange-rate regime that will lead to depreciation.¹³

¹² Actually, not even a positive probability of collapse is needed. Dollarization is independent of the probability of a regime switch. It suffices that in real dollarization, the public expects a depreciation of sufficient size (Ize and Parrado 2002). This expectation is translated to financial dollarization.

¹³ One major reason why the central bank stepped up the rate of crawl between 1999 and 2002, in addition to keep the competitiveness of Bolivian production, was to pre-empt the expectation that a major (and catastrophic) devaluation may occur, given the turmoil in the region. In doing so, it was expected that the peso problem would be limited. The Bolivian system was shown to the public as a system of smooth transition to a more depreciated, equilibrium exchange rate. Of course there was the cost that the public anticipated correctly that a continuous depreciation would go on, and this may have increased dollarization temporarily. On the other hand, it was important to forestall the expectation of a major devaluation, because this would have led to a run of dollarized bank deposits. A hint of this happened in June 1999 (the so-called Corpus Christi episode), when fears of a major devaluation (and the abandonment of the crawling peg) caused a deposit run.

Figure 2 shows the evolution of the difference between the borrowing rates in dollars and domestic currency (lagged 12 months) and compares it with the actual currency depreciation. The monthly data show that in the period from January 1992 through July 1999, except occasionally, the interest rate spread was above the depreciation rate. From July 1999 on, when the depreciation rate speeded up, the relation was inverted. Moreover, because of a more rapid depreciation and of changes in the regulations on foreign exchange positions, the banks discouraged the constitution of remunerated deposits in domestic currency. The perceived funding costs by the banks were so high, that they refused local currency deposits. The easiest way to refuse them, without incurring in the displeasure of the authorities, was to offer ridiculous low interest rates to depositors, lower than the exchange rate depreciations. Banks did not want to operate with local currency, except with costless sight deposits and very low cost savings passbooks.¹⁴ Because of this non-linearity, the econometric analysis cannot take fully into account the extent of the peso problem.

Figure 2
Exchange rates and interest rates spread



Even with the caveat given above, the econometric analysis of the data in Figure 1 reveals a peso problem. The absence of a peso problem is rejected in the different tests on the regression coefficients in Appendix A.

¹⁴ After becoming more aware of the default risk that exchange rate devaluations may cause, banks returned timidly to offering time deposits in local currency, and increased their interest rates for domestic currency deposits.

Furthermore, the residuals of the regression models are correlated and heterocedastic. Note also that, before the crisis of 1999, lending rates and borrowing rates were closely correlated because, among other things, of the tightness of the loan market. When banks started to accumulate excess reserves, once the crisis started, this correlation was lost. We can conjecture that the peso problem that is usually associated with depositors, also appeared in the loan market. There are other, more qualitative, elements, that support our belief in a peso problem. While inflation has been very low in the past few years, the perception in the public remains (e.g. in press reports), that this has been the case because of the recession and the slack in aggregate demand, and that once the crisis is over, the rate of inflation will increase. To many, the steady state inflation rate is significantly higher than the observed one.

Furthermore, the persistence of macroeconomic dis-equilibriae, like high fiscal and current account deficits in the Balance-of-Payments makes the public more inclined to anticipate a catastrophic devaluation (followed by inflation). In particular, the persistent and large current account deficit may be behind the public's concerns on the exchange rate. For instance, if its financing is perceived as endangered because of reductions in foreign aid, or foreign direct investment, or sudden stops in capital inflows. If there is no financing, the elimination of the current account deficit will require a large-scale redeployment of resources from non-traded to traded good sectors, something that can occur smoothly, without a recession, only if it is gradual.¹⁵ The redeployment requires, in turn, improvements in the RER that lead to the persistence of doubts on the maintenance of the exchange rate regime. Unless the twin deficits, fiscal and external, are solved and their solution is expected to be permanent, the public would prefer dollars to domestic financial instruments. The twin deficits are the fruit of weak institutions. Thus, the ultimate cause of dollarization lies on institutions that pale with those of countries issuing hard currency, especially in terms of their taxing powers.¹⁶

The perceived uncertainty on the returns of assets in domestic currency (whatever the form it takes) deters depositors and pushes creditors (banks) to set very high premia on the interest rates they charge in their credits in domestic currency. On an ex-post basis, borrowers feel that they are better

¹⁵ A point made by Eichengreen (2003) when discussing the Asian crisis.

¹⁶ At a deeper level, the peso problem reflects the persistence of weak currencies. In turn, the weakness of the currency results of several factors: incomplete markets, weak institutions and moral hazard, this time on the part of the government. See De la Torre, Levy Yeyati and Schmukler (2002).

off with loans in dollars and prefer to bear the exchange rate risk than to pay very large uncertainty premia.

It has been often suggested in the past four years that a more parsimonious approach to the crawl would reduce dollarization. Parsimony in the rate of devaluation may obtain this result for a while, but if, for lack of credibility, there are pressures on the stretched foreign exchange reserves of the central bank, more dollarization rather than less may eventually occur. Moreover, the slower rate of crawl would have enhanced the government guarantee on the fixed exchange rate, contributing to more dollarization.¹⁷

The exchange rate uncertainty of course affects all types of returns, whether on capital or labor.¹⁸ Holders of financial wealth seem however to be more sensitive. In fact it is exactly the fact that real dollarization is limited in face of financial dollarization that is at the root of many of the difficulties of partial (or de facto) dollarization. In Bolivia, two big items of Gross National Income, namely wages and taxes, with few exceptions, are settled and paid in domestic currency.¹⁹

Domestic currency still has a role because of its properties as a real shock absorber, according to the model of Ize and Parrado (2002). More important, with the regime of virtually unrestricted access to foreign exchange, the domestic money is a stepping stone to the coveted dollars. We have noticed that any excessive supply of domestic money is rapidly converted into dollars, with excessive meaning any amount beyond the cash needed for obtaining wage goods.²⁰ While domestic currency carries some costs and inconvenience, they are relatively minor vis-à-vis alternative measures, for instance delays in payment by the public sector, as could happen if salaries and other expenses were paid in dollars.²¹

¹⁷ A point made, in a general setting, by De Nicoló, Honohan and Ize (2003).

¹⁸ See the analysis of Ize and Parrado (2002) and Chang and Velasco (2003) for very important insights.

¹⁹ Arrears in tax payments are however formally readjusted to the exchange rate, to avoid Olivera-Tanzi effects. Also, the tax base of some taxes is informally readjusted with the exchange rate which amounts to a dollarization of some tax collections, for example, the local taxes on properties and vehicles.

²⁰ It is interesting to note that a few weeks after the Christmas bonus is paid (in domestic currency) there is a big demand for dollars at the central bank. The amount of domestic currency decreases very significantly in January, while the central bank experiences a big loss in its reserves of foreign exchange.

²¹ Alternatively, public sector cash shortfalls of foreign exchange in a dollarized economy can lead to the issuance of quasi-monies like the notorious "patacones" in Argentina, which were not convertible to dollars (or pesos).

4. PUBLIC POLICY AS SUBSTITUTE FATHER OF DOLLARIZATION

It is useful to see dollarization as an extreme case of a fixed exchange regime; i.e., a “hard peg”, and with the government that grants an irrevocable exchange rate guarantee that remains valid, except when the financial system collapses, or what amounts very closely to the same thing, when the central bank runs out of foreign reserves. “Fear of floating” and shyness in managing the crawling peg reinforce the perception in the public of this exchange rate guarantee.

The government can assure the rate of conversion of the local dollars to “true” dollars, yet the risk remains that some deposits in local dollars would not be able to be converted to true dollars, through mechanisms like deposit freezes. Indeed, after the Argentinean experience of year 2001, the risk of a deposit freeze has become more present to the public than before. Even so, given that in the event of bank’s failure, the liquidation policy gives a symmetric treatment to deposits in dollars and domestic currency; this favors dollarization in most cases, and independently of moral hazard considerations.²²

A strong central bank (because it carries large inventories of foreign exchange) reduces the subjective probability assigned to a collapse of the financial system caused by exchange rate movements. The higher the level of central bank reserves, the more dollarized the system becomes. Moreover, holders of dollar deposits feel that they have a senior claim on the resources of the central bank (its reserves) vis-à-vis other stakeholders because there are precedents. In any event, dollar depositors as well as dollar borrowers expect to be bailed out if a catastrophic devaluation happens, so there is a moral hazard problem. The central bank finds itself facing a dilemma: a) to keep a high level of reserves in order to safeguard deposits and avoid a catastrophic run on banks; b) the high level of reserves and efficient assistance with liquidity to banks, increases dollarization, which augments liquidity (and solvency) risks.²³

The systemic risks of currency mismatches of the economy can be compounded by procrastination, when weak banks are allowed to continue

²² See the arguments of Broda and Levy Yeyati (2003).

²³ This dilemma leads to the discussion on the optimal level of reserves, a difficult problem insofar that the volatility of liquidity shocks is itself endogenous to the amount of reserves, as pointed out by Broda and Levy Yeyati (2003b) and by Levy Yeyati and Sturzenegger (2003b).

operating. Frequently, those weak banks already exhibit a high percentage of (short-term) dollarized deposits, while the value of their deteriorated dollarized loans is smaller (because of provisions) than the value of their dollarized deposits. This creates an incentive for the banks to increase risky loans, provided that they are dollarized. Their exposure to both exchange rate risk and credit risk increases, and leaving them to continue operating creates hazards for the whole system.

The conversion risk of domestic dollarized deposits to cash or foreign deposits explains the spread (that sometimes has been very high) of domestic rates over US rates on deposits of similar nature. This spread is sometimes called, by extension, "country risk". In the past four years, that were years of recession and weakening of the banks, the spread however continuously fell. We can conjecture that depositors are not pricing adequately the conversion risk, probably under the assumption that it will be fully shifted to the government and the central bank in the event of a collapse.

Also, given their liquidity and their inability to place loans to credit-worthy customers because of the recession, banks have been discouraging deposits (in any currency) by offering very low borrowing rates in dollars, only slightly above the international ones. Also, the regulations on money laundering in the industrial countries have significantly increased the transaction costs for cross-border deposits. Increased transaction costs plus low international rates have mitigated capital flight.

As liquidity insurer, the central bank can attenuate the risk, shifting from dollarized deposits to local currency deposits; and the moral hazard problems, by charging punitive interest rates on its lender-of-last-resort loans in dollars, or equivalently making access to these loans contingent on stringent conditions. High interest rates have the shortcoming that they may penalize the profits of the banks more in need. Also, it must be added that high central bank interest rates increase the premia on the bank's own liquidity. It becomes then difficult for the central bank to redirect the liquidity of banks with excess reserves to banks lacking them, because of, say, a deposit run. The central bank finds then more difficulties in acting as a middleman in brokering liquidity arrangements among banks. On the whole, the benefits of central bank's high interest rate as a lender-of-last resort outweighs the costs.

The stringent conditions for lender-of-last-resort loans may lack credibility in the case of systemic risk, as banks may believe that the central bank will yield on them. Still, some dose of ex-ante stringency may be helpful in the sense that, if banks believe that central bank liquidity is either expensive or of difficult availability, they will increase the share of their dollarized liquid assets in their total assets. The first line of defense, in case of a confidence crisis, is then provided by the banks themselves. Maintaining high levels of international reserves is costly to the central bank, and, contrary to commonly held belief, dollarization is also costly to the banks, insofar that they have to assume higher liquid positions than otherwise.²⁴ When banks privilege liquidity, their lending activity is sharply reduced and even performing loans are not renewed or are called in, with negative effects on financial intermediation. So, dollarization, that favored financial deepening after the hyperinflation, in times of stress of the financial system, impedes the recovery of intermediation. This has happened in Bolivia in the past four years.

5. DOLLARIZATION AND THE WEAKENING OF CENTRAL BANKS

The problems posed by dollarization to the conduct of economic policy in highly dollarized economies are more severe than generally admitted. When high inflation was the problem to tackle, relatively minor changes to the standard IMF approach were needed. This changes substantially when the dollarized economies suffer the effects of strong shocks, as has been the case for many Latin American countries in the past five past years. It is not only a problem of a more careful choice of intermediate targets for monetary policy, but of a whole new environment for the central bank.²⁵

Full dollarization changes the nature of the central banks in some fundamental ways. Actually, it makes them redundant or with wholly different functions as is well known. It is less well known that even partial dollarization

²⁴ It is curious to note that in the mild bank runs that Bolivia has experienced since the stabilization of 1985, most depositors converted their deposits to cash, actually to dollar bills, rather than to cross-border deposits. The central bank has thus been obliged to carry large inventories of dollar bills or to import them on short notice, assuming at the same time very high operational risks. The holding of this type of reserves has been very costly to the central bank, and ultimately to the Treasury. The stashing of large amounts of dollar bills by the public is basically unstable. So, once the confidence shocks that led to the bank runs subsided, most of the cash returned to the banks.

²⁵ The conventional thought, at the IMF and elsewhere, may have been too optimistic in believing that the standard monetary program design should be guided by the same criteria in non-dollarized economies, as stated, e.g., in Baliño *et al.* (1999).

(if high) changes the nature of central banks. They do not any longer have full control of the monetary base, as long as banks can accumulate foreign liabilities and deposits in foreign currency, and onlend them directly to their costumers, without passing through the central bank to convert them to domestic currency.

With partial dollarization, the central bank loses its grip on the monetary aggregates that are normally under its control in less dollarized economies. A setting of a multiplicity of central banks is created. In addition, in a highly dollarized economy, the transmission channels of the central bank policies to the financial sectors are largely clogged: the interest rate channel is barely available; the banking credit channel probably has some reach, but more as a result of the public sector borrowing needs (or lack of) than of central bank policy. Ironically, the exchange rate may be the only direct channel insofar as the frequent adjustments in the exchange rate, given by the crawling peg arrangement, Granger-cause interest rates in foreign currency, presumably because they change the dollar excess reserves of the banks as well as their perceptions of exchange risk.

The econometric exercises in Appendix B show that the rate of depreciation Granger-causes the lending rate in dollars of the banks and the interbank rate. This was not however the case before mid-2001. The situation changed afterwards, coincidental with the rate of devaluation stepping up. From mid-2001 on, it appears that the depreciation rate incides on the lending activity of the banks and on the interest rates that they charge, except when the banks were under distress, as was the case in the bank runs of June-July 2002. It is noteworthy that similar procedures applied to dollar borrowing rates, and domestic currency lending and borrowing rates do not show the same type of causality.

For many years, we have tried in the Central Bank of Bolivia to conduct a monetary policy in dollars, including the central banks' usual fare of open market operations, and of lending and borrowing facilities. There was the illusion that we could have operational targets in dollars like: a) with a controlled monetary base; b) short-term interest rates.

Although we cannot dismiss entirely the results, the bulk of the quantity of money and of interest rates was almost completely endogenous, as predicted by standard economic theory with fixed exchange rates, and with perfect capital mobility, substituted this time by movements of dollars off-

shore and on-shore. Attempts to guide the interest rates of the banking system were specially futile: expansionary policies only resulted in more capital flight and contractionary policies had a very high off-set coefficient.

The central bank in a highly dollarized economy doesn't have a monetary policy *strictu senso*. It limits itself to try not to succumb to the borrowing pressures of the government to finance its deficits and to act as a liquidity insurer for the banking system. The constitution of liquidity buffers (that is, high levels of international reserves) becomes the dominating concern. Price stability, the main mandate of the modern central bank, depends by and large of the soundness of the fiscal accounts, and (most) nominal income stabilization is beyond the reach of the central bank.²⁶

As a side effect of partial dollarization, the demand for domestic money becomes rather unpredictable and the signs in the usual explanatory variables may not be the ones expected from economic theory and conventional assumptions. For instance, if credit was mainly granted in dollars and becomes less available, there will be an increase in the demand of money for transaction purposes, which is largely satisfied with domestic currency. If the demand for domestic currency is largely unstable, the demand for bank reserves held at the central bank (that given the high deposits dollarization is also in dollars in Bolivia) is even more unstable and largely beyond the control of the central bank.

6. THE BIPOLAR OPTION

As is well known by now, partial dollarization and the currency mismatch between debtors and creditors (mainly banks) gives rise to great fragility in the financial sector. It increases liquidity and solvency risks.²⁷ The fragility has become more apparent in view of the somehow more rapid exchange rate adjustments in response to the major changes in the exchange rates of our trade partners. The problem goes beyond borrowers with income in domestic currency. In fact, the problem remains with all borrowers in the non-tradable sectors (mainly construction and services), for even if they price in dollars, the purchasers of their goods and services have their incomes in

²⁶ To be sure, the central bank still provides crucial payment services to the banking system, that could however be offered also by the private sector. In addition, it provides crucial information to the market, but again, other public and private institutions could do the same.

²⁷ However, with more integration to international capital markets, the risks may be diminished. Bolivia is not yet there.

domestic currency and hence, with real depreciation, the prices of most non-tradable sectors fall in dollars, regardless of the currency in which they are denominated.

The multilateral exchange rate volatility has shaken the confidence in the bi-monetary arrangement, that seemed to have worked so smoothly over 14 years after the inflation-stabilization of 1985. Bolivian policy-makers (as in other countries facing similar problems) find themselves in the uneasy situation where, if they use the exchange rate as a shock absorber to protect national income and employment, they may, by the same measure, be imperiling the banks and other financial institutions.

Given the direction of trade of Bolivia, that goes in a significant fraction to its neighbors and the weak exposure of Bolivia to international capital movements, it is reasonable to assume that real shocks, especially those arising from exchange rate fluctuations, are more important than monetary shocks. The real shocks to the Bolivian economy have been, moreover, region idiosyncratic and presumably uncorrelated with the real shocks of the country issuing dollars (the US). The optimal currency area argument remains fully in force. So there should be a case for an independent counter-cyclical monetary policy.²⁸

Table 2 illustrates what happened to Bolivia's net exports after the big currency depreciations of our regional trade partners. Notice the big falls in net exports with respect to Argentina and Brazil between 1998 and 2002, and with respect to Chile until 2000. The negative net exports mainly resulted from the huge bilateral RER appreciations of the Bolivian currency.²⁹

²⁸ Unless the Bolivian currency aligns itself with the Brazilian real, the Argentinean or the Chilean peso, or a basket of these currencies. Bolivia would not be willing to take this step, except when a regional MERCOSUR currency is agreed.

²⁹ It must also be said that Table 2 underestimates the extent of the worsening of the Bolivian trade, as it does not include informal (contraband) trade that is deemed to be substantial.

Table 2
Bolivian net exports and REERs*
(in U\$ millions and percent)

	1998		1999		2000		2001		2002	
	Net exports	REER	Net exports	REER	Net exports	REER	Net exports	REER	Net exports	REER
Argentina	-148.0	98.9	-192.3	100.0	-256.8	102.4	-223.2	101.4	-283.4	47.5
Brazil	-223.6	90.3	-248.1	67.6	-238.4	67.9	-214.2	66.3	-319.4	53.3
Chile	-108.2	96.9	-103.7	91.2	-139.7	91.0	-110.5	85.5	-90.5	86.5
The world	-	97.5	-731.2	96.2	-666.8	98.1	-593.8	100.1	-663.9	99.1
	1181.6									

* Excluding natural gas exports. REER : bilateral real effective exchanges rates with the countries in the table with base 1996 = 100. A fall in REER is appreciation.

In this case, welfare can be enhanced with more flexibility of the exchange rate, rather than with more rigidity. In that setting monetary policy can be used to stabilize income and as a shock absorber. While real dollarization may be prevented, it would be at the cost of increasing financial dollarization. The high degree of financial dollarization puts a brake on, otherwise, sensible adjustments in the exchange rate, and increases the vulnerability of the banking system to confidence crisis.

Partial dollarization increases the likelihood of persistently high real interest rates. Indeed, in a dollarized banking system where most borrowers either have their incomes in domestic currency or are in the non-tradable sectors of the economy, the relevant real interest rate for them is (approximately) the interest rate in dollars plus the rate of real depreciation. If a policy of adjustments of the (pegged but adjustable) exchange rate takes place to obtain real depreciations, reductions of the nominal dollar interest rate may offset the bilateral (domestic currency/dollar) depreciation.

The argument that real depreciations increase the burden of the debt, because of its effects both on the stock and the flows, is quite straightforward. Yet, if outrageous overvaluation of the domestic currency were allowed to persist, the balance sheet of the banks may also suffer, because of the deterioration in their assets brought about by the recession, in turn explained by the overvaluation.

A point often overlooked is that, since most broad money is constituted by dollar deposits, a real depreciation increases its domestic currency real value. Thus, real depreciation may prevent deflation and sow the seeds for

recovery, as in some models of the Great Depression. Partial dollarization, despite all its shortcomings, may have some benefits.

However, all in all, partial dollarization adds vulnerability to the financial system, and increases the risks of a collapse of the banks and of a fiscal crisis, if the government comes to the rescue of the former. A full, *de jure*, dollarization may overcome this problem by eliminating currency mismatches. In addition, given the already very high degree of *de facto* dollarization, the transition costs to full dollarization may be small.³⁰ Moreover, given the feeble fiscal position and the weakened financial system, putting monetary policies in automatic pilot may have many benefits.³¹

The problem is what would happen afterwards, to a dollarized economy, which depends for its foreign exchange on the exportation of a few commodities and on foreign aid, with low productivity growth, weak fiscal position, banks saddled with a large amount of dollarized non-performing loans, an inflexible labor legislation and no foreseeable scheme of fiscal compensation from the issuer of dollars.³² Also, without resorting to full dollarization, the inflation rate is already low and very close to the international one. Thus there will be no gain with dollarization in terms of the fight against inflation, except to pre-empt expectations of it, which is very important. Last, with full dollarization in situations that can be handled with other means, the option to give up monetary policy and the exchange rate *in extremis* is killed.³³ The convergence of domestic dollar interest rates to international rates may not be forthcoming either.

The other corner solution is to aim to inflation targeting and a truly floating exchange rate. This road is even bumpier than the one to full dollarization. It implies back-tracking the route followed over 17 years (or even more). Beyond this legacy, there is the point made by Fischer (2001), recalling the observation of Mussa et al. (2000) that for low income, small countries, with "limited involvement with modern global financial markets, some form of

³⁰For instance, in terms of the capacity of the central bank to act as lender-of-resort, and of the loss-of-seigneurage.

³¹ Would dollarization significantly accelerate the process of policy reform? This is one important question that Eichengreen (2000) addresses in a general context.

³² Dollarization by itself, if not accompanied by policy reform, will not solve the problems and may even be counterproductive. See the arguments of De la Torre, Levy Yeyati and Schmukler (2002).

³³ Going beyond the argument of Fisher (2001) along similar lines.

exchange rate peg is generally more viable and more appropriate for them than for most of the emerging market countries”.

The political obstacles to reduce dollarization are also formidable, as the constituencies in its favor are very large.³⁴ In fact, not even all exporters, particularly if they are commodity exporters, are against dollarization, since they are price-takers in the international market, their production is capital intensive, most of their inputs are imported, and their debts are in dollars. The exchange rate is of marginal importance to them, unless it is absurdly overvalued. Only the producers of import substitutes or in border towns have been supporters of a more active exchange rate policy. To cope with the destruction of productive activity, caused by the exogenous shocks, entrepreneurial groups have been lobbying for financial assistance from the government rather than for a more aggressive exchange rate policy.

The current intermediate exchange rate arrangement has its merits, without ignoring its risks. The Bolivian authorities feel that, to overcome the crisis, dollarization has to decrease. However, given the dramatic experience with forced de-dollarization, any increased use of domestic currency has to be fully voluntary. Relatively small changes in prudential regulations may be supportive of the efforts to reduce dollarization, but the thrust has to be on institution strengthening. Reducing dollarization requires, first and foremost, a credible commitment to maintain inflation low, not only now but in the future, even the distant future. Full credibility in the domestic currency may take time to achieve and a long track record of stability is required. The changes in prudential regulations intend to make banks internalize the costs of dollarization; a first step is to make them aware of these costs.

7. CONCLUDING REMARKS

The paper has examined the causes and consequences of dollarization using the Bolivian experience as a case study. The emphasis throughout the paper has been on the importance of inflation and, especially, expectations of it, to explain dollarization in countries with limited integration to the international economy. It is argued that the quality of institutions would be a major factor for reducing the extent of dollarization, should this be deemed desirable.

³⁴ See the discussion of Frieden (2003) on the political economy of dollarization.

Dollarization is a major problem, especially when it is partial because of the currency mismatches that are produced in the economy and the reduction of the range of policies, and without contradiction, the unconventional roles that it imposes to central banks. Full dollarization is an issue to the problem, but the countries willing to follow this route, have to be ready. The question on when to dollarize is more relevant than ever. With full dollarization, there is no place for a central bank, strictly speaking, but also its unconventional burden of being a liquidity insurer of dollar deposits disappears.

There are many questions not addressed in this paper and that are in need of further research. Among them, we have to see the full implications of liability dollarization as distinct from asset dollarization. More understanding is needed too on the optimal policies for central banks in partially dollarized economies. Also, granted that a reduction in dollarization is desirable, to what extent financial operations indexed to inflation, including public debt bonds, can be encouraged and issued. Would inflation indexed instruments help to develop long-term capital markets in domestic currency? Last, what political economy problems can be expected in reducing dollarization, and who would be the winners and losers?

APPENDIX A. VOLATILITIES AND PESO PROBLEMS

A. SAMPLE CHARACTERISTICS (MONTHLY DATA)

Interest rate spreads: domestic currency –
dollars

	Lending	Borrowing	Interbank	Depreciation rate	Inflation	Real depreciation rate
Sample: 1988.01 - 2003.07						
Mean	22.76	7.87	6.56	8.71	9.28	-0.57
Std. Dev.	12.17	3.22	3.93	4.37	6.42	5.18
Skewness	0.24	0.13	0.35	1.09	0.60	-0.17
Kurtosis	1.81	2.04	2.15	3.75	2.56	2.10
Sample: 1992.02 - 2003.07						
Mean	25.09	7.19	6.56	6.58	6.41	0.18
Std. Dev.	13.21	3.04	3.93	2.06	4.05	4.58
Skewness	-0.19	0.25	0.35	-0.06	0.18	-0.09
Kurtosis	1.63	2.06	2.15	2.01	1.97	2.20

B. COVARIANCE MATRIX - SAMPLE: 1988.01- 2003.07

	INFLATION	REAL DEPRECIATION
INFLATION	41.02	
REAL DEPRECIATION	-24.35	26.65

Sample: 1992.02 - 2003.07

	INFLATION	REAL DEPRECIATION
INFLATION	16.3	
REAL DEPRECIATION	-16.46	20.84

C. CORRELATIONS MATRIX - SAMPLE: 1988.01- 2003.07

	INFLATION	REAL DEPRECIATION
INFLATION	1.00	
REAL DEPRECIATION	-0.74	1.00

Sample: 1992.02 - 2003.07

	INFLATION	REAL DEPRECIATION
INFLATION	1.00	
REAL DEPRECIATION	-0.89	1.00

D. λ^* = Underlying dollarizationSample: **1988.01 – 2003.07** λ^* 0.87875593Sample: **1992.02 – 2003.07** λ^* -0.037914692

The sample exhibits the following main characteristics for the spreads between local currency interest rates and (domestic) dollar rates: 1) The means are high in both samples for lending and borrowing interest rates. The interbank spread is significantly smaller, given the very short maturities of the operations leading to low currency risk. 2) The standard deviations are larger for the spreads in lending rates than for the other rates. 3) The spreads have a positive skewness for all rates, except for the lending rates in the smaller sample, reflecting hence that high spreads have been more frequent than low spreads. 4) The kurtosis are lower than 3, indicating that the spreads are more concentrated around the mean than in normal distribution. The hypothesis of a normal distribution of the spreads is rejected with the Jarque-Bera test (not shown) at 5% significance level.

The mean yearly depreciation rate and inflation are below 10%, and close to each other in both samples. The real depreciation rate is small and negative in the large sample, and small and positive in the smaller sample. The smallness of these means confirms the policy of stable RERs on average. More strikingly, for our purpose, while the standard deviation of the real depreciation rate is smaller than the one for inflation in the large sample, the opposite result holds for the smaller sample.

Inflation has a positive skewness in both samples. Also, its kurtosis is below 3. Depreciation has a positive skewness and a kurtosis higher than 3 in the large sample; these measures are reverted in the smaller sample. The real depreciation has a negative skewness and a kurtosis smaller than

3. Given the closeness to zero of the mean values of real depreciation, we can assert that real appreciation was more frequent than real depreciation.

E. The peso problem

The following specification can be used to assess the presence of a peso problem:

$$\ln \frac{1+i_{t-12}}{1+\pi_t} = C(1) + C(2)\ln(1+i_{t-12}^*) + C(3)\ln \frac{1+d_t}{1+\pi_t}$$

where i = interest rate in domestic currency; i^* = interest rate in dollars in the domestic system; π = inflation; d = depreciation.

Method: Least squares
Date: 09/05/03 Time: 19.10
Sample (adjusted) 1990:01 2003:07
Included observations: 163 after adjusting endpoints.

	Coefficient	Std. deviation	t-statistic	Prob.
C(1)	0.06	0.01	5.79	0.00
C(2)	0.24	0.11	2.26	0.03
C(3)	0.40	0.07	5.58	0.00
R-squared	0.17		Mean dependent var	0.08
Adjusted R-squared	0.16		S.D dependent var	0.04
Log likelihood	322.74		F-statistic	16.22
Durbin-Watson	0.40		Prob.	0.00

Wald test

H0: C(1)=0 C(2)=1 C(3)=1

Test statistic	Value	df	Prob.
F-statistic	29.89605	(3,1609)	0.0000
Chi-square	89.68816	3	0.0000

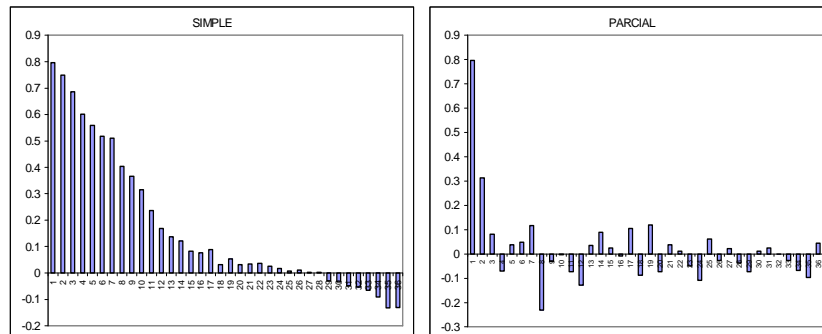
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(1)	0.060545	0.010453
-1 + C(2)	-0.755863	0.108193
-1 + C(3)	-0.601675	0.071411

Restrictions are linear in coefficients.

The null hypothesis is rejected at the 1% significance level.

The graphs below suggest the presence of autocorrelation and heterocedasticity. Indeed, Box-Pierce applied to the residuals and the squared residuals show problems of autocorrelation and heterocedasticity.



**APPENDIX B. GRANGER CAUSALITY TEST ON INTEREST RATES
(PERIOD: MARCH 1994 TO JUNE 2003)**

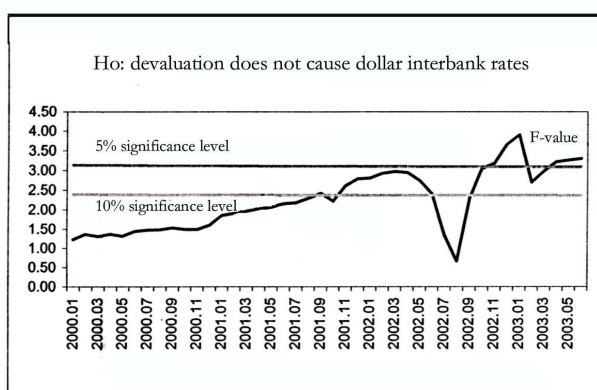
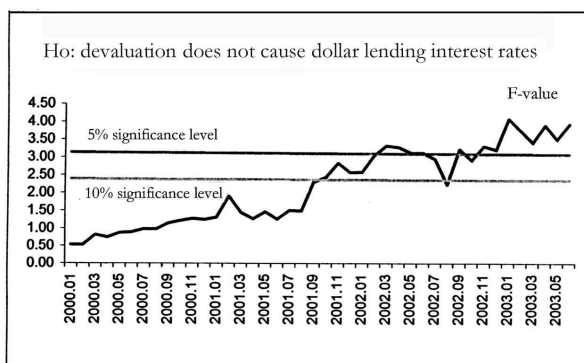


Figure B1 and B2 give rolling F-values, obtained by including every time a extra observation to the sample to the initial set March 1994-January 2000. The data was first tested and corrected for non-stationarity.

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