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FINANCIAL DOLLARIZATION AND DEDOLLARIZATION

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Abstract

Financial dollarization is a key factor behind systemic financial fragility in Latin America. The experience shows that dedollarization can be achieved but can just as easily be missed…and worse: blunt dedollarization measures repressing dollarization may easily fail to solve fragility and, instead, foster risky short-term debt or provoke massive financial disintermediation and crisis. This paper analyzes the sources of liability dollarization in a portfolio framework and identifies the failures leading to excessive dollarization meriting policy intervention as well as the reasons why dedollarization policy often goes awry. It then derives an analytically sound multipronged domestic dedollarization program that takes into account the risks of misdiagnosis and the experience, both successful and failed. This program centers around the development of good local currency substitutes for dollar debt, such as CPI-indexed debt, rather than the repression of dollar debt.

JEL codes: F31, O16, G11, G28

Foreign currency liabilities owed by economic entities whose assets are linked to the local currency is a serious concern in Latin America nowadays. For short, there is a concern with dollar liabilities and peso assets in the same balance sheet. When widespread across the domestic economy, this kind of currency mismatch entails a risk of systemic crisis in the case of substantial real exchange rate depreciation, which in turn is typically associated with losing access to external financing. Financial and economic collapses in recent years demonstrate the extreme danger of this mismatch in the absence of solid international financial integration.

The crises unleashed by widespread dollarization of liabilities involve firms, banks, and the fiscs mutually reinforcing the collapse. Real depreciation financially chokes (non-tradable) firms *en masse*, disrupting the real economy, leading to the demise of viable firms, and ultimately engulfing most non-exporting sectors. The banking sector (as well as other components of the financial system) suffers a systemic crisis, either directly from currency risk in its own balance sheet or, more commonly, from the noted increased credit risk of its dollar loans. And in many cases of its public bond assets too. In fact, the public sector is also choked financially as dollarized public debt balloons and becomes unsustainable. The fisc is then forced to resort to contractive fiscal and monetary policies at a time of deep recession and systemic financial failures, relinquishing its constructive policy support and ultimately becoming part of the problem of systemic economic and financial crisis.

Why is dollar financing so prevalent? Dollarized external debt ("original sin") is the source of the countries' *aggregate* dollar liability position and has been traditionally blamed for the widespread currency mismatch within the domestic economy. However, an equally important contributor to the dollarization of liabilities in the countries most affected by it, and arguably a

more tractable policy problem, is the dollarization of domestic savings. In fact, the domestic intermediation of dollarized savings by residents amounts to dollarized liabilities within the domestic economy. Furthermore, dollarized domestic savings that are invested offshore ("capital flight") create the need for additional external debt to satisfy overall domestic financing demand, and in this way indirectly contribute to additional dollarized liabilities despite not being intermediated domestically. In summary, liability dollarization needs to be analyzed alongside with domestic asset dollarization, i.e. analyzed in terms of financial dollarization (FD) as a whole. This paper gives full consideration to FD and emphasizes the relevance of domestic asset sources of liability dollarization for the diagnosis of the problem and for effective policy action.

There is at this point ample recognition in both academic and policy circles that widespread liability dollarization is a heavy burden that merits serious consideration of policy intervention proposals. However, there is a strong debate on policy feasibility. Pessimists contend that there are solid reasons why markets deliver high FD which can only change in the long run. Market-friendly policies can be expected to be frustrated by mistrust fuelled by memories of inflation surprises; repressive policies can be expected to lead to capital flight and financial disintermediaton. Pessimists point to the existence of very few successful dedollarization experiences (like Chile and Israel) and a good number of dedollarization failures or outright disasters (like Bolivia and Peru in the eighties). On the other hand, optimists point out that current conditions of low inflation and exchange rate flexibility throughout Latin America, and the added credibility of inflation targeting regimes in many countries, are an auspicious break with the past. They counter that successful dedollarization may be rare but it has been seldom attempted seriously; dedollarization fiascos were conducted under very adverse conditions and are not representative of the risks of decisive shock treatment policies.

This paper contains a analytic survey of the issue of FD and concludes with a policy proposal for dedollarization. The analytic survey (sections I through IV) reflects what is known about FD in a unified analytic framework and critically examines the empirical arguments of dedollarization pessimists and optimists. The first two sections review the evidence that supports the widespread policy concern with financial dollarization and the risks of dedollarization attempts (Section I) and then analyze what is known about the factors that may warrant high FD as a useful market adaptation of the financial system in a simple analytic framework. The remainder of the paper analyzes FD as a policy issue. Section III makes the case of dedollarization as a policy objective to reduce excessive FD to an optimal level and suggests theoretically fitting policy instruments. Section IV discusses the experiences of dedollarization policies (or the prevention of FD) in developing countries, both successful and failed, and the lessons they contain on policy feasibility and risks.

Finally, Section V proposes a dedollarization strategy grounded in the theory and evidence analyzed in the previous sections. The proposed approach is mindful of the risks that antidollarization policies pose in terms of risk shifting (financial disintermediation and duration shortening) and the lack of wisdom of a narrow policy focus on simply bringing down FD. The dedollarization strategy suggested relies on the displacement of FD through the development of attractive peso substitutes of dollar debt, and appeals to policies of currency discrimination against the dollar as a complement only when warranted by underlying distortions. The policy agenda is centered in fostering domestic savings in local currency (as opposed to redressing original sin, much harder to crack) and gives a special role to multilateral development banks (MDBs) to provide key ingredients to facilitate it. Concluding remarks follow. Financial

dollarization is often excessive and should be fought with deliberate financial dedollarization policies. It can be effectively fought by addressing the underlying failures generating excess: missing markets and institutions necessary to support strong peso financing (e.g. promoting inflation-indexed financing) and market and policy distortions (e.g. discriminating in favor of peso financing in prudential regulation to compensate distortions).

I. MACROECONOMIC CONCERNS WITH FINANCIAL DOLLARIZATION AND DEDOLLARIZATION

FD is widespread in many developing countries by all measures. The typical country in Latin America (simple average across countries) has a bank FD of around 40% (either in deposits or loans) and a dollar public debt share of 75%, ratios almost twice as high as in the rest of emerging countries; after the 1998 Russian crisis aftermath bank FD has been increasing while the degree of dollarization in public debt has been slowly receding (Galindo and Leiderman, 2004). Reinhart, Rogoff and Savastano (2003) construct FD indexes on the basis of the share of dollar bank deposits in broad money, the share of dollarized domestic public debt and external debt as a proportion of national income. FD in Latin American countries appears extremely high on every count, especially concerning domestic FD (see table 1).

The problems of financial dollarization

There is the widespread concern that financial dollarization is socially costly. There has been a traditional concern with the effectiveness of monetary policy in the context of high FD. Recent crises, however, have pushed the risk of crisis and prudential concerns to the forefront. The

empirical evidence strongly supports the concerns, especially that found in De Nicolo, Honohan and Ize, NHI, (2003), Reinhart, Rogoff and Savastano, RRS, (2003); and Levy Yeyati, LY, (2006). A summary of the main empirical findings follows:

FD substantially contributes to financial fragility and the risk of systemic crisis. Widespread currency mismatches, largely unmitigated by hedging derivatives whose markets are fairly underdeveloped for most local currencies, increase solvency risk of debtors (including the public sector) and, consequently, of the banking system even if currency matched. Liquidity risk in the banking sector is further increased by the lower ability of the Central Bank to perform as a lender of last resort in foreign currency. Systemic crisis may also result from fiscal risk due to dollar public debts, which are quite high in a good number of countries. The reader is referred to NHI for strong evidence concerning solvency and liquidity effects on banks, as well as Gulde et al. (2004), Goldstein and Turner (2002), and IMF (2005). LY shows that exchange rate changes increase the propensity to suffer systemic banking crisis only in the presence of high FD. Calvo, Izquierdo and Mejia (2003) find that liability dollarization is a predictor of sudden stops in capital inflows, which is an indirect indication of the systemic fragility it induces.

FD prevents countercyclical policies. There is a well established link between fear of floating and liability dollarization, that is fear of a real exchange depreciation due to currency mismatches that may bring insolvency and financial crisis (see Calvo and Reinhart, 2002; Levy Yeyati, Sturzenegger and Reggio, 2002). RRS empirically confirm this link. Dollarized public debt heightens this fear, and complicates fiscal sustainability when real exchange rate depreciation takes place during economic downturns. Large external debt, and liability dollarization in general, induces a contractionary bias to real depreciation. FD severely limits the

scope of countercyclical monetary and fiscal policy, and in extreme cases makes optimal policy procyclical. Furthermore, the monetary transmission based on peso rates is weakened by the prevalence of dollar rates (Balino et al. 1999).

FD has an overall negative effect on output volatility. To the extent that financial dollarization contributes to crises and complicates countercyclical policies, a negative effect on output volatility is to be expected. This prediction is confirmed by the econometric analysis in LY and agrees with the evidence shown by RRS concerning the association between their overall dollarization index and output volality. This effect is also confirmed by microeconomic evidence in a number of Latin American countries which shows the destabilizing effect of liability dollarization in a good fraction of firms in terms of profits and investment, possibly leading to contractionary devaluations (see Galindo, Panizza and Schiantarelli, 2003 and references contained therein).[2]

FD appears to have some negative effect on the inflation level and volatility. By and large, cross-country evidence shows that the higher the degree of dollarization, the higher and more variable the inflation rate (notwithstanding the widespread improvements in inflation performance over the past decade as financial dollarization increased). However these effects do not appear to be strong. Furthermore, FD does not appear to have complicated disinflation policies. The reader is referred to RRS for information and a complete non-econometric analysis of FD and monetary policy and to LY for some econometric evidence pointing in this direction.

[2] Depreciations are expansionary with low levels of dollarization and contractionary with high levels of dollarization.

The potential benefits of financial dollarization

At the same time there is a widespread premise that financial dollarization contributes to deeper financial systems (provides a credit instrument of good quality) and, hence, the growth level. This premise translates into fear of artificially impeding FD, that is dedollarizing, because of the risk of financial disintermediation leading to lower investment and long-run growth. Surprisingly, recent econometric evidence is mixed and suggests that impediments to financial dollarization need not have adverse effects if carried out with adequate policies under the right circumstances. The following two empirical findings stand out:

FD contributes to financial depth only under high inflation. Being financial dollarization a coping strategy for market agents to be willing to agree on credit contracts, in the absence of such instrument many of these contracts may not be carried out. A reasonable presumption is that part of these savings would be frustrated or would be invested abroad, legally or illegally, and therefore there would be financial disintermediation and a smaller domestic financial system. However, NHI established the important econometric finding that FD does not significantly contribute to financial depth unless under circumstances of high inflation, which is confirmed with a variety of econometric methods to control for endogeneity bias that would result from adverse unknown conditions causing both higher FD and less intermediation. LY also obtains this key finding with his own FD measures and specification using a dollarization restrictions index as instrument, providing confirming evidence that the negative effects of impeding dollarization with restrictions depend on inflation circumstances.

FD does not appear to contribute to faster average growth. This finding results from LY econometric analysis of the issue on the basis of a Barro-type regression enlarged with financial dollarization and is also consistent with the simple association analysis in RRS. This result can be explained in part because, as noted, FD does not necessarily improve financial depth and in part because the increased output volatility associated with FD may in itself depress average growth (Ramey and Ramey, 1995). Nevertheless, the fact that LY controls for investment opens the possibility that FD contributes to faster growth through larger investment on the basis of better access to credit, which is precisely the fear of the dedollarization pessimists. It appears advisable to be cautious at this point with this preliminary finding and conclude that there is no evidence that FD contributes to faster long-run growth.

All in all, in this macroeconomic literature FD appears to create a number of stability problems and deliver little growth benefit, except perhaps in special cases. For this reason a consensus is emerging that policy should be aimed at reducing FD if remedies can be found for a smooth transition.

II. WARRANTED FINANCIAL DOLLARIZATION

For all its problems, FD may play a useful role under the circumstances faced by highly dollarized countries and be well justified, preferable to a less dollarized alternative. This section analyzes how economic fundamentals warrant some degree of FD and its relevance to account for observed FD.

What financial dollarization?

The central concern of financial dollarization has to do with dollar assets and liabilities in the residents' balance sheets. It focuses on residents' asset substitution as opposed to currency substitution; its concern is not inflation but insolvency, not flows but stocks. In this context, let us start by distinguishing among alternative concepts of financial dollarization that will be utilized throughout the paper.

Liability dollarization encompasses liabilities of residents denominated in foreign currency (L^*). Liability dollarization is the most interesting concept to analyze in relation to the consequences of FD to the extent that it is on the head of firms in the non-tradable sector, as well as public sector's debt, because in these cases liability dollarization entails a currency mismatch between assets and liabilities that would give rise to a negative balance sheet effect in the case of real depreciation. The degree of liability dollarization (l) in this concept is measured as a share of total debt liabilities (L), be it in the aggregate (more on this later) or for specific economic sectors (e.g. non-tradable private firms' debt, public debt).

$$l = L^* / L$$

It is clear that the existence of domestic currency derivatives markets to help allocate opposing currency hedging needs or capacities would reduce the problem of currency mismatch for any given overall dollarization l (it would facilitate tradable sectors to absorb exchange rate risk from non-tradable sector borrowing without engaging in unnecessary borrowing and lending operations, which would help to reduce effective liability dollarization in non-tradable sectors and increase it in tradable sectors). Ideally, liability dollarization would be measured net of

currency hedges and considered only when it entails a currency mismatch; this crude liability dollarization index *l* is best interpreted as a proxy of such ideal measure.

Liability dollarization may originate in dollar claims held by residents or by foreigners. As we will see, the analysis of this lending side is key to understand the drivers of FD and design dedollarization policies. *Domestic financial dollarization* encompasses dollar claims held by residents (D^*). The degree of domestic financial dollarization (d) will be measured as a share of total debt assets D held by residents (the remainder of which is of course debt assets in pesos). In turn, debt assets D can be claims against other residents or held abroad (flight capital, amounting to a fraction f of total debt assets D).

$d = D^* / D$

fD = country's debt assets abroad;

Alternatively, *external financial dollarization* refers to dollar claims (against residents) held by foreigners ($E^3{}^*$). In line with the "original sin" hypothesis (Eichengreen and Hausmann, 1999), developing countries do not obtain external financing in pesos and therefore E^* also amounts to total external debt. (Correspondingly, I will assume that flight capital fD is also held in dollars).

E^* = country's debt exposure;

It is useful at this point to frame other definitions of country currency mismatch as particular concepts of liability dollarization associated with a particular forms of aggregation. In fact, if the

whole country is aggregated for the purpose of computing liability dollarization, thus netting out dollar assets and liabilities of residents, then liability dollarization would amount to E^*-fD, the net debt position of the country. This is Goldstein and Turner's (2003) country currency mismatch definition, but is not quite the concept of original sin, which refers to the (gross) debt liability position E^*. To obtain that concept the assumption is that domestic dollar claims against residents can be netted out from their dollar liabilities but not assets abroad. This exception is consistent with the idea that residents' assets onshore can be somehow allocated to offset external liabilities but no so with capital "flight", which flew and the government cannot lay its hands on it. However it is not clear how the government could or why it would have an incentive to offset liabilities with domestic dollar claims.[4] Rather, theory and experience suggest that any individual or sectoral currency mismatch is a potential concern and that therefore netting out is not a good methodological approach to the policy issues of liability dollarization in countries where domestic financial dollarization is significant. Our definition of liability dollarization l aggregates *debtors* without any netting out.

Equating borrowing and lending in the country, total and in each currency, we can derive identity relationships linking the various concepts described above:

(1a) $L = (1-f)D + E^*$

(Total borrowing = Lending from residents + Lending from foreigners)

(1b) $L^* = (D^* - fD) + E^* = D^* + (E^* - fD)$

[3] The "original sin" assumption in this paper is that all foreign debt is contracted in dollars, irrespective of whether foreign peso debt is not offered at all or simply appears too expensive to borrowers.

(Dollar borrowing = Domestic dollar lending + External lending =

= Domestic dollar savings + Net foreign savings)

(1c) $L - L^* = D - D^*$

(Peso borrowing = Domestic peso lending)

(2a) $(1 - l) = (1 - d)(D / L)$

As long as *D/L* remains constant, that is the macroeconomic relationship between (accumulated debt-intermediated) domestic savings and investment is stable, liability dollarization *l* moves along with domestic financial dollarization *d* (given original sin as assumed, of course). (At this point it is worth noticing that the above asset/liability balances would apply to any on- shore financial intermediary which does not take a dollar position. This is typically the case of the banking sector, which would therefore match peso and dollar deposits to peso and dollar loans. A popular measure of domestic financial dollarization and of liability dollarization is precisely obtained from *d* and *l* applied to bank deposits and loans, respectively.)

As to macroeconomic changes in *D/L*, for any given degree of domestic financial dollarization, liability dollarization decreases with domestic savings and increases with domestic investment. This macroeconomic ratio is a measure of the country's reliance on foreign savings (from 1a): $D / L = 1 - (E^* - fD) / L$. Because of original sin, the higher the reliance on net foreign savings *E*-fD* to finance domestic investment *L*, the higher liability dollarization. An important case to

[4] Witness the recent Argentinean crisis to see how difficult it is to pessify dollar debts at the expense of domestic dollar lenders (bank depositors).

analyze is the case in which aggregate domestic savings D are constant but net external financing is subject to variations, either affecting debt capital inflows E^* (external debt) or debt capital outflows as measured by the offshore savings coefficient f (capital flight). For example, a sudden stop of capital inflows would lead to lower liability dollarization at the cost of lower aggregate domestic liabilities L (1a) backing investment. On the other extreme, in the case of perfect financial integration an increase in offshore savings f would not lead to financial disintermediation because it would be perfectly offset by external debt.

It is clear that another source of change in liability dollarization would be the reduction of the dollarization rate of foreing lending from 100% (making a dent to original sin). It is useful to consider partial external financial dollarization (net of foreign currency hedging offered; foreigners willing to receive pesos in exchange for dollars would alleviate original sin). Let e be the dollarization rate of foreign lending (net of swaps), assumed 1 above, and E be total foreign debt $(E^* = eE)$. Then the liability dollarization expression can be written as:

(2b) $$(1-l) = (1-d)(D/L) + (1-e)(E/L) = (1-d)(D/L) + (1-e)(1-(1-f)(D/L))$$

Assuming again that the aggregate stock ratio D/L remains constant, now changes in liability dollarization l come from changes in domestic financial dollarization d or in external financial dollarization e. This paper mainly focuses on policies concerning d, while Eichengreen, Hausmann and Panizza (2002) propose policies to redress original sin and focus on e. It is clear then that both initiatives are complementary to reduce liability dollarization.

Liability dollarization as a share of GDP (*l'=L*/GDP)*, which is arguably a better measure of systemic currency mismatch because it incorporates the degree of debt leverage of debtors, can also be expressed in terms of the same parameters. In fact:

(3) $l' = dD' + e(L' - D') - (1-e)fD' = dD' + (L' - D')$ when $e = 1$ (original sin)

where $D' = D/GDP$ and $L' = L/GDP$

In this formulation, liability dollarization *l'* also moves with domestic financial dollarization *d* (and external financial dollarization *e*). As long as the (accumulated) domestic savings and investment ratios *D'* and *L'* remain constant, it still holds that liability dollarization depends linearly on domestic financial dollarization *d* (under original sin *e=1)*.[5] For this reason, in this paper I examine aspects of the empirical evidence on either one almost interchangeably. Note that constant domestic savings and investment *D'* and *L'* imply a constant excess absorption *L'-D'*, and therefore a constant net debt asset position of the country $(fD - E^*)/GDP$, or put differently, that debt capital outflows *fD* and inflows *E** move in tandem to bring about a given net debt capital account (as a share of GDP). Otherwise, as before, less inflows or more outflows (a negative shock to the capital account) lead to less liability dollarization through financial disintermediation.

Both domestic and foreign sources of liability dollarization are important in most countries, although their relative importance varies. Table 2 shows countries ordered by their degree of overall FD from high to low (measured as liability dollarization as share of GDP, *l'*) and the

[5] Also as before, for a given degree of domestic financial dollarization, liability dollarization decreases with domestic savings and increases with domestic investment.

contribution of domestic and external savings to it based on (1b). It considers two bounds for the contribution of domestic dollar savings in line with the two formulations of (1b): a lower bound in which the external source is proxied by gross external savings, thus ignoring the indirect contribution of domestic savings abroad provoking an external borrowing offset, and an upper bound in which foreign savings is proxied by net external savings, which assumes that domestic savings abroad induce borrowing from abroad for the same amount (consistent with a constant net debt asset position discussed above). This upper bound is actually underestimated because the estimate of this net position does not include errors and omissions and other debt assets abroad not included in reported off-shore deposits.

The impact of alleviating domestic financial dollarization *d* on liability dollarization *l* appears very substantial. A simple regression of *l* on *d* across countries (series shown in table 3 ordered by overall FD from high to low) reveals that as much as 85% of the cross-country variation of liability dollarization *l* can be accounted for the variation in domestic financial dollarization *d*. Table 3 shows, for each country, the marginal elasticity of liability dollarization *l* to changes in domestic dollarization *d* based on that regression. It also shows estimates of the same marginal elasticity to changes in domestic dollarization *d* and original sin *e* based on (2b).

It is clear that the domestic contribution to FD is as important as the external contribution, and actually more important in a number of high FD countries, especially those with large unreported capital outflows not reflected in table 2. Furthermore, while in other countries the effectiveness of changes in the degree of original sin *e* would predominate over changes in the degree of domestic dollarization *d* as measured by the elasticities in table 3, policy effectiveness also needs to factor in the feasibility of these objectives. There is consensus in that the degree of domestic

FD appears significantly more amenable to policy treatment and easier to crack than that of external FD, and arguably a precondition in terms of sequencing for reasons explained later. Therefore, this paper, centered on domestic financial dollarization, addresses a key direct contributing factor to liability dollarization in high FD countries, which, I believe, is also the first node in the critical path for a comprehensive solution to high FD.

What drives domestic financial dollarization?

This section gives a brief and selective account of what we know about the (warranted) drivers of FD that may give it a useful financial role and justify its consequences as background for the policy analysis in the remainder of the paper. The reader interested in more details is encouraged to read the excellent review of Levy-Yeyati (2004) and references contained therein.

There is widespread consensus in that domestic financial dollarization is a coping strategy on the part of agents to obtain insurance against surprise changes to peso prices, which make real returns of peso nominal debt very risky. To the extent that the main fear is a surprise inflationary surge of the kind many developing countries have experienced in the past, one can interpret this fear as domestic lenders eager to defend the real value of their savings from dilution by inflation.[6] In summary, domestic financial dollarization is a market adaptation to cope with low quality currencies.

The high and volatile inflation that has been observed in many developing countries over the years, including episodes of hyperinflation, jibe well with the widespread development of

financial dollarization as financial globalization established itself with a strong footing and increasingly facilitated it by offering opportunities to save abroad. However it has been observed that over the past decade there has been a remarkable reduction in inflation in Latin America while at the same time financial dollarization has tended, if anything, to increase. The question arises as to whether FD is reversible. Of course, what matters is the expectation about future inflation (strictly speaking, surprise changes in inflation), rather than current or past inflation. One way to reconcile this apparent anomaly of high FD under low inflation is to consider that despite the reduction in observed inflation rates, currencies and monetary policies lack credibility: bad memories are not easily forgotten and it will take a long time for credibility building policies and institutions to be effective (see Savastano, 1996).[7] This hysterisis view of the persistence of FD does not bode well for the prospects of dedollarization based on monetary discipline (see for example Reinhart, Rogoff and Savastano, 2003). Even the best attempt would be blocked by lack of credibility.

In this section I suggest a more optimistic view derived from the portfolio approach introduced in the foundational paper by Ize and Levy-Yeyati (2003), from which this section draws heavily. This portfolio optimization approach allows the translation of the identities in the previous section to behavioral equations, from which implications can be examined. While I will return in the next section to the drivers of FD and go behind some of the proximate causes, it is useful at this point to cover the basics that this basic portfolio model lays out.

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[6] This approach calls for a policy analysis of other forms of defense, of which financial dollarization may be just one, to which we will return in the last section.

[7] Another way to explain the evidence is to consider costs of reswitching to local currency instruments due to network externalities, although this argument appears more relevant for currency substitution (Guidotti and Rodriguez, 1992) than for asset substitution.

Let us start with the case of domestic lenders (say depositors) and borrowers (say firms) choosing between contracting in pesos or dollars for the repayment of a given loan. These choices entail different real return profiles: a peso loan delivers a real return r_p and a dollar loan a real return r_d. Let P be the debt repayment for one unit loan from borrower to lender. They choose the fraction d of dollars (and $1-d$ of pesos) of their debt financing portfolio, so that

$$P = (1-d)r_p + dr_d .$$

Being domestic agents, they discount nominal payoffs with the domestic price index, so that returns are subject to currency or price risks: peso loans are subject to inflation risk (uncertain inflation) and dollar loans are subject to exchange rate risk (uncertain real exchange rate). From the point of view of the depositor, returns on peso claims are diminished by inflation and returns on dollar claims are enhanced by real depreciation. Besides these price risks, all returns are subject to credit or default risk, that is the uncertainty concerning the fraction of the contractual obligation to be recovered on account of the possibility that the borrower fails to honor the contract with the lender (this failure amounts to a transfer from lender to borrower, which for the moment is assumed costless to the contracting parties). Expected inflation, exchange rate depreciation, and default loss are of course factored in contractual terms to offset their effect on expected real return, but the deviations of their realizations from their expected values (surprise inflation, real depreciation, and default) make returns risky. Let e_i be unexpected *inflation*, e_x unexpected *real appreciation*, and e_d be unexpected *default loss*:

$$r_p = E[r_p] - e_i - e_d$$

$$r_d = E[r_d] - e_x - e_d$$

where $V[e_i] = V_{ii}$ (inflation risk), $V[e_x] = V_{xx}$ ((real) exchange rate risk) and $V[e_d] = V_{dd}$ (default or credit risk). Price risks, inflation and real exchange rate risk, are possibly correlated with each other according to covariance V_{ix}. Notice that unexpected *nominal* exchange rate e_n and nominal exchange rate risk V_{nn} correspond to:

$$e_n = e_i - e_x \quad \text{and} \quad V_{nn} = V_{ii} + V_{xx} - 2V_{ix}$$

If unexpected inflation and exchange rate real depreciation are positively correlated (V_{ix}<0), then peso and dollar claims hedge each other's returns (and the nominal exchange rate is very volatile: $V_{nn} > V_{ii} + V_{xx}$). In the other extreme, V_{ix}>0 takes its maximum value in the case of a fully credible fixed exchange rate ($V_{nn} = 0$). For simplicity, I assume that both price risks are uncorrelated with default risk ($V_{id} = V_{xd} = 0$).[8]

Lenders (depositors) are risk averse and are concerned with the return volatility of their asset portfolio. For simplicity, borrowers (firms) are assumed risk neutral. In this basic model the currency composition of loan repayment, d, is determined by:

(4a) $\underset{d}{Max}\ E(P) - aV(P)$ (Lenders)

(4b) $\underset{d}{Max} - E(P)$ (Borrowers)

Joint maximization efficiency adding up objective functions (4a) and (4b) determines dollarization *d* such that the variance of the portfolio is minimized:

(5) $\underset{d}{Min}\, V(P)$

Private efficiency leads to choosing the dollar fraction *d** ratio that minimizes the variance of payment (see Appendix):

(6) $d^* = (V_{ii} - V_{ix}) / V_{nn}$

$= V_{ii} / (V_{ii} + V_{xx})$ if price risks are uncorrelated

The main intuition of the equilibrium result is that what matters for FD is not just inflation risk but the relative risk between inflation and real exchange rates: FD may coexist with low inflation risk if real exchange rate risk is also low (under the assumptions, default risk is irrelevant for FD).[9] The decline in inflation volatility need not lead to a decline in FD if there is a concomitant decline in real exchange rate volatility. Exchange-rate based stabilization in Latin America in the 1990s illustrates such a case. More generally, fear of floating associated with high FD appears to be behind real exchange volatility declining even more than inflation volatility, which

[8] Given the association between default and real exchange rate depreciation, a more realistic assumption would be $V_{xd} < V_{id}$ (developed in the Appendix). The key results do not depend on this simplification.

[9] The hedging value between peso and dollar claims (a negative V_{ix}) is also important. It would pull dollarization towards one half, and therefore it would have an ambiguous effect depending on which type of claim is more risky.

led to an increase in latent dollarization d^* partly explaining the persistence of observed FD. This more elaborate explanation of the observed trends assigns better prospects to a dedollarization strategy based on monetary discipline (say inflation targeting) combined with flexible exchange rates.

Could this portfolio analysis be applied to foreign lenders to explain original sin (i.e. a corner solution $d^* = 1$)? Eichengreen and Hausmann (1999) forcefully contend that other factors such as country size (the currency's value for international diversification purposes) are more important and explain why countries with strong monetary and fiscal policy like Chile also suffer from original sin. However, the portfolio approach offers an additional explanation: because foreign savers would discount with a different factor (their own foreign consumption basket), they are not as aligned as domestic savers are concerning the borrowers' appreciation of the relative volatility of real returns of lending instruments.[10] This misalignment with foreigners induces home bias, as noted by Thomas (1985). From the point of view of foreigners' real returns, dollar lending would not contain price risk ($V'_{xx} = V'_{ix} = 0$, abstracting from surprise international dollar inflation) and peso lending would contain not only inflation risk but also exchange rate risk involved in the conversion of the peso deflator into dollar deflator ($V'_{ii} = V_{ii} + V_{xx}$). Equation (6) would hold *mutatis mutandis,* optimal foreign FD would be in fact 100% and original sin would be the natural result of this home bias.

[10] The effect of expected real exchange rate changes on expected returns is also asymmetric: it affects foreigners' expected real returns on peso lending and residents' expected real returns on dollar borrowing, thus opening a gap between expected payments between lender and borrower in (4a) and (4b). Expected real depreciation (appreciation) would favor foreigners' lending in pesos (dollars). To simplify, in the text I am assuming that the real exchange rate is in equilibrium (expected real depreciation is zero).

For completeness, let's extend the simple portfolio model above to the portfolio consideration of other incomes of lenders and borrowers to see how this broader framework may alter basic dollarization *d** in (6) and lead to "safe haven" dollarization *d*'>d**. Let I be other lender's income sources (from non-financial assets) per unit lent (for a total of $I+P$) and S be borrower's net revenue sources (net non-financial assets) per unit borrowed (for a net revenue of $S-P$), everything in real terms. In this more complete model, equations (4a) and (4b) are:

(4'a) $\underset{d}{Max}\ E(I)+E(P)-a(V(I)+V(P)+2Cov(I,P))$ (Lenders)

(4'b) $\underset{d}{Max}\ E(S)-E(P)$ (Borrowers)

Joint contracting efficiency (being incomes *S* and *I* exogenous, not affected by the decisions on currency mix) now amounts to:

(5') $\underset{d}{Min}\ V(P)+2Cov(I,P)$, instead of Min $V(P)$ as in (5).

Assuming that lenders' non-financial income *I* (say real wages) is negatively correlated with nominal exchange rate depreciation ($V_{In}<0$), which is certainly the case in currency crises, it is easy to check that a more dollarized debt contract would be a hedge for the lender ($Cov_d(I,P)<0$), as emphasized in Ize and Parrado (2002) and Rajan (2004). This additional factor leads to even higher dollarization *d*'* (see Appendix), which is consistent with the finding in De Nicolo et al. 2003 on this safe haven effect reflected in the coefficient of their GDP hedging variable:

(6') $d^{*'} = (V_{ii} - V_{ix} - 2V_{In})/V_{nn} = d^{*} - 2V_{In}/V_{nn} > d^{*}$ when $V_{In} < 0$

Finally, borrowers' risk aversion and costly default (both assumed away so far) may also be relevant factors in the determination of warranted FD. However their likely effect is to *moderate* FD (see Appendix). Borrowers' risk aversion is neutral in the simple portfolio model because their risk evaluation is aligned with that of lenders and would call for *less* liability dollarization as a hedge against a fall in real profits or equity values ($Cov_d(S,-P) > 0$), consistent with the microeconomic evidence in Galindo, Panizza and Schiantarelli (2003) on the significance of (partial) hedging via the currency composition of the stock of debt. Costly default would also call for *less* liability dollarization to the extent that default risk is higher for a dollar loan than for a peso loan.[11]

Financial Dollarization and International Lending

Finally, let us consider again the same simple portfolio model in a financially open economy (but subject to original sin). Now domestic lenders have a choice of offshore investment (in dollars) not subject to country risk. Its return, r_f, is thus only subject to exchange rate risk (therefore with variance V_{xx}). Then the portfolio problem entails three choices: onshore peso, onshore dollar, and, now, off-shore dollar. Let *d* denote the fraction of dollar claims in the portfolio as before (now the sum of onshore and offshore dollar claims) and *f* the fraction of offshore claims in the portfolio:

$P = (1-d)r_p + (d-f)r_d + fr_f$ (with $d \geq f$, so that no short positions exist).

On the other hand, borrowers have a choice to borrow from foreign lenders (also in dollars). Foreign lenders are not explicitly modeled, but they are assumed to add a risk premium *k* on top of their alternative return at home on account of country default risk (or any other motivation behind home bias). Let *r* denote the (exogenous) expected real cost of foreign financing for a domestic borrower (inclusive of risk premium *k*). Then non-arbitrage implies that the expected return of off-shore investment (for a domestic lender) is $r-k$: $E[r_f] = r-k$. To simplify we continue to assume that borrowing firms are risk neutral. Then borrowers always pay *r* in expected value to all lenders, domestic and foreigners: $E[r_p] = E[r_d] = r$. Therefore:

$$r_p = r - e_i - e_d$$

$$r_d = r - e_x - e_d$$

$$r_f = (r-k) - e_x$$

Then the domestic lenders' portfolio problem to determine dollarization *d** and offshorization *f** becomes:

$$(7) \qquad \underset{d,f}{Max}\ E(P) - aV(P) = r - fk - aV((1-d)r_p + (d-f)r_d + fr_f)$$

[11] However these effects are ambiguous. Jeanne (2002) is able to construct a special model in which costly default induces dollarization because of a large peso premium, and presumably the same result could be obtained under similar assumptions in the case of risk averse firms.

It can be checked (see Appendix) that optimal dollarization d^* is the same one that minimized the variance of payments before, the key result in Ize and Levy-Yeyati (2003), that is to say, the previous result continues to hold for the degree of dollarization d^* of *total* deposits, but part of them are made offshore. Again, this degree of domestic financial dollarization is warranted given the circumstances. This portfolio model has been empirically tested by these authors to explain domestic financial dollarization using historical variances and covariances to proxy expected volatilities for the computation of d^* as the explanatory variable. This variable is always found relevant and substantial in regression analysis However, observed domestic financial dollarization systematically exceeds d^*, an issue to which I will come back.

As to offshorization, the optimal fraction of *total* deposits made off shore is f^*, which depends on country default risk (see Appendix):

(8) $$f^* = 1 - k/(2aV_{dd})$$

(The above results for d^* and f^* hold for an interior solution in which there is onshore dollar deposits, that is $d^* > f^*$. Given the high demand for domestic dollar savings in countries with high FD, this appears to be the most interesting case to focus on. However, I will come back to this to review the implications of the alternative case of a corner solution.)

Finally, liability dollarization is affected not only by domestic financial dollarization d but also by the level of debt financial intermediation as measured by L and D (domestic investment and savings as a share of GDP, here taken as constant to simplify notation); see (3). Domestic investment L can be assumed to be a decreasing function of real cost of capital $r : L = L(r)$,

$L' < 0$. The portfolio models above take domestic savings D as given. Presumably, however, domestic savings depend on the value of the objective function (7): $D = D(r - kf^* - aV(P^*)), D' > 0$. This assumption is consistent with Cowan, Kamil and Izquierdo (2004), who found that the variance of the currency mix negatively affects financial development. Therefore an increase in international interest rates r would push up D/L and reduce liability dollarization (also investment and external debt).[12] If such increase is due to an exogenous increase in country risk premium k, then domestic savings would increase by less (the capital flight option is not enhanced) but the qualitative results are the same. In particular, a sudden stop (rationing of external debt E^* at lower level) can be modeled in this way. As long as these external shocks are exogenous, not dependent on domestic portfolio choices, resulting FD is warranted. I will come back to this question in the next section.

The portfolio model above leaves out potentially important factors.[13] In particular, other portfolio choices such as the choice of maturity, ought to be studied alongside the dollarization decision. Being a short maturity peso loan an alternative way to obtain protection against surprise inflation, it is a natural substitute to a dollar loan. The evidence in IDB (2004) showing that dollarization is prevalent in long maturity bank loans and deposits clearly confirms this conjecture. A fortiori, short maturity financing, with all its attendant price and rollover risks, can be expected to expand if dollar deposits were banned. This is a concern rightly emphasized by De la Torrre and Schmukler (2003) as a potential pitfall of a narrow dedollarization strategy. Similarly, equity financing is another hedge against surprise inflation and therefore, presumably,

[12] This result makes use of the envelope theorem applied to f^* and P^*.

[13] For example, the relevance of the asymmetry of stochastic distributions for inflation, exchange rate, and default risk (skweness due to events such as potential hyperinflation bursts, peso problems, sudden stops) and asymmetric behavior to large downside risk due to imperfections is muted by preferences towards risk that can be summarized by the variance of returns like in the portfolio model above but may merit a value-at-risk type of approach.

also a substitute of dollar financing without the obvious downside of short-term debt. Empirical work on this link between dollar debt and equity financing is sorely missed.

III. EXCESSIVE DOLLARIZATION: DEDOLLARIZATION AS A POLICY OBJECTIVE

The empirical analysis of the macroeconomic consequences of FD in section I points to important costs in terms of financial instability and growth volatility that do not appear to be offset by any clear advantage in terms of average growth. A consensus is visibly emerging around the idea that some degree of dedollarization is a valid policy objective. However, if the only basis for analysis is a set of empirical regularities, it is easy to end up attacking symptoms or to miss the incidental costs associated with the benefits of dedollarizing. This section analyzes the conditions under which FD is excessive and dedollarization is welfare improving as well as the corresponding policy instruments that would be required to achieve.

Financial dedollarization would be straightforward to obtain using strong antidollarization policies (financial policies discriminating against dollar debt), but at the peril of financial disintermediation and mounting external debt. Would such antidollarization policy stance be welfare improving? To the extent that FD is warranted, i.e. observed FD is the equilibrium resulting from the portfolio models of the previous section, it would not be: private returns determining market portfolio allocations are also social returns. However, if there is a gap between social and private returns due to market distortions, then the resulting FD is no longer warranted. If bilateral private dollar contracting imposes costs to third parties, then social returns to dollar claims warranting FD are lower than private returns and we would observe *excessive*

FD, for which antidollarization policy may be useful. I open this section discussing these issues. Nevertheless, dedollarization policy is not exhausted in dealing with market distortions leading to excessive FD beyond the warranted level. Warranted FD is only *constrained optimal* because it is constrained by missing financial markets and weak institutions. If these constraints are subject to welfare improving policies on fundamentals, then even warranted FD is excessive. At the end of the section I turn to the issue of *optimal FD*.

Antidollarization Policy: The Perils of Shrinking Credit and Mounting External Debt

What would it happen with portfolio allocations, that is dollarization and osffshorization, if dollar financing is impeded exogenously, say by antidollarization policy? I now show how the above model would be altered if onshore dollar deposits are impeded, producing lower dollarization possibly accompanied by financial disintermediation and external indebtdedness (see Appendix for similar tax schemes encompassing external financial dollarization) . Some of the qualitative implications emerging from this augmented model have been further confirmed econometrically by De Nicoló et al. (2003), where they control for administrative restrictions to domestic dollar deposits and test their effects. If FD was warranted, antidollarization policy would be effective but counterproductive. If FD was excessive, appropriate dedollarization policy may improve social welfare.

Consider a tax t on dollar onshore deposits (to simplify assumed to be payable up-front, so that its real value is not subject to uncertainty and return volatilites are not affected). This tax imposes a wedge in the expected return between domestic lender and borrower. Since the borrower's expected borrowing cost r is still pinned down by external debt, then the after-tax

expected return on onshore dollar lending is *r-t.* (I assume that offshore dollar lending cannot be effectively taxed). The portfolio problem then becomes (see Appendix):

(9) $\underset{d,f}{Max}\ E(P) - aV(P) = r - dt - f(k-t) - aV(P)$ w/tax *t* on onshore dollar deposits

(10) $d(t) = d^* - (t/2aV_{nn}) < d^*$

(11) $f(t) = f^* + (t/2aV_{dd}) > f^*$

The tax on onshore dollar deposits reduces domestic financial dollarization (peso savings are now more attractive relative to dollar savings) but increases offshorization (now the tradeoff between onshore and offshore dollar savings is tilted in favor of untaxed offshore deposits). It is interesting to notice that the sensitivity of dollarization to the disincentive *t* is larger the smaller risk aversion *a* and the closer the substitutability between peso and dollar as measured by the variance of the nominal exchange rate V_{nn}.[14] Dollar savings are difficult to dislodge when they are not close substitutes to peso savings, that is they provide important insurance to peso savings.

By design there is no credit reduction because the effective cost of borrowing remains *r*, which sustains overall domestic financing *L*. Domestic savings *D* could be hurt due to lower after-tax return on onshore dollar deposits, but this effect could be offset by a budget neutral subsidy on peso deposits refunding the tax revenue to domestic savers, so that effects on overall savings can also be disregarded. We can then focus on portfolio effects (10) and (11)[15].

[14] This measure of sensitivity corresponds to the concavity of the variance of payment. The flatter the variance, the easier to dedollarize.

[15] In fact, in the presence of the budget-neutral subsidy *s=t(d-f)/(1-d), d* would decline further.

The downside of this intervention is that external debt increases: absorption remains but capital flight increases. (The Appendix shows other tax schemes encompassing foreign borrowing which moderate the increase in external debt at the cost of lower investment.) The flipside of this result is that if foreign savings are not available because of an external credit constraint, or if mounting debt imposes additional costs (i.e. an increase in *r*), then credit would shrink. In this case credit reduction could be avoided if impediments to offshorization can be jointly used. The bottom line is that selective taxation of onshore dollar deposits may be useful for the purpose of reducing dollarization but works best either with easy access to external debt inflows or with impediments to offshore domestic outflows.

The previous antidollarization intervention assume that there is a fraction of dollarized domestic savings lent onshore, that is to say, $d > f$. Offshorization puts a floor to dollarization, which is reached when onshore dollar deposits are zero, that is $d = f$ (offshorization is the only way to save in dollars). In the case of a tax on onshore resident dollar deposits, that limit is reached in the case of a *prohibitive tax or a ban on onshore dollar savings*. Such a ban would yield the following minimum dollarization level (equal to the new offshorization level):

$$(12) \qquad d^{**} = f^{**} = (V_{ii} - V_{ix} + f^{*} V_{dd})/(V_{nn} + V_{dd})$$

It can be checked that in fact $f^{*} < f^{**} = d^{**} < d^{*}$ (under the maintained assumption that the basic portfolio model entails positive onshore dollar savings, $d^{*} > f^{*}$).

A ban on onshore domestic dollarization leads to some dedollarization, but part of the onshore dollars do not migrate to pesos but rather find their way into increased offshorization. Onshore dollar deposits $(d^* - f^*)$ become in part peso deposits (d^*-d^{**}) and in part offshore dollar deposits $(f^{**} - f^*)$. This theoretical result appears to be confirmed in IMF (2005), where it is shown that in countries with banned onshore dollarization overall bank dollarization is lower but there are sizable offshore deposits.

The case for Excessive Dollarization: Market and Policy Distortions

The empirical evidence on the relevance of warranted dollarization d^* to explain observed FD is solid. This is especially so when credibility is taken into account to adjust measured historical volatilities to arrive at the kind of expected volatilities that should be included in a theoretically sound measure of d^*. In fact, half of the cross-country variation in De Nicoló et al (2003) is explained by institutional and regulatory variables as well as the macroeconomic environment, which I interpret as a credibility correction term that may be simply adjusting d^* for measurement error. Even with this fix, the evidence on observed dollarization across countries leaves room for more complex theories explaining higher observed FD (Ize and Levy-Yeyati 2005; Castro and Morón, 2004), including market distortions leading to excessive dollarization. Unfortunately, there is little empirical work identifying the factors behind these deviations and, therefore, there is considerable uncertainty concerning the identification of sources of excessive FD and the corresponding policy remedies.

Distortions to the returns perceived by lenders and borrowers call for their removal or their compensation with tax-like wedges. In what follows I distinguish between market externalities

and policy externalities. In both cases I will argue that there are costs of dollar financing external to the contracting parties that can be internalized with a Pigouvian tax wedge *t* of the kind posited in the previous subsection to remove "excessive dollarization", although in extreme cases shock treatment may be necessary. Once the distortion is identified, antidollarization policy is warranted.

Market Distortions. High FD leads to systemic financial fragility because it is both powerful (real exchange rate depreciations can be substantial, especially in this era of international financial turmoil and sudden stops) and widespread across agents, which are then hit at once. Recent crises have clearly illustrated the potential for aggregate economic collapse when financial and real networks among firms and banks are disrupted systemically (Calvo and Fernandez-Arias, 1998). In fact, it is this coordination mechanism what has substantially increased the risk of liquidity crisis in highly dollarized economies, as the ripple effect of a solvency shock on the balance sheets quickly becomes sufficient precondition for a self-validating liquidity run. Even in the unlikely case that peso default risk is higher than dollar default risk for individual firms as in Jeanne (2002), at a systemic level dollar default risk is likely to predominate because of the default correlation that large real depreciations induce. The failure of contracting private agents to internalize their contribution to aggregate FD and the consequent systemic inefficiency costs is arguably the most important reason for excessive FD in the market and yet it has received very little attention in the dedollarization debate (most of the enquiry has focused on policy failures that induce excessive FD).

The risk of systemic crisis produced by *aggregate FD* as a vehicle for a systemic shock and a coordinating device is not internalized by private agents in our simple portfolio model.[16] A related aspect of market externalities associated with FD to which little attention has been paid relates to the risk of turbulence and disruption in international financial markets, or risk of sudden stop for short. To highlight the specific *aggregate* and *foreign* characteristics of this risk (see Tirole, 2002 for an elaboration in terms of dual agency theory), we can model this risk in terms of *aggregate foreign debt stock E**: the higher this stock the more likely it is that there would be a financial disruption leading to output losses throughout the economy. This problem has been studied by Fernandez-Arias and Lombardo (2002) and more recently by Wright (2004). In the Appendix I model these market externalities and show the corresponding optimal taxes similar to that in equation (9).

Finally, there is the intriguing possibility raised in Chamon (2001) and Broda and Levy-Yeyati (2003) that dollar financing displaces peso financing because of a coordination failure among creditors to share bankruptcy partial payments. In fact, limited liability implies that in a state of default partial payments are shared according to a rationing rule. According to bankruptcy law, within each creditor class receiving partial payment the pie is shared according to total due to each creditor. Since (nominal) depreciation inflates dollar values in pesos and surprise nominal depreciation is associated with macroeconomic crisis and firms' default, dollar financing would have an advantage over peso financing in default states.[17] In equilibrium there is an undue advantage to dollar financing leading to excess dollarization (part of the cost is implicitly

[16] For example as in Aghion, Baccketta and Banerjee (2001), where a self-fullfilling currency and banking crisis obtains through the dynamics of incomplete pass-through once FD reaches a critical level. This social bankruptcy cost could be present even in models of firm default dollarization like in Ize and Powell (2004), which would then justify prudential banking regulation penalizing dollar loans.

absorbed by the debtor's peso lenders, an externality, because a switch from peso to dollar lending at going (uncontingent) rates leaves a rent to dollar lenders from the sunk peso lending carrying less default payments after the switch.[18]

The excess dollarization produced by this market failure is exacerbated by the feedback between the degree of liability dollarization and the risk of default: the more dollarized the firm's debt, the tighter the association between depreciation and default and, therefore, the stronger the disadvantage for peso lenders. The available evidence suggests that this effect may be substantial. Microeconomic data suggest that, ceteris paribus, more leveraged firms (a proxy for riskier firms) are also more liability dollarized (see for example Galiani, Levy-Yeyati and Schargrodsky, 2003). Macroeconomic data suggest the same thing: across countries in table 3, the degree of liability dollarization significantly increases with total liabilities (as a share of GDP) according to an estimating equation *l=0.50+0.27L'*.

Policy Distortions and Moral Hazard. The literature has mainly focused on policy failures as opposed to market failures, with the implication that government is the problem causing excess FD. An excellent analysis of most of the cases reviewed in this subsection (except liquidity issues) in the context of an integrated formal banking model can be found in Ize and Powell (2003).

A first case is that of arbitrage across currencies in financial intermediation costs unduly favoring dollar intermediation. For example, costs in intermediating local currency may be higher due to

[17] Ironically, this distortion would tend to disappear with inefficient bankruptcy procedures, which would tend to uniformly dissipate the value of all claims.
[18]

deficiencies in the payment system or monetary management that may lead to higher or more expensive liquid reserves in local currency. Unremunerated (or not adequately remunerated) reserves is also a regulatory disadvantage for peso intermediation in the context of inflation (Catão and Terrones, 2000). Unequal competition with less regulated off-shore banks, which operate in dollars, is yet another reason for currency regulatory arbitrage favoring FD. The argument has also been made that currency-blind safety nets such as deposit insurance or policies of lending of last resort result in an undue advantage to dollar instruments, for the same reasons that this was so under partial bankruptcy recovery (Broda and Levy Yeyati, 2003). This is because payment events are associated with depreciation, in which case the face value of dollar debts capture a larger share of the insurance.

Finally, there is a large literature on how free public insurance, explicit or implicit, causes moral hazard. In general, such hazard favors excessive risk taking on the part of the parties that stand to benefit from the insurance as a way to capture the expected wealth transfer. While banks are generally currency matched, they are still exposed to exchange rate risk through credit risk (of mismatched borrowers). In relation to FD, given that the real value of dollar claims is countercyclical in developing countries, free insurance is better captured by contracting in dollars (McKinnon and Pill, 1997; Schneider and Tornell, 2000). Dollar liquidity being costly, the Central Bank ability to provide liquidity support is also a source of moral hazard (Dooley 2000). Furthermore, once FD is beyond some threshold, dollar borrowing becomes privately less risky because in the case of devaluation some form of financial rescue is to be expected (Burnside et. al., 2001). This is a good example of the negative feedback mechanisms that amplify excess dollarization effects: high FD entails implicit insurance as a response to systemic risk which in turns make bank dollar intermediation even more attractive.

On top of this generic banking moral hazard argument, it has been suggested that dollar pegs represent an implicit guarantee to borrowers in case of breaking the peg (De la Torre et al., 2003). Fixed exchange rate regimes encourage excessive FD by its insistence on currency-blind regulation as a way of deriving credibility for the sustainability of the peg. Argentina 2001 is a good example of ex-post rescues of dollar debtors and, probably, of ex-ante pro-FD distortions (on the latter, see microevidence in Galiani et al., 2003).

Moral hazard also plays in reverse, from FD to public incentives to pursue certain policies that fit a highly dollarized economy but may be suboptimal overall. The detrimental effect of aggregate FD constraining public policies ex-post is similar to an externality. Anticipating the constraints that FD may impose on policies ex-post it could be justified to discourage FD in the first place.[19] This linkage between FD and exchange rate policy is a key example of a perverse feedback mechanism that may lead to excessive FD (relative to a precommitted optimal policy). High FD induces fear of floating as an ex-post optimal policy response, which in turn reinforces the incentives to FD for portfolio reasons (low exchange rate risk), and so on.[20] On the contrary, a credible commitment to a more flexible exchange rate regime would encourage less FD and could be better overall. Chang and Velasco (2003) discuss a general equilibrium portfolio model with these characteristics. This two-directional causality makes clear that dedollarization policies depend on maintaining floating exchange rate policies, which in turn may be risky if there is not rapid success in bringing down FD.

[19] Contrary to the traditional time inconsistency problem leading to incentives to dilute nominal peso debt, dual-agency distortions by which governments may want to help debtors with dollar liabilities through confiscatory measures in the case of real depreciation make the case for less FD (see De la Torre and Schmukler, 2003, for an interesting analysis of systemic risks in emerging markets debt contracting).

These mutually reinforcing influences between FD and exchange rate policy may be strong enough to produce multiple equilibria. Observed high FD/inflexible exchange rate policy may be a bad equilibrium of a set that includes a better equilibrium with low FD and flexible exchange rates. In this case, observed FD would be excessive and would merit policy intervention to dedollarize and dislodge the bad equilibrium (Chamon and Hausmann 2003; Ize and Powell 2004). This is a vague but optimistic theory of high FD: In theory equilibrium selection is simply a matter of coordination (in principle, bad luck), and therefore the policy effort may be confined to facilitate coordination without necessarily requiring any change in fundamentals or credibility.

The case for Excessive Dollarization: Weak Policy Framework and Missing Markets

FD may be warranted, free from distortions, and still be part of a weak financial system in the absence of a sufficiently fertile contractual environment for agents to arrive at better (private and social) outcomes. Warranted FD is only constrained efficient. Adequate remedies to lift these constraints are the provision of market infrastructure to make the environment functional, such as the provision of missing markets and, more generally, the reform of policies and institutions underlying financial market returns. To the extent that these reforms are cost/effective from a social viewpoint, warranted dollarization is excessive, not optimal, and calls for policy intervention on the constraints.

[20] Following the same logic, flexible exchange rate regimes would induce an inflationary bias as a way to dilute debts of debtors in difficulties. This case is the private sector generalization of the inflationary bias of public debt in Guidotti and Rodriguez, 1992 in the context of dual agency theory.

Warranted FD $d^* = V_{ii}/(V_{ii} + V_{xx})$ in equation (6) contains they key proximate factors needed to achieve dedollarization, namely reduce the expected volatility of (unexpected) inflation relative to that of the real exchange rate. The safe haven motivation in equation (6') suggests the relevance of moderating the expected negative association between nominal depreciation and non-financial real income V_{In}. The next section deals with macroeconomic financial policies and supporting institutions that may be able to produce these changes in expectations.

The reduction of country default risk would appear to be another candidate for dedollarizing but in this portfolio model it would not have any effect on warranted FD.[21] However, this irrelevance of country risk is at variance with the evidence in Levy-Yeyati (2004), where a reduction in country risk is beneficial. Some modifications could account for this discrepancy. The derived warranted FD holds under the assumption that price risks are equally associated with country risk $(V_{id} = V_{xd})$; if country risk is negatively correlated with nominal exchange rate risk as it appears likely $(V_{id} > V_{xd})$, then country risk reduction would be dedollarizing (see Appendix). Alternatively, if the maintained assumption that $f^* < d^*$ does not hold, then the derived warranted FD is no longer valid and dollarization is found as a corner solution with no onshore dollar deposits as found in (12) for the case of a ban: $d^{**} = f^{**} = (V_{ii} - V_{ix} + f^* V_{dd})/(V_{nn} + V_{dd})$. In this case, lower country risk V_{dd} is dedollarizing because dollarization is driven by offshorization ($d^{**} > d^*$). This case would apply to very risk averse asset holders so eager to eliminate country risk through offshorization (large a leads to $f^* \geq d^*$) that end up increasing their minimum variance onshore portfolio in (6).

[21] It appears relevant for offshorization f^* in equation (7) but only in a ceteris paribus sense, keeping risk premium k constant. If foreigners' risk premium k is proportional to country risk V_{dd}, as would be obtained under the class of

The relevance of the missing risk-free peso market (peso lending takes place only onshore, and is therefore subject to country default risk) depends on the same factors. In the basic model, a risk free, "off-shore", peso market with fair expected return *r-k* would be useless because offshore peso savings would fully crowd out onshore peso savings. This is so because the return in the missing market can be replicated by the return in the onshore peso market plus switching a dollar claim from onshore to offshore (which eliminates default risk by lowering expected return by *k).* However, in the case of the corner solution $d^{**}=f^{**}$, there is no onshore dollar claim to switch and the missing market is not redundant. The availability of the risk-free peso market would allow the replication of the interior portfolio solution and dollarization would fall to d^{*} (Levy-Yeyati, 2004), consistent with Eichengreen, Haussman and Panizza (2003) who advocate the separation of country and price risk in the context of original sin..[22]

The development of some key missing markets, namely inflation-indexed peso debt, may conceivably entail significant reductions in warranted FD in all cases. Dollar terms amount to a form of indexation that protects residents' savings from peso inflation at the cost of exposure to real appreciation; it trades exchange rate risk for inflation risk. The most direct way to address the demand for inflation protection behind the choice of domestic FD would be through inflation-indexed instruments, a synthetic strong local currency for the purpose of storing value. The return profile of an (onshore) inflation-indexed peso deposit, or real peso deposit, r_r is:

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preferences of the simple portfolio model, then benchmark offshorization f^{*} would also be *invariant* to changes in country risk.

[22] Similarly, the development of currency derivatives markets would have an effect to the extent that it attracts a class of agents willing to take currency risk (say exporters) but that are deterred from doing it because it is bundled with country risk they are unwilling to take.

$r_r = r - e_d$

These real deposits would contain no inflation risk and would therefore be safer than nominal peso deposits. Not being subject to price risk, they would be also superior to onshore dollar deposits. The only risk they would contain is risk of default (country risk), and therefore it would only face direct competition from off-shore dollar deposits, which are free from country risk. Therefore all domestic FD would be offshore like in the case of a ban on domestic dollar deposits $(d = f)$ in equation (12) which resulted in dollarization *d***. The dollarization *d**** resulting from the introduction of onshore inflation-indexed deposits in the simple portfolio model is (see Appendix)[23]:

$$(13) \quad d^{***} = f^* V_{dd} / (V_{xx}(1-\rho_{ix}^2) + V_{dd}) \quad \text{if } V_{ix} < 0$$

$$f^* V_{dd} / (V_{xx} + V_{dd}) \quad \text{if } V_{ix} \geq 0$$

The dedollarization power of inflation-indexed deposits appears enormous. Resulting dollarization (and offshorization) is smaller than under a total ban on domestic dollar debt $(d^{***} = f^{***} < f^* < d^{**} = f^{**} < d^*)$; see Appendix. These claims would be safer than any nominal claim, either peso or dollar, for domestic lending (it would still be subject to country

[23] It is interesting to notice that dollarization in (13) is not obtained utilizing equation (12) simply replacing onshore (nominal) peso deposits by onshore inflation-indexed deposits substituting $V_{ii} = V_{ix} = 0$. and $V_{nn} = V_{xx}$. As long as nominal peso deposits retain portfolio value to hedge (offshore) dollar deposits, that is if $V_{ix} < 0$, inflation-indexed or real deposits do not dominate nominal peso deposits (unless dollarization is fully eliminated). In fact, nominal peso deposits $N = d^{***}(-V_{ix}/V_{ii})$ (see Appendix). The hedging value of dollar deposits implicit in $V_{ix} < 0$ pushes up dollarization *d****; the closer the correlation between price risks as measured by $-\rho_{ix}$ (the more complementary they are), the higher dollarization. (If $V_{ix} \geq 0$, then there is no hedging value and $N = 0$).

risk).[24] In a more sophisticated model it would also achieve the desirable objective of delinking real returns from changes in circumstances or perceptions that would affect the expected return profiles of other instruments concerning the evolution of their prices. If inflation-indexed debt is also available offshore, domestic FD would be eliminated: dollar holdings would be dominated by inflation-indexed peso holdings both onshore and offshore![25] And the problems originated in original sin would be almost solved: local currency intermediation would apply the entire stock of domestic savings *D* to domestic financing in local currency and only net liabilities *L-D* would be financed in dollars.

The development of markets currently missing could also help alleviating the adverse consequences of FD, or the fear of sudden stops (Caballero, Cowan and Kearns, 2004). Domestic currency derivatives markets would expand peso markets by separating price risk from credit flows, eliminating the need to actually borrow or engaging in borrowing and onlending with its attendant credit risk of those willing to absorb the exchange rate risk from dollar liabilities (e.g. exporters). These markets would thus allow a better allocation of inflation risk among residents (and would also reduce the ex-ante incentives for excessive FD in Caballero and Krishnamurthy, 2003). Contracts contingent on external shocks can also serve the purpose of hedging against liability dollarization (without the burden of mistrust or moral hazard to the extent that the contingency is exogenous).

IV. LESSONS FROM DEDOLLARIZATION EXPERIENCES

[24] Empirically, Ize and Levy-Yeyati (2003) note that in the countries in their sample in which indexed peso instruments provided a good alternative to nominal peso instruments actual financial dollarization was far below d^*.
[25] Nominal peso deposits would also disappear because there are no dollar claims to hedge.

The two main reviews of the experience are Reinhart, Rogoff and Savastano, RRS, (2003), and Galindo and Leiderman, GL, (2004). In fact, RRS think that recent proposals towards dedollarization ignore history and should not be taken seriously for that reason. This section attempts to extract the lessons from success and failure in light of the previous analysis.

There is no doubt that financial dollarization is pervasive and persistent. According to RRS, as of end-2001, there were about 35 developing countries in which bank dollar deposits exceed 20% of broad money, including 9 in Latin America.[26] In the previous 20 years, 20 developing countries saw the bank dollar deposit ratio decline substantially (at least 20 percentage points to a level below 20%), but rebounded in the vast majority of cases (16 countries of the 20).[27] Not that the failure rate is 80%, because the 20 cases of significant reductions in FD were not necessarily the result of policy attempts to achieve an objective of dedollarization, but the fact is that only in the other 4 cases the gain was sustained and can be considered dedollarization experiences with RRS definition (Israel, Mexico, Pakistan and Poland). Alternatively, GL define dedollarization as a situation in which dollar bank deposits or loans exceeding 40% are reduced to less than 20% for a period of at least 5 years. With this definition, only 3 countries dedollarized: Chile, Israel and Poland.[28] More recently, Argentina has emerged from its crisis with a dedollarized banking system.

[26] Argentina, Bolivia, Paraguay, Peru, Costa Rica, Ecuador, Jamaica, Nicaragua and Uruguay. Since then, Argentina has largely dedollarized.

[27] A few countries saw substantial reductions in FD in recent years after recovering from high inflation, such as Bosnia, Egypt, Slovenia and Poland, but even in these cases dollar deposits remained substantial. A number of Transition economies (Albania, Armenia, Czech Republic, Estonia, Georgia, Lithuania, Mongolia, Mozambique, Yemen) saw falling FD after stabilization but then increasing again.

[28] The differences between the two sets are easily explained: Chile's high dollarization was not in bank deposits but loans (not considered by RRS), Mexico's initial level of dollarization did not reach 40%, and Pakistan's dedollarization too place less than 5 years ago.

I now turn to the three main lessons that emerge from successful and failed experiences of financial dedollarization and avoidance of FD concerning: a) the role of financial prudential policies; b) the development of dollar substitutes; and c) the importance of favorable conditions to launch policy packages.

Antidollarization prudential policies: Necessary but risky

Most dedollarization experiences included some shock treatment to bank dollar deposits and loans. In Chile bank dollar loans, mostly financed by capital inflows, were converted to inflation-indexed loans in a market-friendly way using the sweetener of a generous fiscal package designed to solve the 1982 banking crisis, which was precisely produced by liability dollarization.[29] Others delivered shocks not with carrots but with sticks. Israel imposed a mandatory holding period for dollar deposits valued at administrated rates (an implicit tax). In Argentina, Mexico and Pakistan dollar deposits were forcibly pessified inflicting capital losses in the conversion.

The evidence of countries that have avoided the surge of dollarization or redollarization of bank deposits also points to consistent antidollarization prudential regulation. In Israel banks are required to actively hedge currency risks or impose higher collateral in the case of dollar lending to the non-tradable sector. Success in Latin America has also been accompanied by strong financial prudential policies favoring local currency lending such as legal restrictions to dollar bank deposits: Chile (prohibition to lend to borrowers in the non-tradable sector), Mexico (quantitative limitations on lending and prohibition for households to hold dollar deposits),

Brazil (prohibition of dollar lending except on-lending of foreign credit and prohibition of dollar deposits), and Colombia and Venezuela (ban or strong legal restrictions on dollar deposits).

At the same time, dollar repression is also associated with failure more often than not. For example, Bolivia and Peru bluntly prohibited bank dollar deposits in the early 1980s only to see extreme macroeconomic instability, financial disintermediation and capital flight that led them to allow again dollar deposits (remaining very highly dollarized to this day). Venezuela does not suffer from FD in banking due to regulatory prohibitions but faces massive capital flight and bouts of financial instability.[30] Even in countries where the experience of banning onshore dollar bank deposits can be considered satisfactory, like Brazil, Colombia and Mexico, there is a substantial degree of offshore dollar bank deposits (see GL) which reduces domestic financial intermediation and contributes to larger external debt.[31] Repressed dollar deposits also lead to shorter duration of local currency deposits and loans (nominal rate instruments at short maturities or floating rate instruments that allow frequent repricing) as a way of recovering some of the protection against surprise inflation that dollar instruments offered (Brazil is a clear example).[32] This form of "repressed dollarization" avoids exchange rate risk at the cost of interest rate risk and roll-over risk, which share some of the harmful characteristics of exchange rate risk.

The overall experience suggests that strong prudential policy discouraging dollarization is needed but is insufficient and is often risky. The key question is how it has to be complemented

[29] This is reminiscent to the recent pesification of dollar debts in Argentina but with the twist of attaching inflation indexation, a proposal that was actually considered at the time for all dollar contracts.
[30] Mexico suffered dearly and pressures for dollarization subsided only in the 1990s.
[31] See IMF (2005) for details on the strict regulations on dollar financial transactions in these countries and the extent to which repressed dollarization onshore is partly reflected in dollarization offshore.
[32] It also leads to the dollarization of non-bank lending such as domestic public debt, tendency also experienced by Brazil.

in order to contain its financial risks and make it work in a successful policy package, to which I now turn.

Dollar substitutes: Key for success but hard to produce

The existence of an indexed peso instrument attractive as a dollar substitute to hedge surprise inflation, which can be used as a carrot to sway repressed dollar depositors to peso deposits, is a key feature of the most successful experiences. Israel offered indexed peso assets from the start of dedollarization. Mexico created an inflation indexed unit of account in the 1990s which is offered by banks.[33] Chile had inflation-indexed peso instruments from a crisis decades ago (Unidad de Fomento (UF)). In fact, other Latin American countries also inherited indexed instruments designed to protect savings from inflationary erosion during past macroeconomic instability that allowed them to cope better with the trend towards FDs, such as Brazil (e.g. SELIC index of overnight interest rates in local currency) and Colombia. In fact, Brazil's SELIC rate plays now a key role in its public debt dedollarizing strategy to match its higher exchange rate flexibility.[34] By contrast, Venezuela, for example, has not counted with any such financial innovation.[35]

The particularly successful case of Chile is revealing as to the combination of policy sticks and carrots (and favorable preconditions) that allowed it to dedollarize and then build a solid financial system around indexation for 20 years. The key was the embracing of indexation in

[33] Poland did not create indexed instruments but had the perspective of joining the euro currency union as a strong monetary anchor.
[34] Nevertheless, this interest-rate indexation has its own fiscal risks due to large interest rate risk.
[35] Argentina has recently created an inflation index used in debt stock restructurings but has not yet been made it available for bank deposits and other debt financing flows; its future use remains uncertain.

policy making, not only encouraging it in financial markets but also engineering the banking crisis resolution with the objective of switching to these instruments and designing the entire macroeconomic framework around it (e.g. exchange rate and monetary policy in real terms).[36] Successful cases such as Chile's have also been able to develop other markets supporting peso financing over time.) After flotation, which eliminated the implicit incentive for dollarization of the 1990s, the forward foreign exchange market and the local bond markets have started to develop (see Herrera and Valdés, 2003).[37]

Nevertheless, the establishment of inflation-indexed financing is difficult. Within Latin America, inflation-indexed bank deposits are only substantial in Chile.[38] Indexation has failed to take root in a number of countries that tried to incorporate this innovation (e.g. Uruguay and Argentina), despite the presence of inflationary concerns (see Shiller, 1998 for an analysis). Credibility of the integrity of the index appears to be a key factor; even in Chile and Brazil, the necessary credibility of indexation was hard to secure (Brazil privatized the agency computing the inflation index out of concerns of manipulation; in Chile the CPI index was manipulated in the 1970s and 1980s). Another obstacle is lack of confidence that the indexation would survive high inflation.[39] Furthermore, the usual difficulties in setting up new financial markets, such as imbalances between demand for assets and liabilities and lack of development of secondary markets are also important obstacles to overcome.

[36] After having reached low levels of inflation for a long time Chile is making efforts to substitute indexed instruments for nominal instruments and is finding that the indexed instruments have strong demand, especially at longer maturities. This suggests that indexation remains fundamental as a tool in a dedollarization strategy even in the case of solid advances in inflation control.

[37] Israel, the other clearly successful case, has also actively pursued the development of financial derivatives markets and made efforts to deepen local currency bond markets.

[38] Inflation-indexed deposits are marginally significant in Argentina after pessification. Inflation indexed loans are also significant in Mexico and Colombia.

What did it take for developing strong inflation indexed markets where they were successfully established? The successful experiences of Chile and Israel in developing inflation-indexed instruments throughout the economy were based on the credibility of monetary and fiscal policies. Low inflation and low public debt respectively reduce the ability and the incentive to tweak with the inflation index, out of concern for the cost of either public or private debt, and, consequently, lends credibility to the index itself.[40] The early importance of long-term institutional investors with a natural demand for inflation indexed assets, such as pension funds, was also very functional to the development of this market in Chile (in the case of life insurance companies demand is not only natural but mandated by regulation).

The importance of favorable economic conditions

Reasonable access to foreign financing to offset a potential temporary surge in capital outflows is also important to contain the risks of strong antidollarization prudential policy. Alternatively, effective temporary controls on capital outflows could achieve the same goal; although a repeat is difficult to imagine nowadays, Chile's long experience and legal tradition with dual exchange rate capital controls was key to limit off-shore dollarization before capital inflows were ample in the 1990s (Herrera and Valdes, 2003). The most disastrous cases of failed dedollarization are characterized by periods of instability, capital flight, and lack of access to external financing. Shock treatment of dollar deposits appears extremely risky under those circumstances.

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[39] In fact, in Argentina there was arbitrary de-indexation in the 1970s and change of index base in the aftermath of the recent crisis, although it is fair to say that pessified dollar-indexed claims fared even worse.

[40] There is the related concern that due to inevitable lags hyperinflation would still dilute inflation indexation, thus weakening its attractiveness. This concern appears academic, however, since in such a extreme situation any form of

Conditions of favorable and improving returns on peso claims relative to dollar claims facilitated the transition in a number of successful cases. Monetary policy induced a favorable evolution of relative real returns at the beginning of the transition in Israel and Poland, where dedollarization success started with a successful disinflation program based on the exchange rate that tilted ex-post real returns against dollar deposits. Mexico dedollarization took hold after 1988 as the process of real exchange rate appreciation made peso instruments more attractive to depositors fearful of the traditionally weak peso (as noted, in the years after the forced conversion in 1982 it suffered severe credit contraction and capital flight that authorities weathered).

Is Dedollarization Feasible?

If the fight against excess FD is feasible, why haven't most countries afflicted by high FD attempted to fight against it, or at least not in a resolute way along the lines reviewed in this section, and succeeded? One key answer is that it is only after recent experiences that the staggering costs of high FD have been revealed, so we can expect more policy action in the future.[41] Furthermore, only now with more flexible exchange rates and low inflation levels conditions are set for a substitution of peso for dollar instruments within the reach of policy. In fact, recent trends indicate that a number of countries are currently embarked in dedollarization (e.g. Argentina, Colombia, Peru, Uruguay) and that FD is slowly receding. The dedollarization purpose and achievement is clear in the structure of public debt of major countries: Mexico has been paying down foreign (dollar) public debt after the Tequila crisis, Brazil has dramatically

indexation or contracting would also be at risk, including dollar indexation (witness Argentina's pessification of dollar contracts).

[41] In fact, Herrera and Valdes (2003) conclude that learning from the dollarization-driven crises of the early 60s and 80s helped policymakers and market agents to converge in the healthy financial system developed afterwards in Chile.

reduced dollar and dollar-indexed liabilities (debt and guarantees) for local currency debt at a substantial cost, and Argentina has also drastically reduced its share of dollar public debt in the context of its recent debt restructuring by offering a valuable (that is, relatively expensive) conversion option for inflation-indexed bonds. A number of countries are issuing inflation-indexed public debt, such as Argentina, Brazil, Bolivia, Chile, Colombia, Costa Rica, Peru and Uruguay.

Yet, the timidity of the dedollarization strategies even today suggests that dedollarization policy, like all investments, impose up-front costs but delivers benefits only in the future; it is possibly too costly or risky to launch in bad economic situations and too unappealing to short-sighted politicians in good economic situations.[42] The implication is that it will be important to think in domestic institutions or outside influence, for example conditionality by multilateral organizations, that can help compensate this status quo bias.

V. FINANCIAL DEDOLLARIZATION STRATEGY

Based on the theory and evidence reviewed in the previous sections, the proposed dedollarization strategy addresses externalities leading to excessive FD by setting the right incentives, both concerning markets and policies, and promotes markets and institutions that may provide a better contracting environment resulting in lower warranted FD. The former involves policies to constrain and alter private *incentives* to discourage the choice of FD under the circumstances and the latter for policies to change the circumstances by promoting attractive *substitutes* of FD. It does so in a coordinated fashion once favorable conditions for success are present.

The strategic approach is one of competing with the dollar, as opposed to bringing down the dollar. In this strategy, markets for dollar substitutes, missing at the moment, are the main characters and antidollarization policies are supporting cast. This approach is based on the potential benefits and risks that each track offers. Antidollarization policies alone cannot get too far in the road of success and pose a number of severe risks. The development of dollar substitutes potentially offers enormous benefits, including greater scope for antidollarization policies, in a safer manner. In what follows I elaborate on this analysis.

Antidollarization Policy: Aligning Private Incentives and Prudential Regulation

The most effective and safer way to align private incentives to social returns is to eliminate the source of the distortion. While this clean approach to excessive FD is generally infeasible and policy needs to aim at compensating distortions, addressing the distortions created by currency-blind bankruptcy law by legal reform appears to be a case in which a rather direct approach is feasible. As discussed in section III, bankruptcy law gives an opportunistic advantage to dollar financing due to its likely increase in relative value under default. Reform would introduce the conversion of dollar claims to pesos for the purpose of the allocation of bankruptcy liquidation or debt restructuring haircuts according to a formula that eliminates the ex-ante advantage and restores currency neutrality (and efficiency) to the financing currency choice on this account.[43] In the same vein, one way to deal with moral hazard currency disparities in banking would be to specify a penalized conversion formula for dollar claims for the purpose of granting official

[42] Perhaps a crisis calling for a restructuring is an ideal opportunity for converting dollar claims: it was fully exploited by Chile in the 1980s but it may have been partially lost by Argentina in recent crisis.

help.[44] (This proposed approach to curtail excessive FD, and similar to the circuit breaker proposal in Ize, Kiguel and Levy-Yeyati (2005) for managing liquidity risks under FD, is intended to be formally stipulated ex-ante, not as a surprise ex-post resolution mechanism.)

More generally, the existence of a special crisis regime in which contracts (in our case dollar contracts) are altered in pre-specified ways bears a clear parallel with the automatic debt roll over triggers (Buiter and Sibert 1999) and collective action clauses being proposed for international bonds, which would enable or facilitate contingent debt restructuring. If the ill effects of high liability dollarization are mostly felt in cases of real exchange depreciation and crisis, then it may make sense to build in escape clauses that apply in that contingency. Such approach would retain most of the inflation protection advantage that makes dollar lending attractive to savers while moderating most of its private and social costs, and may therefore be more efficient than traditional blunt antidollarization penalties in prudential regulation, to which I now turn.

Aligning private incentives requires currency-sensitive financial prudential regulation. Currency-specific capital requirements, in the spirit of a value-at-risk approach, would eliminate the FD bias induced by moral hazard. If moral hazard is an important distortion for some of the reasons identified, then dollar lending to non-tradable firms ought to be subject to higher requirements, such as higher capital and liquidity requirements, and dollar deposits to higher deposit insurance and liquidity provision premia. Alternatively, requirements could take the form of quantity ceilings on dollar lending. Moral hazard driven FD calls for safeguards that limit the expectation

[43] I highlight here that the similarity with Argentina's surprise pessification of dollar claims is misleading because in this proposal the conversion rule would be known ex-ante, at contracting time.

[44] This discriminatory approach at crisis time could also be applied to both currency of denomination and maturity in order to protect the core of the banking system when official resources are not enough in systemic crises, as it was

of implicit guarantees and bailouts, in particular concerning dollar borrowing. The pro-dollar bias of currency-blind deposit insurance can be addressed with currency-sensitive insurance coverage or premia. Similarly, currency-specific liquidity requirements may also be needed to further level the playing field taking into account the differential risks of liquidity crises and the fact that it is more costly for the Central Bank to hold adequate reserves to cover dollar deposits; otherwise FD is excessive (Ize, Kiguel and Levy-Yeyati, 2005). All these policy interventions can be summarized in equation (9), where intermediated onshore dollar deposits are penalized on account of these distortions.

Most suggestions in the literature concerning currency-sensitive, antidollarization, financial prudential regulation refer to the banking system, which is at the core of FD and of the policy externalities. However, the market externalities I emphasized in Section III relate to dollar borrowing by non-tradable firms, not necessarily bank deposits or bank lending. The corresponding implications for prudential regulation ought to extend to the internalization of the social cost of liability dollarization of non-tradable firms beyond the implications for bank risk or systemic credit risk of the banking system. Furthermore, as noted, in many instances optimal policy requires taking into account the leverage and financial risks of firms, not only the nature of their revenue. If some of the externalities identified are substantial, this approach calls for a rethinking of the limits of bank prudential regulation to serve objectives of macrofinancial stability beyond banking discipline and banking system risk.

It is not clear how substantial is excessive FD due to market and policy distortions. It may very well be that ideal financial prudential policy would leave a very high level of warranted FD, thus

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done in the recent Uruguayan banking crisis in which sight deposits were fully insured and long-term dollar deposits

failing to make a significant dent to FD and its associated problems even if perfectly implemented. Furthermore, even if the externalities addressed by prudential policy are well identified, I will argue in what follows that antidollarization policy of this kind involves very significant risks of turning counterproductive. For both reasons, the proposed dedollarization strategy does not rely on antidollarization policies and is cautious about its use. One pitfall of an antidollarization focus is the risk of going overboard, beyond the elimination of excessive FD. It is easy to see how policies intended to alter incentives or constrain financial choices to correct mispricing due to externalities may go awry. We know little about the size of the interventions required to deal with the most important externalities, so the risk of keep increasing the dose of the treatment until the desired result in terms of a substantial reduction in FD shows is substantial. In fact, the case has been made that quantities rather than prices may be the most suitable policy instrument given the nature of the problem (Levy-Yeyati, 2003), so policy may take the form of substantial (and arbitrary) quantitative ceilings of FD from the start. If excessive FD is mainly due to poor fundamentals underlying high warranted FD, then an antidollarization policy attempt which would not stop until succeeding in substantially bringing down FD would go too far, be counterproductive, and lead to capital flight and financial disintermediation.[45] This theoretical risk is reminiscent of many of the failed dedollarization experiences. The other major risk of antidollarization policy is risk displacement or fighting symptoms: favoring other harmful forms of debt financing springing from the same disease as an unintended consequence of narrowly fighting FD. FD is only one manifestation of financial

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were reprogrammed for banks that needed help.

[45] It is tempting to refer to successful experiences of prudential regulation without realizing that good regulation crucially depends on the availability of suitable substitutes for dollar financing. Chile's prohibition of bank dollar lending to non-tradable firms may be appropriate for Chile given the availability of long-term UF-financing (in this case the ban would remove a small level of latent FD that would arguably be excessive) but would be inappropriate for a banking system without suitable peso alternatives, where a ban would remove far more than excessive FD and would mean a collapse of financing, especially long-term, to the non-tradable sector.

adaptation to a weak peso; short duration of peso contracts (either short maturity or floating rates) is another protective device against surprise inflation and it is likely to be seen as a preferred alternative to dollar savings (De la Torre and Schmukler, 2003). Policies specifically addressing excessive FD will likely produce shrinking financial duration and heighten the attendant financial fragility risks, which are cousins of the ones associated with FD.[46] Similarly, bank regulation may push financing to unregulated institutions. Sound currency-sensitive bank regulation needs to take into account this substitution for harmful dollar alternatives.

Dedollarization by Substitution: Market Development and Supporting Institutions

By contrast, the development of dollar substitutes in a competing-with-dollarization frame of mind can moderate risk displacement and the deleterious effects of going overboard with antidollarization policy by providing one good alternative to harmful dollar substitutes and financial disintermediation. The development of attractive substitutes would give traction to marginal antidollarization incentives. A substitution approach based on better fundamentals to back local currency financing and the development of healthy peso instruments, for example inflation-indexed, is a remedy of wide spectrum that would erode not only FD but also compete favorably with other risky adaptations such as short duration financing. As shown in both the theoretical analysis and the dedollarization experiences, the key missing market for dedollarization is the inflation-indexed peso market. Even in this idealized context, this new market may not eliminate FD altogether because of original sin (from the perspective of foreigners, inflation-indexed peso terms are better than nominal peso terms but still carry

[46] The positive correlation between dollarization and maturity confirms this prediction. Repressed FD in Brazil also attest to this prediction

exchange rate risk, and therefore do not dominate nominal dollar terms).[47] Furthermore, most of the externalities analyzed in Section III would also apply in this new market to some lesser extent (for example, the dollar would retain bankruptcy advantages on account of real depreciation, instead of nominal). Additionally, inflation-indexation would not be the best indexation scheme in a more complex portfolio model. For example, some form of GDP-indexation may be theoretically better to balance the borrowers' matching of revenues and the lenders desire to hedge non-financial income as in equation (5').[48] But it would clearly go a very long way in reducing FD.

How to jump-start this missing market? Three key players stand out. First is the banking system: banking regulation should play an important role to favor its development in banking while ensuring the matching between bank assets and liabilities. Second, institutional investors such as pension funds and life insurance companies have a natural demand for long-term inflation-indexed claims because their liabilities are indexed similarly, which can be further strengthened by regulation. And finally, the government can be a debt issuer in the context of an active public debt management policy. However it is jump-started, low liquidity will probably be a weak point of this market, especially at the beginning. This and the existence of switching costs, possibly associated with the complexity of a synthetic instrument, imply that public policy may need to subsidize the initial development phase directly or by regulation. An initial subsidy on a temporary basis may be critical to compensate the coordination failure that is bound to exist until markets are fully established. Even then, the experience shows that developing this market is difficult (see Shiller 1998). The key factor that may derail the whole enterprise is lack of trust

[47] Nevertheless, it is a step in the right direction and may be a first step to address original sin, consistent with the proposal in Eichengreen, Hausmann and Panizza 2002.

[48] On the other hand, multiple inflation indexes to cater to agents' preferences and the hedging properties of GDP-indexation would be particularly useful but have practical drawbacks (Shiller 1998, Borenzstein and Mauro, 2002).

in the computation and enforcement of the index, in part bred by complexity but in large measure associated with concerns with moral hazard on the part authority. Institutional reform to ensure the integrity of the index in such a way that any deviation would be verified as a breach of contract (like any other undue alteration to financial contracts) appears critical for success.

Another suitable substitute of dollar debt financing often forgotten is equity financing. So far domestic savings channeled through debt claims have been taken as given in the portfolio models, but leverage is a variable subject to policy influence. In fact, equity financing is another natural protection against inflation risk. A full court pressing dedollarization strategy ought to include incentives on the margin for the promotion of vehicles of equity financing. Furthermore, foreign equity investment (FDI as well as portfolio) is for the same reason a relevant aspect of dedollarization strategy and possibly the first step in addressing the problem of original sin when viewed in this broader perspective (see Fernandez-Arias and Hausmann 2001). The establishment of a risk-free peso market, currently missing, would allow the separation of default and inflation risk, which are currently bundled together in the onshore peso market. As we saw, this development would have traction and lead to lower warranted FD only if there are savers who may potentially be willing to hold peso claims (absorb inflation risk) but are especially inapt to handle country credit risk to the extent that all their dollar claims are offshore. This may very well be relevant in high default risk countries, in the case of extremely risk averse savers and of institutional investors mandated to avoid risks by regulation, such as pension funds.

Risk free multilateral development bank loans may be able to provide such separation by intermediation in pesos (Levy-Yeyati 2004). Their ability to issue investment grade local currency instruments and be counterpart in the currency swap market, both in nominal pesos and in inflation-indexed pesos, would complete markets and may be effective in creating a local

currency claim that can substitute for dollar claims. However, these institutions are intermediaries with full currency matching and therefore would need to raise peso funding. If original sin persists, as it should theoretically, and this funding is in local markets, countries with difficult access to external financing may lose the share traditionally secured by these institutions. So it is not clear that high default risk countries are the best candidates for this market.

All public policies need to be ready to support the development of these new markets. Financial prudential regulation plays a critical role in supporting the development of dollar substitutes, in harmony with the rest of the effort. Dollar substitutes, such as inflation-indexed instruments and equity-like financing (or leverage considerations), need to be incorporated in a coherent prudential regulation. Public debt management can also play a fundamental role in fostering these new markets. It is one large player which may issue inflation-indexed debt and make it appetizing for domestic institutions and the public at large.[49] It can join efforts with multilateral development banks to develop new peso markets by borrowing from these institutions in these new markets. It can contribute to the technical aspects of these markets, such as building a reference yield curve to help long-term private debt markets and liquid derivative markets.

Apart from the direct contributions to the development of peso markets, public debt management can provide an indirect contribution by dedollarizing public debt in order to ensure fiscal sustainability (in the usual case in which public sector balance and net worth is linked to non-tradables). In fact, fiscal soundness is the basis for other supporting policies. For example, controlled inflation is key for nominal peso markets and is likely to also benefit inflation-indexed peso markets by reducing the temptation of manipulating the index. It is fundamental for this market that the credibility of the index be backed with a stable monetary and fiscal position,

along with specific strong supporting institutions to ensure independence in the production of the index and outside oversight. (In this regard, indexation to exogenous variables such as commodity prices would be much easier to implement, but at the same time less useful as dollar substitute).

A flexible exchange rate coupled with an inflation anchor, as in inflation targeting regimes, is the ideal setting for supporting peso instruments as substitutes of dollar instruments. A flexible exchange rate in this context implies real volatility, which discourages dollar financing. Furthermore, by avoiding protracted real exchange rate overvaluation it eliminates the peso problem and reduces the hedging value of dollar claims vis a vis non-financial incomes in crisis situations. More generally, Caballero and Krishnamurthy (2004) show how indexing inflation targeting and foreign exchange interventions to negative external shocks (committing to a countercyclical monetary policy) may also diminish incentives for FD. The realization of the large costs associated with FD call for a reassessment of the benefits to invest in policies and institutions that strengthen the local currency. For example, inflation targeting, the independence of the Central Bank, the credibility of the inflation index, the strength of the fiscal institutions to back all of the above, are all policy concerns that belong to a policy objective of dedollarization and may pass the political cost/benefit test once the gains from such objective are realized.

Favorable Conditions for Launching

Despite the risks involved in antidollarization prudential policies, they are likely to be needed in conjunction with the policy package to develop inflation-indexed and other new peso markets for a successful launching. These market and institutional development initiatives have large set-up

[49] At the same time, by acquiring a direct interest in the index it detracts from its credibility, which will need to be

costs and any help to push them past the first hump is important. In fact, the case can be made for going beyond the appropriate incentives to eliminate excessive FD above warranted FD under current markets conditions in order to impel the switch to dollar substitutes as a way of diffusing set-up costs, although such move has to be carefully weighed against the risk of instability.

If it were not for the enormous financial disintermediation cost of failure, shock treatment of dollarization, including forced conversions, would be recommendable as a way of saving transition costs to the new low FD equilibrium and ensuring obtaining needed critical mass to dislodge dollarization in cases of multiple equilibria.[50] The evidence on shock treatment is mixed: it was an element in some successful experiences but it was also an element in some of the disasters. While it remains a judgment call, it appears that shock treatment may be reasonably used as a device to speed up a transition to a much lower warranted FD that looks certain and as long as its catalytic role is well understood.[51] Otherwise, if prospects are unclear or a blunt policy intervention may constitute a signal of market unfriendliness, shock treatment appears too risky. In any event, it is important to count with the ability to impede capital flight to dampen temporary instability in the transition and to have good access to foreign financing to back financial intermediation if the attempt to reduce domestic financial dollarization is not sufficiently successful and capital flies. This coordinated policy effort should be launched when circumstances are most conducive to success, such as an expected relative low real return of domestic dollar savings (e.g. expected real appreciation) to sweeten the exit from dollar assets and macroeconomic stability to lend credibility to the peso substitutes. Current circumstances appear right for this. Furthermore, the current tendency for real exchange rate appreciation

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strengthened by other means.

[50] The theoretical case of a bad equilibrium is easier, not harder, than the case of unique equilibrium, because dedollarization may not require effort. The case for policy effort in this case is based on a large payoff, not low policy effectiveness.

following dramatic peg adjustments in some of the countries and the tendency for real depreciation of the US dollar, the currency of denomination of most foreign currency debt, is facilitating this transition because it dilutes dollar debts and calms down fear of floating.

[51] Argentina exemplifies an interesting case in which shock treatment was the unintended result of crisis resolution. If a coherent policy is designed around this new initial condition, this structural change may be a silver lining of the crisis.

VI CONCLUDING REMARKS

Liability dollarization is a major financial fragility and source of growth instability in several countries, especially those with high domestic financial dollarization. Domestic financial dollarization, i.e. domestic savings held in dollar claims, is in large part explained by a portfolio decision seeking to protect savings from inflation risk and to hedge the loss of non-financial income during economic downturns. This mistrust on the value of the peso warrants very high FD. On top of that, observed FD is further in excess due to market and policy failures that allow agents not to face the full social costs of dollar debt. There is therefore a clear case for dedollarization policy by: a) aligning private incentives with social costs of FD; and b) developing better peso markets to reduce warranted FD. The dedollarization record shows that success is hard but possible. Three main lessons emerge. First, antidollarization prudential policy is necessary but risky. The two other lessons have to do with how to contain the risks of capital flight and financial disintermediation that may follow.. Second, the availability of a reasonably attractive peso substitute for dollar claims, namely indexed peso debt, is key for success (and hard to develop). And finally, favorable economic conditions are important to entice the currency switch and back temporary financial instability.

From this theory and evidence I derive a dedollarization strategy. The proposal recommends antidollarization policies to redress market and policy distortions, expanding traditional bank prudential regulation. However the strategy does not rely on this component because it offers doubtful effectiveness to bring FD to safe levels and poses severe risks of instability. Rather, the strategic approach relies on the development of attractive peso markets to reduce warranted FD. It is aimed at policies on fundamentals rather than incentive or mandatory policies. Special attention is paid to the development of missing markets such as inflation-indexed and risk-free peso markets that may be important to reduce domestic financial dollarization and the roles that

various national institutions and multilateral development banks (MDBs) can play. Dedollarization is possible and current conditions are conducive for a successful launching.

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Table 1 - Financial Dollarization in Developing Countries (1996-2001 average)

Country	Index			
	Foreign currency bank deposits (% of broad money)	Foreign currency domestic public debt (% domestic public debt)	External Debt (% of GNI)	Composite
	(1)	(2)	(3)	(4)=(1)+(2)+(3)
Ecuador	70	90	90	250
Bolivia	80	70	70	220
Uruguay	90	90	40	220
Argentina	60	90	50	200
Nicaragua	70	0	100	170
Peru	60	40	60	160
Paraguay	50	60	40	150
Honduras	30	0	100	130
Jamaica	40	0	70	110
Guyana	0	0	100	100
Costa Rica	40	20	30	90
El Salvador	20	30	30	80
St. Kitts and Nevis	30	0	50	80
Brazil	0	30	40	70
Guatemala	0	40	30	70
Chile	10	10	50	70
Belize	0	0	70	70
Haiti	30	0	30	60
Trinidad and Tobago	20	0	40	60
Venezuela	10	0	50	60
Dominica	0	0	60	60
Grenada	0	0	60	60
St. Vincent and the Grenadines	0	0	60	60
Colombia	0	10	40	50
Mexico	10	0	40	50
St. Lucia	0	0	40	40
Dominican Republic	0	0	30	30
Mean of LAC	**26.7**	**21.5**	**54.4**	**102.6**
Mean of non LAC	**17.4**	**1.9**	**63.1**	**82.4**
75-percentile LAC	**45**	**35**	**65**	**140**
75-percentile non LAC	**30**	**0**	**90**	**100**

Source: Reinhart, Rogoff and Savastano (2003) and author's calculations

Note: Percents rounded to the closest ten (and truncated at 100%)

Table 2 - Asset sources of liabilities dollarization (end 2001 as a % of GDP)

(non-industrial economies excluding offshore centers)

Country	Domestic dollar lending (D^*-fD) (1)	External lending (E^*) (2)	Domestic dollar savings (D^*) (3)	Net foreign savings $(E - fD)$ (4)	Liability dollatization L^* (5) = (1)+(2)=(3)+(4)	Domestic liability dollarization (%) Min (6a) = (1)/(5)	Max (6b) = (3)/(5)
Nicaragua	51	228	84	195	279	0.18	0.30
Uruguay	46	47	91	2	93	0.49	0.98
Croatia	42	45	74	13	88	0.49	0.85
Philippines	16	68	31	53	84	0.19	0.37
Indonesia	11	67	20	57	77	0.14	0.26
Argentina	17	58	26	50	76	0.23	0.34
Jamaica	9	59	36	32	68	0.13	0.53
Turkey	14	53	25	41	67	0.21	0.38
Moldova	8	56	20	43	64	0.12	0.32
Peru	17	38	31	24	55	0.31	0.57
Egypt	17	33	38	13	51	0.34	0.75
Bulgaria	16	31	35	12	47	0.33	0.75
Malaysia	4	43	18	28	46	0.08	0.39
Chile	5	41	26	20	46	0.10	0.56
Hungary	8	36	16	28	44	0.18	0.36
Thailand	1	43	15	30	44	0.03	0.33
Slovak Republic	11	27	20	17	37	0.28	0.53
Lithuania	9	23	16	16	32	0.29	0.51
Dominican Republic	7	25	18	14	32	0.21	0.55
Guatemala	0	31	15	16	32	0.01	0.48
Latvia	10	20	21	9	30	0.33	0.69
Czech Republic	8	20	32	-4	28	0.29	1.13
Estonia	7	19	20	6	26	0.28	0.77
Romania	5	21	11	15	26	0.18	0.42
Kazakhstan	7	18	12	14	26	0.29	0.47
Poland	7	18	18	7	25	0.30	0.71
South Africa	4	18	18	4	22	0.16	0.81
Mexico	2	19	12	9	21	0.09	0.57
Venezuela	0	18	24	-5	18	0.00	1.30

Source: Eduardo Levy-Yeyati (2004) and author's calculation

Table 3 - Elasticity of liability dollarization (l) to domestic FD (d) and external FD (e) (end 2001)
(non-industrial economies excluding offshore centers)

Country	Liability dollarization (l)	Domestic FD (d)	Domestic elasticity ε_d^l	Domestic elasticity ε_d^l	External elasticity ε_e^l
	(1)	(2)	(3)	(4)	(5)
Nicaragua	0.93	0.80	0.75	0.30	0.82
Argentina	0.92	0.81	0.76	0.34	0.77
Uruguay	0.92	0.92	0.87	0.98	0.51
Moldova	0.89	0.71	0.70	0.32	0.88
Turkey	0.87	0.72	0.72	0.38	0.79
Peru	0.86	0.78	0.79	0.57	0.69
Romania	0.84	0.69	0.71	0.42	0.82
Croatia	0.84	0.81	0.85	0.85	0.51
Kazakhstan	0.82	0.68	0.72	0.47	0.71
Bulgaria	0.80	0.75	0.82	0.75	0.67
Lithuania	0.75	0.60	0.70	0.51	0.71
Latvia	0.70	0.62	0.77	0.69	0.67
Jamaica	0.70	0.55	0.69	0.53	0.87
Philippines	0.70	0.46	0.58	0.37	0.81
Indonesia	0.65	0.32	0.43	0.26	0.86
Guatemala	0.62	0.43	0.61	0.48	0.99
Hungary	0.58	0.34	0.50	0.36	0.82
Mexico	0.56	0.42	0.65	0.57	0.91
Dominican Republic	0.55	0.40	0.64	0.55	0.79
Chile	0.54	0.40	0.64	0.56	0.90
Venezuela	0.54	0.60	0.97	1.30	1.00
Egypt	0.49	0.42	0.74	0.75	0.66
Estonia	0.49	0.42	0.75	0.77	0.72
Poland	0.44	0.36	0.71	0.71	0.70
Slovak Republic	0.43	0.29	0.58	0.53	0.72
Malaysia	0.33	0.16	0.43	0.39	0.92
Czech Republic	0.33	0.36	0.94	1.13	0.71
Thailand	0.32	0.14	0.37	0.33	0.97
South Africa	0.29	0.25	0.74	0.81	0.84

Source: Eduardo Levy-Yeyati (2004) and author's calculation

$$l = \frac{L^*}{L} \quad \text{and} \quad d = \frac{D^*}{D}$$

where: L* is liability dollarization (see table 2), D* is domestic dollar savings (see table 2), L is total liabilities, D is total domestic savings

so that $(1-l) = (1-d)\frac{D}{L} + (1-e)\frac{E}{L}$ with $e = 1$ (original sin)

Note: $\varepsilon_d^l = \frac{\Delta l / l}{\Delta d / d}$ and $\varepsilon_e^l = \frac{\Delta l / l}{\Delta e / e}$

In column 3 $\varepsilon_d^l = \frac{d}{l}(0.89)$ from regression-based cross-country estimating equation $\hat{l} = 0.19 + 0.87d$

In column 4 $\varepsilon_d^l \frac{d}{l}\frac{D}{L}$ assuming constant *D/L*

In column 5 $\varepsilon_d^l = \frac{1}{l}\frac{E}{L}$ assuming constant *E/L* at *e=1*

Appendix

What drives domestic financial dollarization?

$$r_p = E[r_p] - e_i - e_d$$
$$r_d = E[r_d] - e_x - e_d$$
$$P = (1-d)r_p + dr_d$$
$$\Rightarrow P - E[P] = -(1-d)e_i - de_x - e_d$$

$$\underset{d}{Min} \quad V[P] = (1-d)^2 V_{ii} + d^2 V_{xx} + V_{dd} + 2(1-d)dV_{ix} + 2(1-d)V_{id} + 2dV_{xd}$$

F.O.C.: $V'[P] = 0$

$$\Rightarrow d^* = \frac{V_{ii} - V_{ix} + (V_{id} - V_{xd})}{V_{nn}} = \frac{V_{ii} - V_{ix}}{V_{nn}} \quad \text{if} \quad V_{id} = V_{xd}$$

S.O.C.: $V''[P] = V_{ii} + V_{xx} - 2V_{ix} = V_{nn} > 0$

Safe haven financial dollarization

$$Cov[I,P] = V_{IP} = -(1-d)V_{Ii} - dV_{Ix} - V_{Id}$$
$$F.O.C.: V'[P] + 2(V_{Ii} - V_{Ix}) = V'[P] + 2V_{In} = 0$$
$$\Rightarrow d^{*'} = \frac{V_{ii} - V_{ix} - (V_{Ii} - V_{Ix})}{V_{nn}} = \frac{V_{ii} - V_{ix} - V_{In}}{V_{nn}}$$

Borrower's risk aversion

If borrowers are also risk averse with coefficient b>0, then:

$$\underset{d}{Max}\, E[I] + E[P] - a(V[I] + V[P] + 2Cov[I,P])$$
$$\underset{d}{Max}\, E[S] - E[P] - b(V[S] + V[P] - 2Cov[S,P])$$

Joint efficiency leads to:

$$\Rightarrow \underset{d}{Min} V[P] + 2\lambda V_{IP} - 2(1-\lambda)V_{SP}, \quad \text{where} \quad \lambda = \frac{a}{a+b}$$

$$F.O.C.: V'[P] + 2\lambda V_{In} - 2(1-\lambda)V_{Sn} = 0$$

If $V_{Sn} = -V_{In}$, then $d^{*''} = d^{*'}$ (neutral borrowers' risk aversion)

If $V_{Sn} < -V_{In}$, then $d^{*''} < d^{*'}$ (less dollarization)

Erg. $S = G - I$ (Net revenue = Gross revenue – Wages)

If $V_{Gn} < 0$, then $V_{Sn} = V_{Gn} - V_{In} < -V_{In}$

Costly default

If default is costly to the contracting parties, including efficiency costs that may occur in near-default situations, then there would be a wedge between costs incurred by borrower and benefits enjoyed by lender. For simplicity I go back to the simplest portfolio model in which income covariances are ignored and borrowers are risk neutral (results would be strengthened otherwise). In this model this cost wedge can be represented as an additional expected payment cost *w* incurred by the borrower. The new equilibrium conditions are:

$\underset{d}{Max}\ E(P) - aV(P)$ and $\underset{d}{Max} - E(P) - w(d)$

Joint maximization efficiency yields:

$\underset{d}{Min}\ V(P) + (1/a)w(d)$

It is possible to construct models in which peso debt is riskier than dollar debt from the point of view of the firm's solvency (Jeanne 2002), but, as justified before for the assumption $Cov_d(S,-P) > 0$, the relevant case appears to be that dollar debt is riskier. In that case *w'(d)>0* and equilibrium dollarization would be moderated ($\tilde{d} < d^*$) as a way for the parties to avoid default costs.

Financial dollarization and international lending

$$r_f = (r-k) - e_x$$
$$P = (1-d)r_p + (d-f)r_d + fr_f$$
$$P - E[P] = -(1-d)e_i - de_x - (1-f)e_d$$
$$V[P] = (1-d)^2 V_{ii} + d^2 V_{xx} + (1-f)^2 V_{dd} + 2(1-d)dV_{ix} + 2(1-f)(1-d)V_{id} + 2d(1-f)V_{xd}$$

$\underset{d,f}{Min}\ \ r - fk - aV[P]$ yields:

$$F.O.C._d:\ V_d'[P] = 0 \Rightarrow d^* = \frac{V_{ii} - V_{ix} + (1-f^*)(V_{id} - V_{xd})}{V_{nn}}$$

$$S.O.C._d:\ \ V_{nn} > 0$$

$$F.O.C._f:\ \ -k - aV_f'[P] = 0$$

$$\Rightarrow f^* = 1 - \frac{\frac{k}{2a} + V_{id} - d^*(V_{id} - V_{xd})}{V_{dd}}$$

$$S.O.C._f: V_{dd} > 0$$

$$d^* = \frac{V_{ii} - V_{ix}}{V_{nn}} \quad \text{if} \quad V_{id} = V_{xd}$$

$$f^* = 1 - \frac{k}{2aV_{dd}} \quad \text{if} \quad V_{id} = V_{xd} = 0$$

All of the above holds under the maintained assumption that $d^* \geq f^*$.

If $d^* < f^*$, then corner solution $d^{**} = f^{**}$.

(See solution below under Ban on onshore dollar deposit)

Financial dedollarization and shrinking credit

$$\underset{d,f}{Max} \quad r - dt - f(k-t) - aV[P]$$

$$F.O.C._d : -t - aV_d'[P] = 0$$

$$\Rightarrow d(t) = d^* - \frac{t}{2aV_m}$$

$$F.O.C._f : t - k - aV_f'[P] = 0$$

$$\Rightarrow f(t) = f^* + \frac{t}{2aV_{dd}}$$

- Ban on onshore dollar deposit $(d = f)$

$$V[P] = (1-d)^2 V_{ii} + d^2 V_{xx} + (1-d)^2 V_{dd} + 2(1-d)dV_{ix}$$

$$F.O.C.: -k - aV'[P] = 0$$

$$\Rightarrow d^{**} = \frac{V_{ii} - V_{ix} + V_{dd} - \frac{k}{2a}}{V_{nn} + V_{dd}} = \frac{V_{ii} - V_{ix} + f^* V_{dd}}{V_{nn} + V_{dd}} = f^{**}$$

If $a, b, c, d > 0$, and $\frac{a}{b} > \frac{c}{d}$, then $\frac{a}{b} > \frac{a+c}{b+d} > \frac{c}{d}$

Let $d^{**} = \frac{a+c}{b+d}$ where $\frac{a}{b} = d^*$ and $\frac{c}{d} = f^*$

$\Rightarrow f^* < d^{**} < d^*$

(If $d^{**} = f^{**}$ is a corner market solution because $d^* < f^*$,

then $\frac{a}{b} = f^*$, $\frac{c}{d} = d^*$., and then $d^* < d^{**} < f^*$)

- *Tax on all domestic dollar lending.* Consider a tax t on overall domestic dollar lending from all sources, so that there is a wedge in expected returns between lender and borrower (to simplify assumed to be payable up-front, so that its real value is not subject to uncertainty and return volatilites are not affected).

Expected borrowing cost pinned down by external debt is now $r+t$; peso lenders receive this higher expected return but onshore dollar lenders, both residents and foreigners, only receive the after-tax expected return *r* (offshore dollar lending cannot be taxed and continues to receive the prevailing expected return $r-k$):

(9') $\underset{d,f}{Max}\ E(P)-aV(P)=r+(1-d)t-fk-aV(P)$ w/tax *t* on domestic dollar lending

$F.O.C._d: -t-aV_d'[P]=0$

$F.O.C._f: -k-aV_f'[P]=0$

(10') $d'(t)=d(t)=d^*-(t/2aV_{nn})<d^*$

(11') $f'(t)=f^*$

The downside of this policy is that credit shrinks because the effective cost of borrowing is now $r+t$, which depresses overall domestic financing *L*. At the same time domestic savings *D* would increase as effective return in (9') increases (on account of higher returns on peso savings). (If a subsidy *s* on peso lending is granted to neutralize the budgetary impact of the financial tax revenue, then the return wedge widens to $s+t$ and the effect on domestic financial dollarization *d'* and domestic savings *D* would be even stronger.) Both lower domestic FD *d'* and lower reliance on external financing (higher *D/L)* contribute to lower liability dollarization. Furthermore, external debt also declines (because domestic absorption declines as offshorization remains).

- *Selective tax on foreign borrowing.* Consider a tax at rate *t* applied to foreign borrowing, which will increase cost of borrowing and onshore domestic lenders' expected return to *r+t* (offshore deposits, however, will fetch the same return, and therefore relatively lower by a gap of *k+t*):

(9'') $\underset{d,f}{Max}\ E(P)-aV(P)=r+t-f(k+t)-aV(P)$ w/tax *t* on external debt

$F.O.C._d: V_d'[P]=0$

$F.O.C._f: -t-k-aV_f'[P]=0$

(10'') $d''(t)=d^*$

(11'') $f''(t)=f^*-(t/2aV_{dd})<f^*$

Offshorization and external debt are lower but domestic dollarization *d* is unaltered. Liability dollarization would be reduced by less than in the previous case (unless the additional expansion of domestic savings *D* by virtue of increased returns in onshore dollar lending more than compensates higher domestic FD).

Notice that this tax on external debt at a rate *t* is, from a portfolio viewpoint, equivalent to a corresponding increase in the capital flight return gap to $k+t$. Direct restrictions to domestic savings abroad would amount to the same thing (implicitly, an increase in the capital flight return gap *k*). The implication is that, even if feasible, restrictions to capital flight would not be effective for the purpose of dedollarization: their use would avoid financial disintermediation (and reduce external debt) but would not have any effect on dollarization *d**, which holds for any level of offshorization *f*. In this model, (effective) restrictions to capital flight would only shift dollar savings from offshore to onshore without producing additional peso savings (and possibly reducing them in tandem with lower domestic savings *D* as portfolio returns decrease). (If the country is credit constrained by an external debt ceiling, however, impediments to capital flight would increase available loanable savings and increase financial intermediation and credit, but would still fail to dedollarize).

Dollar substitutes

$$r_r = r - e_d$$
$$P = (1-d-N)r_r + Nr_p + (d-f)r_d + fr_f$$
$$P - E[P] = -Ne_i - de_x - (1-f)e_d$$
$$V[P] = N^2V_{ii} + d^2V_{xx} + (1-f)^2V_{dd} + 2NdV_{ix}$$
$$F.O.C._d : V_d'[P] = 2(dV_{xx} + NV_{ix}) = 0$$
$$F.O.C._N : V_n'[P] = 2(NV_{ii} + dV_{ix}) = 0$$
$$F.O.C._f : -k - aV_f'[P] = -k + 2aV_{dd}(1-f) = 0$$

For interior solution, $f = f^*$, $N = d = 0$, which is incompatible because $d < f \Rightarrow$ Corner solution $d = f$.

$$V[P] = N^2V_{ii} + d^2V_{xx} + (1-d)^2Vdd + 2NdV_{ix}$$
$$F.O.C._d : -k - aV_d'[P] = -k - 2a(dV_{xx} + dV_{dd} - V_{dd} + NV_{ix}) = 0$$
$$F.O.C._n : V_n'[P] = 2(NV_{ii} + dV_{ix}) = 0$$
$$\Rightarrow F.O.C._d : -k - 2a(dV_{xx} + dV_{dd} - V_{dd} + NV_{ix}) = 0$$
$$\Rightarrow d^{***} = \frac{f^*V_{dd} - N^*V_{ix}}{V_{xx} + V_{dd}} = f^{***}$$

- If $V_{ix} \geq 0$, $N^* = 0$ (corner) $\Rightarrow d^{***} = \dfrac{f^*V_{dd}}{V_{xx} + V_{dd}} < f^*$
- If $V_{ix} < 0$, $N^* = -\dfrac{d^{***}V_{ix}}{V_{ii}}$

  $$\Rightarrow d^{***} = \frac{f^*V_{dd}}{V_{xx}(1-\rho_{ix}^2) + V_{dd}} < f^*$$

Offshore peso market

- $r_p' = (r-k) - e_i$

  $P = (1-d-f')r_p + f'r_p' + (d-f+f')r_d + (f-f')r_f = -(1-d)e_i - (1-f)e_d - de_x$

  Identical to unconstrained original portfolio problem where $d-f$ may be negative (can be accommodated with $f' > 0) \rightarrow (d^*, f^*)$

- $r_r' = r-k$

  $r_r = r - e_d$

  $P = (1-d-f')r_r + f'r_r' + (d-f+f')r_d + (f-f')r_f = -de_x - (1-f)e_d$

  $V[P] = d^2V_{xx} + (1-f)^2V_{dd}$

  $F.O.C._d : 2dV_{xx} = 0 \Rightarrow d' = 0$

  $F.O.C._f : -k + 2a(f-1)V_{dd} = 0 \Rightarrow f' = f^*$