Currency Competition and Inflation Convergence in Latin America

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Abstract: In Latin America, as elsewhere, use of dollars along with local currency is often a legacy of past inflation. There is considerable literature arguing currency competition contributes to financial fragility and exchange rate instability. However, we present a simple model in which central banks respond currency competition by maximizing seigniorage revenue. With open capital markets, as the substitutability and availability of dollars increases, inflation falls and converges on world rates. Empirical evidence for Latin America and about twenty other countries does suggest use of dollars is both a legacy of past inflation and a constraint on future inflation. Among these countries at least, currency competition appears to have accelerated the continuing decline and convergence of emerging market inflation rates over the past decade.

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"*Currency substitution renders the domestic currency decidedly non-essential, expanding the scope for self-validating domestic price spirals. In sum, if weak legal restrictions and an inflationary environment lead to currency substitution, considerable instability in prices and exchange rates can result*."
Obstfeld and Rogoff (1996) page 552 of Section 8.3.8 "Dollarization"

"*Dollarization, for example, in many emerging markets, forces inflation-prone governments to temper their behavior for fear of having residents flee to other currencies."*
Kenneth Rogoff (2003) speaking to central bankers gathered at Jackson Hole, Wyoming.

The usual expression of [Gresham's] law, "bad money drives out good" is a mistake. Schumpeter refers to this common definition as "not quite correct." But as the statement stands, it is not just "not quite correct;" it is quite false. The opposite is true! … "good money drives out bad," is the more correct empirical proposition. Historically, it has been good, strong currencies that have driven out bad, weak currencies. Robert Mundell (1998) "Uses and Abuses of Gresham's law"

Developing country inflation rates have fallen sharply in the past decade, and they appear to be converging on the same "low" 5-6% rate. As Figures 1 and 2 indicate, average inflation fell from 380% annually in 1990 to about 6% in 2003 as the standard deviation of log inflation declined from about 101% to 7% (*σ convergence* in the economic growth literature). Since high inflation hits poor households hardest and wreaks havoc on credit markets, its abatement must be regarded as a major victory for Latin American policy makers.[1] Yet how disinflation occurred amidst the currency and debt crises of the late 1990s remains a something of a mystery. Many expected high inflation to return once Brazil and Argentina floated their currencies, for example, but it did not. The global forces driving inflation lower are not well understood, as Rogoff (2003) emphasizes. Whatever explains Latin America's dramatic and lasting escape from high inflation certainly is a major part of the global disinflation and convergence story.

[1] It is largely an unsung victory, however, perhaps because of Argentina's dramatic default and disappointing overall economic growth during the 1990s. But lower inflation means greater exchange rate stability, a gradual recovery of local credit markets, and, with time, these developments will boost economic growth (and no doubt reverse the dollarization trends). On the effects of high inflation on poverty, see Cardoso (1992) and Romer and Romer (1998).

This paper explores a possible piece of the puzzle: the connection between disinflation and "dollarization." Recent studies focus on dollar liabilities, internal or external, and on full dollarization as in Ecuador and El Salvador.[2] We focus on the use of the dollar as a substitute for local currency in everyday transactions, or more to the point, competition among currencies, typically foreign versus domestic.

As shown in Figure 3 the average share of dollar deposits among twelve Latin countries that report these data drifted up from an average of 30% to 50% during the 1990s. How does creeping dollarization affect monetary policy and inflation? The answer obviously depends on how the monetary authorities react to currency competition. If policy-makers do not take steps to prevent or roll back currency competition, dollarization acts as a constraint on Central Bank behavior as the Rogoff (2003) quote above suggests. Section I sets up this shifting political economy of monetary policy using standard Barro and Gordon (1993) central bank reaction functions. Section II explores the impact of currency competition more concretely, using a basic two-money utility function. Greater substitutability among currencies causes inflation rates to fall and converge, assuming Central Banks optimize under constraints (and, at the limit, even if they don't). "Dollarization" is a legacy of past high inflation, but it also makes future high inflation less feasible. As "dollarization" afflicts high-inflation economies most, their inflation falls faster, and inflation rates converge.

Section III turns to the empirical evidence on dollarization and disinflation in Latin America and about 20 other countries for which data are available. With the strong caveat that unofficial dollar holdings are hard to track, our results suggest high inflation drove up

[2] Substitutable currencies imply currency competition. Full dollarization, on the other hand, is an effort to end such competition by fiat, replacing one official currency with another-- as when Ecuador and El Salvador adopted the U.S. dollar as their national currency. Of course, some old Ecuadorian notes remain in circulation in rural areas so even full dollarization may not end currency competition.

dollarization ratios in Latin American, which in turn helped bring inflation rates down in the 1990s. Evidence of this disciplining effect of currency competition as noted by Rogoff (1993), complements a number of recent studies that search, largely in vain, for harmful effects of dollarization. [3]

To the extent that the forces affecting Latin America are global, the same should be true for other countries. What is driving the dollarization trends shown in Figure 3? In the 1980s inflation and near hyper-inflation in many Latin countries made dollars the savings vehicle of choice in the 1908s.

But inflation fell in the 1990s and real interest rates rose, so why did dollarization continue? Three supply side factors likely fueled dollarization in the 1990s: i) many "emerging market" economies gained easier access to capital markets at lower interest rates (nominal and real); ii) easier access to dollar notes and bonds created by changes in U.S. tax laws affecting foreign bond holders, by electronic banking and by new currency issues (such as "counterfeit-proof" hundred dollar bills) tailored to international users. And last but not least, iii) dollarization increased due to wider official acceptance of dollar accounts and dollar holdings as part of a trend toward current and capital account openness[4] and financial market liberalization.

Some of these trends can be stopped by LDC governments, some can not. It is this universal, "spontaneous" and often unauthorized dollarization dynamic that makes it a force for global disinflation. Central Banks may not wish to cope with currency competition, but they find

[3] Arteta (2003) finds "little evidence that high dollarization heightens the probability of banking crises or currency crashes" and "when such crises and crashes do come they are no more costly in highly dollarized countries than where dollarization is low." In their provocatively titled survey "Addicted to Dollars," Reinhart, Rogoff and Savastano (2003) find that dollarization does not impede monetary control or disinflation, or even reduce seigniorage revenues (though dollarization does not typically subside when inflation falls). De Nicoló, Honohan and Ize (2003) find that, in highly inflationary economies, dollarization contributes to financial deepening and deposit dollarization is associated with reduced solvency risk in banking systems. Somuano, Serrano, and Gomis-Porqueras (2000) however, claim the probability of future crises and volatility rise with "dollarization" ratios.

[4] Capital and current account openness can reduce inflation, with or without dollarization, as emphasized by Romer (1993) and Gruben and McLeod (2001, 2002, 2004).

they must. For this reason, among others, unofficial dollarization is controversial. Many view Latin America's "addiction" to dollars as source of exchange rate instability and risk to banks with dollar-denominated loans or assets.[5] All agree however, that unofficial dollarization grew rapidly in Latin America heading into the 1990s (see Figure 3 and Table 1 below).

How did "currency substitution" change hats: from the exchange rate destabilizer of Obstfeld and Rogoff (1996) to enforcer of monetary discipline as in Rogoff (1993)? In fact models of currency substitution can generate both outcomes. The dark side of commingling currencies, a la Kareken and Wallace (1981), sees greater substitutability among two intrinsically worthless currencies as a source of exchange rate instability and even hyperinflation. Others see competition among official currencies as stabilizing discipline. Canzoneri and Diba (1992) and Sturzenegger (1992) for example, present models of currency competition similar to those of this paper [6] and more in line with the Rogoff (2003) quote above.

Dollarization may initially be a symptom of poor monetary policy. But as "good money drives out bad" as Mundell (1998) claims Gresham meant to say, Central Bankers have to defend their less good money. The key question is how policy makers respond to competition.[7] If imported dollars are met with tighter capital controls or efforts to ban competing monies, the result is financial repression circa 1970s Latin America. However, if governments take steps to make their currencies more competitive, dollarization can lead to a pandemic of price stability, as

[5] Currency competition can occur with or without banks and or legal sanction. In fact currency competition may just be the "threat" of entry by alternate currencies. We ignore dollar denominated assets or loans at local banks, thereby overlooking the important and perhaps related issue of currency mismatches leading to banking crises. On these issues see Baliño, Bennett, and Borensztein (1999) or De Nicoló, Honohan and Ize (2003).

[6] Sturzenegger (1992) argues hyperinflation fears result from a misunderstanding. Whereas Obstfeld and Rogoff (1996) argue substitute monies lead to "self-fulfilling inflationary spirals" Sturzenegger points out that, on the contrary, a readily available alternative currency allows households to dump the depreciating currency sooner rather than later. Hyper-inflation is only possible when the households must hold some of home currency no matter how costly such holdings become.

[7] This issue surfaced in some of earliest currency substitution literature. Girton and Roper (1981) for example, first derive the "instability" similar to Kareken and Wallace (1981) but argue that once monetary policy makers "react" to incursions of foreign currency, competition among currencies can be a disciplining force.

in the models of the next two sections. Perhaps because everyone seemed to have dollars, or perhaps invigorated by competition, most policy makers chose the latter course in the 1990s. "Black market premiums" faded into the history books (almost).[8]

I. Globalization and the Political Economy of Monetary Policy

Low inflation ultimately reflects better fiscal and monetary policy. But why did monetary discipline improve in so many countries in the 1990s? Latin American inflation plunged from triple to single digits in just a decade. Perhaps more impressive is that even after inflation-prone Brazil and Argentina abandoned their currency pegs, high inflation did not return. Similar patterns are evident throughout the developing world. With a few exceptions (e.g., the Congo) high inflation seems again to be an artifact for history books. Low and falling inflation is now the norm.[9]

Whereas Rogoff (2003) and Romer (1993) emphasize the effects of trade on labor and product markets, greater currency competition reflects the "globalization" of currency and banking services. Local currencies must compete with easy-to-get, low-inflation, low-interest-rate dollars. Whether Central Bankers are disciplined and independent or not, globalization can raise the costs and reduce the benefits of printing national currency. Rogoff (2003), Romer (1993) and Gruben and McLeod (2001) provide Barro-Gordon style stories of how globalization

[8] Of course some responded to currency competition with delaying tactics: pegging their currencies, *de jure,* to the dollar was the first response of many inflation-prone nations. But when exchange rate anchors failed or became too costly, most upgraded - setting their currencies free to compete head on with the dollar, liberalizing and deepening local financial markets, and in some cases, opening their capital and trade accounts. Chile abandoned its capital controls. Even countries that kept their capital markets largely closed, such as Brazil, managed their currencies more carefully, floating, and paying very high real interest rates to head off dollarization.

[9] Disinflation may also reflect a global upgrade in the quality and autonomy of central bankers. The first tenet of Williamson's (1990) "Washington Consensus" was fiscal discipline, and policy fashion has certainly shifted in this direction. These two processes are complementary, as more integrated global goods and currency markets increased the rewards for disciplined policy and the penalties for high inflation. Globalization thus punishes inflationary finance ministers and rewards more those who pursue more fiscal and monetary. Brazilian President "Lula" da Silva's "surprisingly" conservative appointments and fiscal policy, for example, seem to fit this description.

changes the constraints monetary authorities face. Rogoff (2003) argues central bankers are tempted to engineer inflation "surprises" $(\pi - \pi^e) > 0$ occasionally, in response to random productivity shocks x, and chronically to overcome some distortion k that drives a wedge between actual and desired output,

$$U_{CB} = [\mu(\pi - \pi^e) - k - x]^2 + \chi(\pi - \pi^*)^2 \qquad (1.1)$$

where the government sets π, the private sector expects π^e and χ is the weight the government places on its inflation target π^*. Where Barro and Gordon (1993) blame the distortion k on income taxes, Rogoff attributes k to firms' and unions' monopoly powers. Import competition erodes these monopoly powers, reducing k. Globalization also lowers the output effect of money surprises μ by reducing the share of inflexible wages and prices in the economy. Hence, greater international competition created by globalization reduces trend expected inflation,

$$\pi^e = \pi^* + \mu\, k/\chi \text{ and } \pi = \pi^* + \mu\,(k - x)/\chi. \qquad (1.2)$$

Since the random productivity shock is assumed to have mean zero, $\pi^e = \pi$ on average, so the expected inflation equals actual inflation on average. While trade liberalization certainly lowered μ and k and greater fiscal discipline and/or central bank independence may have raised χ in many developing countries, it seems unlikely that the chronic triple-digit and occasional hyperinflations characteristic of Latin America in the 1980s were engineered inflation surprises designed to achieve some desired level of output or counter productivity shocks.

Gruben and Mcleod (2001) argue inflation is driven by the seigniorage revenues – that Barro (1983) is more relevant to developing countries than Barro and Gordon (1983). As in McLeod and Welch (1993) they argue LDC governments are more constrained by balance of payments considerations, as indicated by the high level of reserves these governments hold, with

or without "floating" exchange rates. Hence the desire to raise inflation is tempered by the potential effect on official foreign exchange reserves R such that,

$$U_{CB} = [s(\pi^e,\alpha(\sigma^e)]^2 + \chi(R(\pi^e) - R^*)^2 \quad (1.3)$$

where R* is some desired level of reserves, α is the interest elasticity of money demand and σ^e measures expected capital account restrictions.[10] Ignoring, for now the impact of inflation on foreign currency reserves (dollars do reappear in the next section) this set-up yields a trend inflation rate of,

$$\pi^e = \hat{\pi}(\alpha(\sigma^e)) \quad (1.4)$$

where $\hat{\pi}$ is the revenue-maximizing rate of inflation, perhaps tempered by inflation-induced losses of tax revenue and the expected level of capital account restrictions, σ^e. Easing capital controls and/or greater availability of substitute moneys raises σ and the interest elasticity of demand $\alpha(\sigma)$ thereby lowering the seigniorage-maximizing inflation rate. The next section develops a fuller version of this story in a two-currency world.

Figure 4 pulls together the implications of equations 1.3 and 1.4 using the familiar inflation Laffer curve. Liberalization of the capital account or greater access to substitute currencies raises the elasticity of demand for domestic money, shifting the seigniorage Laffer curve down and lowering the optimal inflation tax from A to B. However, if a government is determined to extract a fixed amount of seigniorage revenue, inflation accelerates from E to F. If the fiscally stubborn government's seigniorage revenue target is above s_{max} the result can be

[10] This particular set of "dependent economy" priorities is articulated more fully in McLeod and Welch (1993) and very nicely in Agénor (2001) chapter 8. The microfoundations for such a formulation may be found in the currency substitution model of Calvo and Rodriguez (1976). In their model a burst of local money growth leads to greater desired holdings of "dollars." Since dollars are the only foreign asset in their model, the country must run a current account surplus, implying a real depreciation of the currency. Though it boosts exports, nominal exchange rate depreciations raise the costs of higher money growth for the Central bank, as in Romer (1993). A modern *fear of floating* version of the Calvo and Rodriguez model might have prudent governments increase desired reserve holdings to insure against a sudden flight of dollars, yielding a very similar Central Bank loss function to 1.3.

hyper-inflation. The idea of currency substitution (aka dollarization) as an object of dread revolves around this scenario.

If, on the other hand, central bankers lower domestic money growth in response to changes wrought by globalization currency competition, is it exercising more discipline? Compared to the fixed deficit government; yes. However, rational central bankers are in a sense no more disciplined at point A than B. It is the reality of a higher-inflation elasticity of demand for local currency that changes central bank behavior, lowering the optimal inflation rate from point A to B in Figure 4.[11] In the next section, we add spontaneous dollarization to the constraints central bankers face more formally.

II. Currency competition and Inflation Convergence

Currency substitution or partial-dollarization has many implications. Our focus is the most rudimentary form of currency substitution, that is, the use of foreign currency for everyday transactions. More taxi drivers accept payment in dollars, more landlords demand it, etc. In this context, dollarization is really a synonym for currency substitution or competition. Though we do not focus on "asset" substitution or dollar-denominated bank accounts, households can hold dollar-denominated bonds, or borrow in dollars creating the usual "opportunity cost" for holding cash foreign or domestic. The key idea is that now two rather than a single currency can provide similar transaction or convenience services. Our model is a small country version of Canzoneri

[11] Point C represents the less-than-credible policy shift case. Expected inflation moves to some intermediate level C and the liberalization is less effective at reducing inflation. One can tell a story along the lines of Rodrik (1991) where the private sector places a positive probability on a policy reversal (or new exchange controls) in period 2.

and Diba (1992).[12] Households derive utility from consumption c_t and transaction services $v(m_t,n_t)$ provided by domestic and/or foreign real money balances m_t and n_t,

$$U = \sum_{t=0}^{\infty} \beta^t [c_t + v(m_t, n_t)] \qquad (2.1)$$

where $\beta = 1/(1+\delta)$ and δ is the discount rate, assumed identical at home and abroad. Utility is linear in c and separable in consumption and transactions services, fixing the real interest rates $r_t^* = r_t = \delta$. We assume income effects on money demand. The degree of substitutability between the two currencies in providing transactions services $v(\bullet)$ is determined by σ. The higher σ the more substitutable the two currencies become. As $\sigma \to \infty$ the two currencies become perfect substitutes. The properties of $v(\bullet)$ are spelled out further for a particular functional form below. Household maximizes (2.1) subject to the budget constraint,

$$\begin{aligned} c_t + n_t + m_t + b_t - \bar{d}_t^* / e_t \leq \\ y_t - \tau_t + m_t(1+\pi_t)^{-1} + n_t(1+\pi_t^*)^{-1} + (1+r_{t-1})b_{t-1} - (1+r_{t-1}^*)\varphi_t d_{t-1}^* / e_t \end{aligned} \qquad (2.2)$$

where $(1+\pi_t) = p_t/p_{t-1}$ and $(1+\pi_t^*) = p_t^* / p_{t-1}^*$. The identical consumption good costs p at home and p* abroad yielding the flexible home currency price of foreign exchange $e = p/p^*$. Note that up to a point, households can borrow abroad but transactions fees and capital controls increase the cost, as $\varphi_t < 1$.[13] A high φ_t may also reflect risks of future taxes or restrictions on dollar borrowing. Since dollars n_t can either be held as cash or used to pay down foreign debt, the real opportunity cost of holding foreign currency is $(1 + r^*)\varphi$. Capital controls and restrictions on currency use affect the degree of substitutability between home and foreign currency (σ) as well.

Completing the fiscal side of the story is the government budget constraint,

[12] Sturzenegger(1992) and Obstfeld and Rogoff (1996) employ a very similar transactions cost driven money demand function.

[13] The ability of households to borrow abroad adds current account adjustment issues that we ignore here.

$$g_t + (1 + r_{t-1})\, b_{t-1} = \tau_t + s_t - \kappa(\pi) + b_t \qquad (2.3)$$

The government needs to finance fixed spending g_t and retire bonds $(1 + r_{t-1})\, b_{t-1}$ using new local bond issues b_t or lump-sum tax revenues τ_t or real seigniorage revenues s_t net of Olivera-Tanzi tax revenue losses $\kappa(\pi_t)$. Assuming that seigniorage generated by domestic pesos circulating abroad is negligible, total gross real seigniorage revenue is,

$$s_t = m_t - m_{t-1} + \pi_t m_{t-1} . \qquad (2.4)$$

Ignoring income related money demand, this reduces to $\pi_t m_{t-1}$. The government sets the inflation rate to maximize the present value of seigniorage net of inflation-induced tax revenue losses $\kappa(\pi)$,

$$\max_{\pi} s' = \sum_{0}^{\infty} \beta^t \left\{ \left[\beta(\delta + \pi_{t+1}) \right] m_t - \kappa(\pi_t) \right\} \qquad (2.5)$$

The linearity of the consumption function creates an intimate relationship between nominal interest rates and inflation (the real interest rate is fixed at δ), so the term in square brackets can also be written in terms of the nominal interest rate,

$$\left[\beta(\delta + \pi_{t+1}) \right] = \frac{i_t}{(1 + i_t)} = \hat{i}_t \qquad (2.6)$$

To solve the government's maximization problem for an explicit optimal inflation rate, we use the functional form for transactions services suggested by Canzoneri and Diba (1992),

$$v(m,n) = -.5(2V - m - n)^2 - (.5/\sigma)\left[(V - m)^2 + (V - n)^2 \right], \qquad (2.7)$$

where households are satiated once they hold $V \geq .5$ of each type of money. Transactions demand is limited by the opportunity cost of money. As the elasticity of substitution $\sigma > 0$

increases, the two moneys become increasingly substitutable and the second term in (2.7) goes to zero.[14] The first-order conditions implied by (2.7) are,

$$\begin{aligned} v_m &= 2V - m_t - n_t + (1/\sigma)(V - m_t) = \hat{i}_t \\ v_n &= 2V - m_t - n_t + (1/\sigma)(V - n_t) = \hat{i}_t^* \varphi_t \end{aligned} \tag{2.8}$$

Solving for money demand m_t implied by (2.8) yields,

$$\begin{aligned} m_t &= V - \eta\left[\sigma(\hat{i}_t - \hat{i}_t^* \varphi_t) + \hat{i}_t\right] \\ n_t &= V - \eta\left[\sigma(\hat{i}_t^* \varphi_t - \hat{i}_t) + \hat{i}_t^*\right] \end{aligned} \tag{2.9}$$

where $\eta = 1/(2+1/\sigma)$. As σ becomes large, $\eta \to 1/2$ and $\sigma\eta$ becomes large, pushing demand for the high inflation currency to zero. As in Mundell's version of Gresham's law, good, low-inflation money drives out bad high-inflation money. Equation (2.9) makes it clear why empirical studies of dollarization may be inconclusive: dollarization has many potential causes. High domestic inflation raises i relative to i* leading to substitution of foreign for domestic currency. A fall in i* due to low inflation abroad, or easier access to international credit markets also increases dollarization. Or financial innovation or relaxed currency restrictions can raise σ.

Using (2.6) we can rewrite in (2.9) in terms of foreign and domestic inflation,

$$\begin{aligned} m &= V - \eta\beta\left[\sigma(\pi - \pi^* \varphi) + \pi + \delta\right] \\ n &= V - \eta\beta\left[\sigma(\pi^* \varphi - \pi) + \pi^* + \delta\right] \end{aligned} \tag{2.10}$$

where we drop the time subscripts to focus on the key inflation differentials. Again as the substitutability among currencies increases, σ becomes large and $\eta \to 1/2$ - increasing the importance of the inflation differential. The optimal inflation rate can be solved for by

[14] This particular functional form has some advantages of the CES specification used by Imrohoroglu (1994) or the more intuitive specifications used by Sturzenegger (1996) and Obstfeld and Rogoff (1996).

maximizing net seigniorage revenues s' = πm - τ(π). Setting $\frac{\partial\{s-\tau(\pi)\}}{\partial\pi}=0$ and solving for $\hat{\pi}$ yields,

$$\hat{\pi}=\frac{1}{2}\left\{\left(\frac{1}{(1+\sigma)\eta\beta}\right)[V-\tau'(\pi)]+\theta\pi^{*}\varphi-\left(\frac{\delta}{1+\sigma}\right)\right\} \tag{2.11}$$

$$\text{where } \theta=\left(\frac{\sigma}{1+\sigma}\right) \text{and as before } \eta=\frac{1}{2+1/\sigma}.$$

Note that as currency substitution increases (i.e. $\sigma\to\infty$), $\theta\to 1$ *and* $\eta\to 1/2$ and all of the terms in (2.11) except the θπ* term go to zero. In sum, the optimal inflation rate converges to the foreign inflation rate π* as currency substitutability becomes greater.

If governments ignore currency competition dollarization ratios rise and eventually force their hand (unless they succeed in lowering σ by imposing restrictions on uses of and access to dollars). Using (2.10) and setting φ = 1 to simplify notation, the dollarization ratio z = n/(n+m) is,

$$z=\frac{n}{n+m}=\frac{V-\eta\beta\left[\sigma(\pi^{*}-\pi)+\pi^{*}+\delta\right]}{2V-\eta\beta(\pi+\pi^{*}+2\delta)}. \tag{2.12}$$

Suppose central banks ignore falling dollar inflation π* and a rising σ, and increase domestic inflation. The speed with which dollarization (z) rises is determined by,

$$\frac{\partial Z}{\partial\pi}=\frac{2\eta\beta\sigma\left[V-\eta\beta(\pi^{*}+\delta)\right]+\eta\beta\left[V-\eta\beta(\pi^{*}+\delta)\right]}{\left[2V-\eta\beta(\pi+\pi^{*}+2\delta)\right]^{2}}, \tag{2.13}$$

which is clearly positive as long as money holdings are positive. As dollars become better substitutes for pesos, z rises faster for a given increase in domestic inflation. Note that as σ rises,

the denominator of (2.13) remains fixed and positive ($\sigma \to \infty$, $\eta \to 1/2$) while the numerator continues to increase and becomes dominated by: $\beta\sigma\left[V - (1/2)\beta(\pi^* + \delta)\right]$.

To the extent that dollarization is beyond their control, greater currency substitutability presents central bank policy makers with two options: reduce domestic inflation or suffer steadily rising dollarization ratios. These results are familiar and intuitive, but they can also explain recent trends toward inflation convergence. As access to dollars became easier, for example, via internet banking, newly minted $100 bills or via new access to international financial markets, small inflation differentials continue to drive dollarization ratios (z) up. But this same process drives inflation rates down as central banks seek to slow dollarization and to find their new lower optimal inflation rate $\hat{\pi}$ defined in (2.11) above. As σ increases domestic rates tend to converge on π^* providing our potential, as yet untested, explanation of global disinflation, as Rogoff (2003) suggested. Following the notation of Canzoneri and Diba (1992) and assuming central banks choose an optimal inflation rate, we have, for better or worse, σ-convergence driven by σ.

As Canzoneri and Diba (1992) and Chang and Velasco (2000) point out, the international "dollar" inflation rate is not necessarily the optimal rate for all countries, particularly if alternative sources of tax revenue are limited and costly. If dollarization drives seigniorage revenues down to very low levels, national welfare may decline despite welfare gains from lower inflation. However, as Friedman and Verbetsky (2001) argue for Russia, until inflation falls below (say) 5%, the welfare gains from reduced inflation are likely swamp losses due to lower seigniorage. [15]

[15] Put differently, at low inflation rates, and to the extent governments can costly alter σ, there may be an optimal σ for each country. The welfare consequences of dollarization-induced disinflation are beyond the scope of this paper.

III. Deposit dollarization and inflation: some empirical evidence

Any empirical evaluation of the causes or consequences of unofficial dollarization must begin with a stronger than usual caveat regarding data availability. Use of dollars for everyday transactions is particularly difficult to track, in part because dollar payments and dollar deposit accounts are illegal in many countries. However, a number of researchers have put together data on deposit dollarization as reported to the IMF or by the Central Banks of those countries. Table 1 combines "spontaneous" dollarization data from Berg, Borensztein and Mauro (2003) with changes in inflation from the early 1990s to the late 1990s. Plotting disinflation rates against dollarization ratios as in Figure 5 reveals a correlation between disinflation and dollarization: the higher the rate of dollarization, the faster the rate of disinflation. Of course, causality can run in either or both directions. High inflation leads to higher levels of dollarization (see especially Peru, Nicaragua and Argentina) but dollarization may also play a role in bringing down inflation, as the model of the previous section suggests.

To explore these relationships for a larger number of countries we use data on dollar deposit ot total deposit rates reported in Table 1 in De Nicoló, Honohan and Ize (2003). Unfortunately, the data cover only the period 1990 to 2001 and are only those deposits reported by the authorities: the actual use of dollars in everyday transactions could be a larger or smaller share of total money in circulation. Nevertheless, we can use deposit dollarization as a crude

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But we suspect seigniorage-related welfare losses are largely irrelevant to Latin America and most LDCs until inflation falls below 5%. As inflation falls from double or triple to single digits, the welfare gains from lower inflation likely swamp losses due to forgone seigniorage. This is what Friedman and Verbetsky (2001) find for Russia until inflation falls below 2-3% (they ignore the costs of alternative taxes, but the inflation tax is not costless either, and it is regressive). Also as countries "remonetize" at low inflation rates, increased money holdings help offset seigniorage losses due to lower inflation. Finally lost seigniorage can be replaced with a low check cashing fee as Brazil did in the 1990s.

proxy for transactions demand for dollars, as a ratio of total currency in circulation (see Appendix A and Table A.1 for the data set used in this paper).

Dollarization: a legacy of past inflation

Table 2 reports regressions of dollar deposit ratios on past inflation. As indicated in Table 1, there are a few countries that report exceptionally high dollarization ratios and not coincidentally also experienced very high inflation in the 1980s or early 1990s. To avoid letting these four high inflation countries drive all of our results, we routinely remove them from our sample (Bolivia, Peru, Nicaragua and Argentina fall into this category). A general pattern that emerges from Table 2 is that past inflation is an important determinant of dollarization. Somuano, Serrano, and Gomis-Porqueras (2000) obtain similar results, but rule out reverse causality, from dollarization to lower inflation since inflation falls, but dollarization ratios do not. For Latin America, high inflation in the 1980s explains almost all the variance in dollarization. Adding information on 1990s inflation contributes little predictive power to these equations. However, outside Latin America, inflation in the 1990s is an important determinant of dollarization.

Some Table 2 equations also include an "inflation rate squared" term to capture the potential diminishing effect of inflation on dollarization. This term also allows us to compute a crude "maximum dollarization" ratio - which varies between 50% and 70% for the country samples we use. In light of widespread concerns that the dollar may spontaneously drive out any use at all of domestic currency in some countries, the implications of these estimates are important. They suggest that even with very high inflation, dollarization ratios might peak at 50-

60%: just about the baseline share of foreign currency assumed in the model of the previous section.

Table 3 expands our list of explanatory variables to include a number of policies that may also affect dollarization ratios. Country size as measured by total GDP in $PPP 1990 reduces dollarization rates. Policy reversals (retreats from open to closed capital markets) increase dollarization, as one would expect if dollar holdings reflect confidence in the monetary authorities and expected inflation rates (assuming that closed capital accounts give the monetary authorities more leeway to raise the inflation tax). Recall that in the model of the previous sections relaxing capital controls can have two effects on the dollarization ratio. If the result is to increase the substitutability between dollars and local currency (i.e., raise σ) dollarization increases. However, if the result is to raise the return on dollar assets or the cost of dollar debt, the opportunity cost of holding currency shifts against dollars and towards the local currency (an increase in φ). Both effects may be at work in Table 3. In the 1980s relaxing capital and current account restrictions raised 1990s dollarization rates, while the same capital account opening reduced dollarization in the 1990s. Why the opposite effects? One explanation is that during the debt crisis, high inflation 1980s investors were looking for a safe haven, even if it paid little interest. The liberalizations in the 1990s, on the other hand, increased confidence and raised the return to dollar denominated assets, thereby reducing dollarization ratios (as the model in above would predict for a rise in φ).

However, there is another interpretation of these opposite and roughly equal effects[16] of capital controls in the two decades: liberalizing capital controls in the 1990s reduced dollarization either by raising the return on dollar assets or by increasing confidence in the

[16] Wald tests of the hypothesis that the sum of these coefficients is zero cannot be rejected for any of these equations—the two effects appear to cancel each other out, unless we subtract 1980 from 1990 openness levels—in other words focus on capital account liberalization rather than levels of openness.

discipline of the monetary authorities. Equations 3.1a, 3.2a and 3.6a all re-estimate the previous equation using the change in, as opposed to an index of the levels of, capital and current account restrictions. In every equation, the goodness of fit improves when we switch from levels to changes (that is, from the degree of openness to changes in openness). This suggests capital account liberalization may be, in effect, a substitute for dollarization. Both rising dollarization and/or a more open capital account increase the penalties for high inflation and reduce the potential seigniorage revenue generated, inducing policy makers to issue less domestic money.

Dollarization, Capital Account Liberalization and Inflation

Table 4 examines the effect of "past dollarization" on future inflation. Unfortunately, since we only have data back to the early 1990s "past dollarization" means early 1990s dollarization ratios. Fortunately, since we know that past inflation explains significant variation in dollarization ratios we can use the equations of Table 3 to construct instruments for deposit dollarization ratios.

Equation 4.1 regresses log average inflation in the 1990s on early dollarization ratios, together with some other policy and geographic determinants of inflation. Capital account openness shows the same pattern of opposite signs for the 1990s and 1980s. Latitude is our proxy for developing countries, as this regression includes all the countries available in the De Nicoló, Honohan and Ize (2003) data set. To look at the potential interaction between dollarization and capital account opening, equation 4.1a adds an interaction term to equation 4.1, multiplying the dollarization ratio times the capital account openness index. Note that the explained variation in inflation across countries jumps substantially each time we add this interaction term to the equation (the adjusted R^2 jumps from .63 to .77 in equation 4.1 and from

.80 to .92 in equation 4.2). In Latin America, equation 4.2a explains a remarkable 90% of the variation in inflation rates, albeit for a very small sample of 15 countries (note that due to the small size of our Latin America sample, and that all four high inflation-high dollarization countries were Latin American, these results reflect the experience of those four countries).

The interaction between capital account openness and dollarization is consistent with the hypothesis that capital account openness is a substitute for dollarization—as discussed above. Either dollarizing or capital account openness constrains the behavior of the monetary authorities and brings down inflation. An alternative interpretation is that dollarization has a greater impact in economies with open capital accounts, as dollars may flow in or out in response to higher inflation rates or expected devaluations. Removing the high inflation four from our sample clearly reduces the explanatory power of this regression (also capital account openness in the 1980s instead of the 1990s interacts positively with dollarization to bring down inflation quicker for this sample, perhaps because of technological advances in moving assets). Note also that equations 4.1 vs. 4.2 show that policy reversals are largely a Latin American problem, as this variable does not have a significant effect in our full sample of countries (equation 4.1 vs. 4.2).

Finally, we estimate equations 4.1 and 4.3 using 2SLS-GMM methods. The results carry through for the most part, increasing our confidence that causality is running from dollarization (the endogenous rhs variable in equations 4.4 and 4.5) to inflation as the regression of Table 4 suggest. Note that Sargan tests of our instruments, which include 1980s inflation and various country size variables, suggests that they are indeed suitable for their role in this context.

IV. Conclusions and Policy Implications

The main idea of this paper is easily summarized. Dollarization is both a legacy of past inflation and a constraint on future inflation. Switching from pesos to dollars provides a refuge from the inflation tax. If the monetary authorities ignore dollarization and pursue the same seigniorage revenue, high or even hyper-inflation can be the result, followed by even more dollarization. In this fashion growing "spontaneous" dollarization inevitably drives down future inflation, though governments can delay this process by implementing new capital controls. Fortunately, with few exceptions Latin and developing country governments did not ban currency competition, and inflation fell as dollarization ratios increased. This is consistent with both the model and the empirical results of this paper.

The risks of "spontaneous" dollarization or widespread currency substitution have been given much attention in the literature of late. However, most recent empirical studies of dollarization fail to find many negative impacts. We add a small silver lining. It appears from the very preliminary empirical evidence present here, that dollarization and capital account openness act in concert to drive inflation down. Since dollarization ratios rose sharply in many Latin American countries during the high inflation debt crisis years, Latin disinflation and convergence have been especially sharp and dramatic. That said, there is much room to improve both the model and the empirical results of this paper. Longer data series for dollarization ratios would be most helpful and apart from one footnote, the welfare consequences of lower seigniorage revenues have not been addressed (Chang and Velasco (2000) for example, cite lost seigniorage revenues as a major drawback of "full" dollarization). Still, the results of this paper suggest Rogoff (2003) may be correct: easier access to dollars is one factor driving global inflation rates down in the 1990s, particularly in Latin America.

References

Agénor, Pierre-Richard (2000) *The Economics of Adjustment and Growth* , Academic Press, New York.

Baliño, Tomás, Adam Bennett, and Eduardo Borensztein (1999). "Monetary Policy in Dollarized Economies," IMF Occasional Paper 171 March.

Barro, Robert J. and David B. Gordon (1983) "A Positive Theory of Monetary Policy in a Natural Rate Model," *Journal of Political Economy,* 91, 1983, 589-610.

Barro, Robert J. (1983) "Inflationary Finance Under Discretion and Rules" *Canadian Journal of Economics*, 16, February, 1-16.

Berg, Andrew and Eduardo Borensztein (1999). "The Choice of Exchange Rate Regime and Monetary Target in Highly Dollarized Economies." IMF Working Paper 00/29 (February)

Berg, Andrew, Eduardo Borensztein and Paulo Mauro (2003), "Monetary Regime Options for Latin America," *Finance and Development,* (September) 24-26.

Bowman, David (2003), "Market Power and Inflation," Federal Reserve Board of Governors International Finance Discussion Paper No. 783 (October).

Calvo, Guillermo A. and Carlos, A. Rodríguez (1977), "A Model of Exchange Rate Determination Under Currency Substitution and Rational Expectations," Journal of Political Economy 85, 617-624.

Campillo, Marta and Jeffery Miron (1996) "Why Does Inflation Differ across Countries?" National Bureau of Economic Research Working Paper #5540, NBER, Cambridge, MA.

Canzoneri, Matthew and Behzad T. Diba (1992), "The inflation discipline of currency substitution," *European Economic Review* 36, 827-845.

Cardoso, Eliana. (1992) "Inflation and Poverty," NBER Working Paper # 4006.

Chang, Roberto and Andres Velasco (2000) Dollarization: Analytical Issues, NBER and Harvard University.

De Nicoló, Gianni, Patrick Honohan and Alain Ize (2003), "Dollarization of the Banking System: Good or Bad?", IMF Working Paper WP/03/146.

Friedman, Alla and Alexey Verbetsky (2001), "Currency Substitution in Russia," Economics Education and Research Consortium Working Paper Series, Working Paper No. 01/05.

Girton, Lance and Don Roper (1981), "Theory and Implications of Currency Substitution," *Journal of Money, Credit and Banking* 13, 12-30.

Gruben, William and Darryl McLeod (2001) "Capital Account Liberalization and Disinflation in the 1990s," Federal Reserve Bank of Dallas, Center for Latin America Working Paper 0101.

Gruben, William C. and Darryl McLeod (2002), "Capital Account Liberalization and Inflation," *Economics Letters*, October, 77(2), 221-225.

Gruben, William C. and Darryl McLeod (2004) "Openness and Inflation Revisited" *Applied Economics Letters*, 11(8), July.

Hanson, James A. (1995), "Opening the capital account: costs, benefits and sequencing," in Edwards (ed.) Capital controls, exchange rates, and monetary policy in the world economy, 383-429, (Cambridge; New York and Melbourne: Cambridge University Press)

International Monetary Fund, Various Issues, Annual report on exchange arrangements and exchange restrictions, (International Monetary Fund, Washington, D.C.).

McKinnon, Ronald I. and Donald J. Mathieson (1981) How to Manage a Repressed Economy, *Essays in International Finance #145*, December, Economics, Princeton University, NJ.

McLeod, Darryl and J. Welch (1993) "Costs and Benefits of Fixed Exchange Rates in Latin America, *Economic Review*, 1st Quarter, Federal Reserve Bank of Dallas, 31-43.

Mundell, Robert (1998) "Uses and Abuses of Gresham's Law in the History of Money" Columbia University, to appear in Zagreb Journal of Economics.

Obstfeld, Maurice and Kenneth Rogoff (1996), "Foundations of International Economics," (Cambridge, MA: MIT Press)

Reinhart, Carmen M., Kenneth S. Rogoff, and Miguel A. Savastano (2003), "Addicted to Dollars," NBER Working Paper 10015 (October).

Rodrik, Dani (1991), "Policy uncertainty and private investment in developing countries," *Journal of Development Economics,* 36, 229-242.

Rogoff, Kenneth (2003), "Globalization and Global Disinflation," Paper prepared for the Federal Reserve Bank of Kansas City conference on "Monetary Policy and Uncertainty," Jackson Hole, WY., August 28-30, 2003. September 10, 2003 revision.

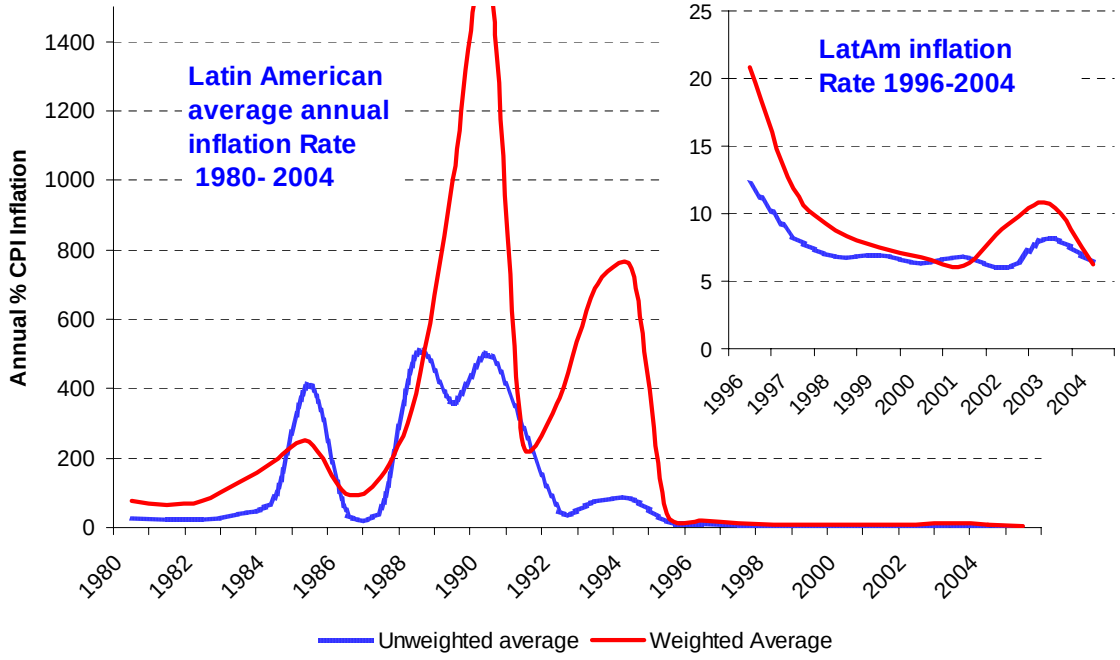
Romer, David, (1993), "Openness and Inflation: Theory and Evidence," *Quarterly Journal of Economics,* CVII (4), November , 869-904.

Romer, David and Christina Romer (1998) "Monetary Policy and the Well-Being of the Poor," NBER Working Paper #6793, November, Cambridge, MA.

Somuano, Alejandro Carlos Serrano, and Pere Gomis-Porqueras (2000) "Currency Substitution in Latin America: Lessons from the 1990s" World Bank Working Paper # 2340, May 2000 Wash D.C.

Sturzenegger, Federico A. (1994), "Hyperinflation with Currency Substitution: Introducing an Indexed Currency," Journal of Money, Credit and Banking, 26 (3), August, 377-395.

Figure 1: Latin American Inflation Declines, sharply



Source: IMF, WEO April 2004 weighted average based on PPP GDP weights, also from the WEO.

Figure 2 Latin America Inflation σ Convergence

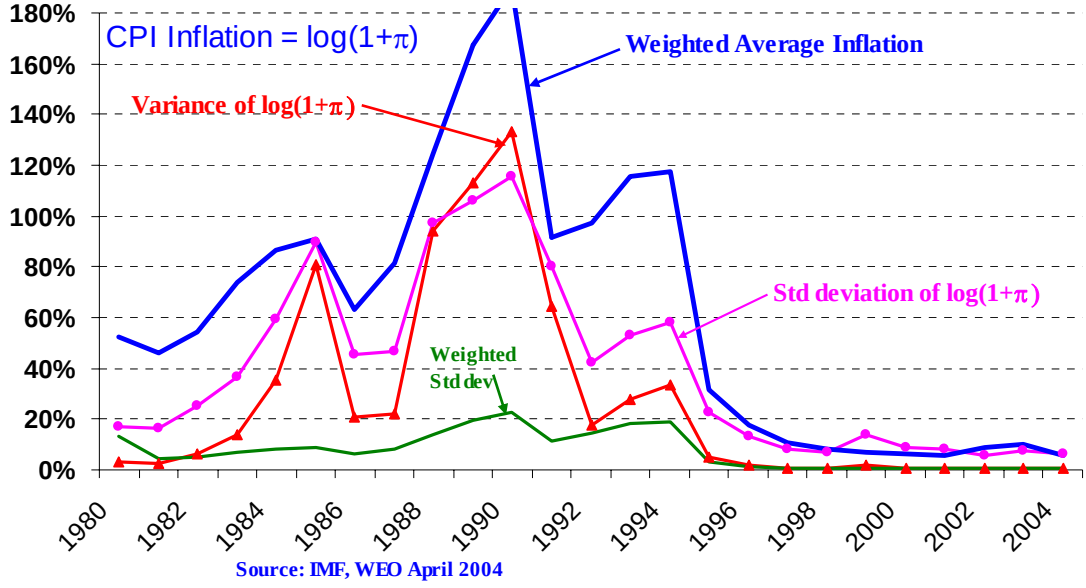
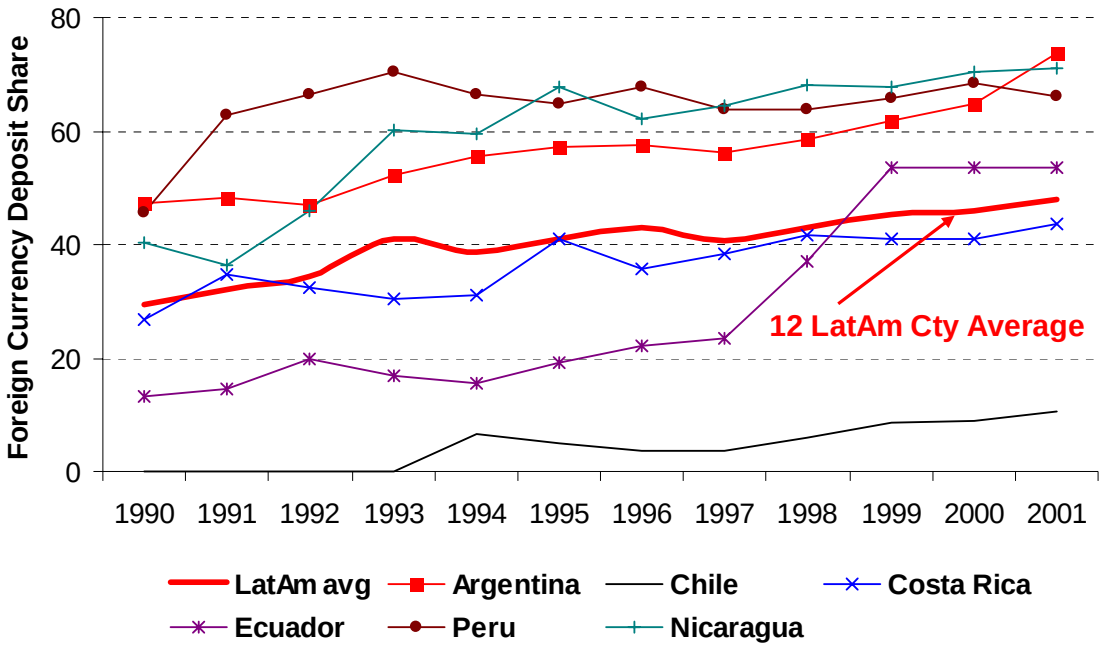


Figure 3 Deposit Dollarization in Latin America



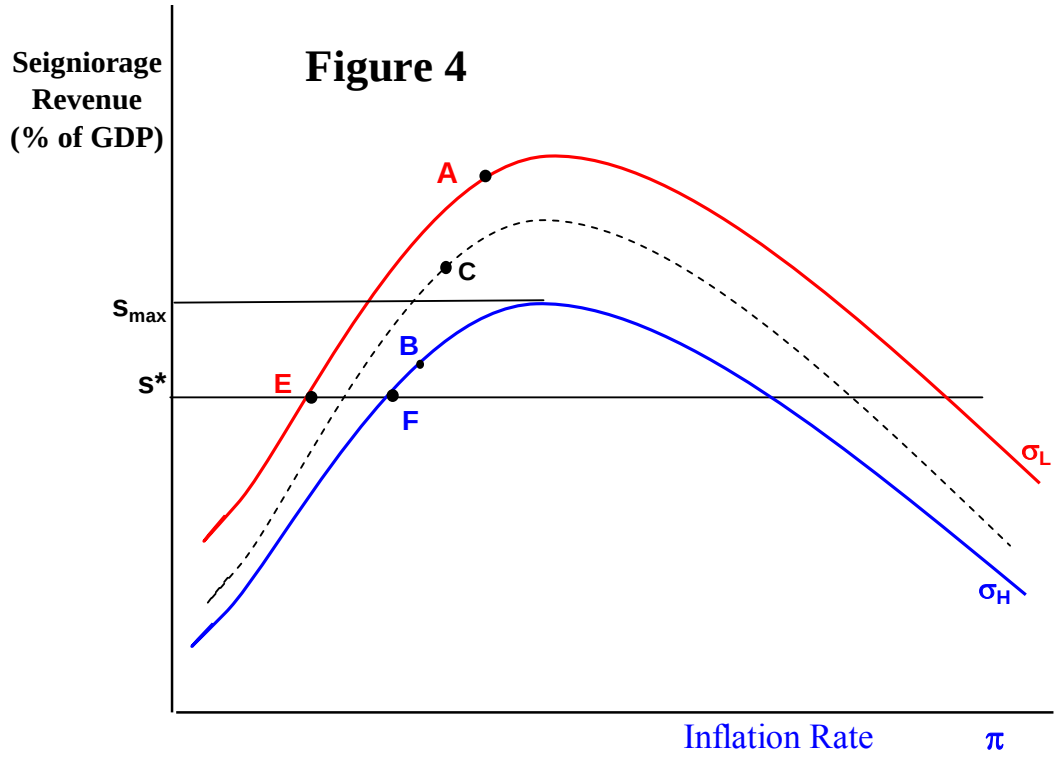


Figure 5: LatAm Disinflation and Dollarization 1990-2000

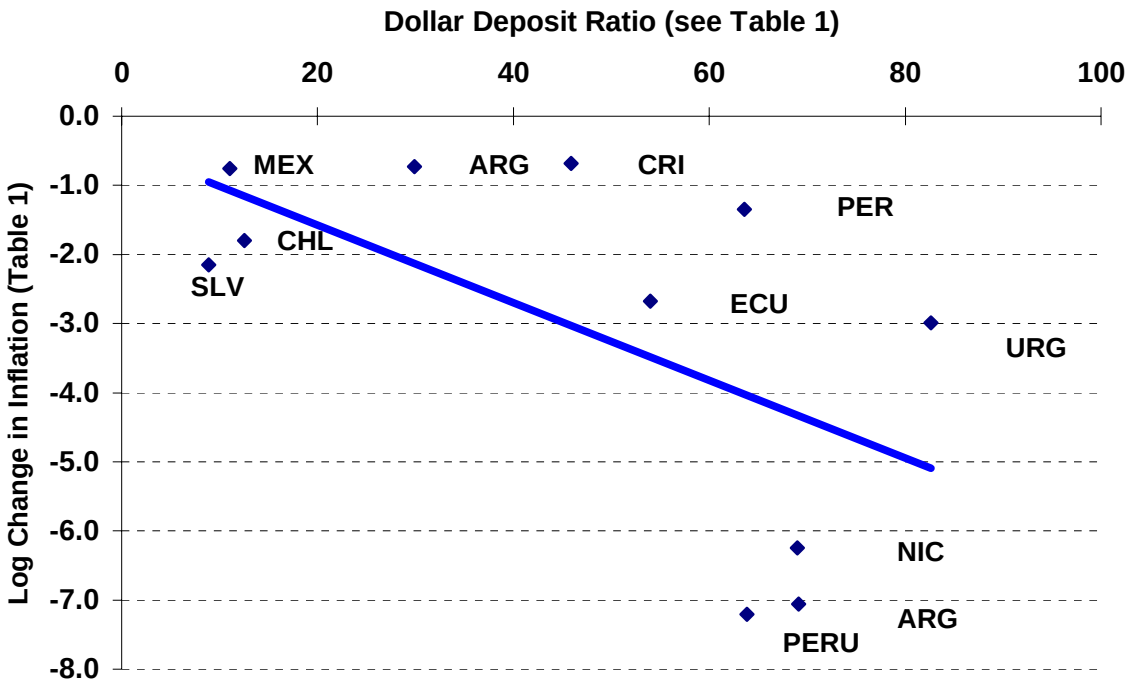


Table 1
Spontaneous dollarization and Inflation[/1]

	Dollarization[2/]		CPI Inflation (%)	
South America	1990[3/]	2000[4/]	1990[3/]	2000[4/]
Argentina	48	69	1855	-1.1
Bolivia	82	93	18	2.8
Chile	5.8	13	22	3.6
Ecuador	20	54	3.9	0.3
Paraguay	40	64	30	7.7
Peru	62	64	3281	2.4
Uruguay	78	83	98	5.0
Average	48	63	758	3.0
Mexico and Central America				
Costa Rica	31	46	21	11
El Salvador	4.2	8.9	19	1.6
Honduras	7.7	30	22	11
Mexico	5.6	11	23	11
Nicaragua	41	69	5197	11
Average	18	33	1057	9.0

Sources: Nicoló, Honohan and Ize (2003) and IMF WEO September 2004 database

1/ Berg, Borensztein and Mauro (2003) provide a similar table with only 2000 data on foreign currency deposits. We omit the same countries they do. As they point out, "dollar deposits are not allowed in Brazil and Guatemala" and "Colombia and Venezuela have negligible foreign currency deposits. Panama has been dollarized for many years. The data for Ecuador and El Salvador precede their full dollarization."

2/ Foreign currency deposits as percent share of total deposits,

3/Averages for 1989-1991 or closest years for which data are available.

4/Averages for 1999-2001 or closest years for which data are available

Table 2: Inflation and Dollarization: late 1990s deposit ratios

Dependent Variable: Dollarization Ratio late 1990s						
Sample:	**1.1** All Ctys	**1.2** All ctys exc.HI4	**1.3** All LDCs	**1.4** LDCs exc. HI4	**1.5** Latin America	**1.6** Latin America
Constant	**22.6** *(4.1)*	**22.6** *(4.1)*	**24.4** *(4.1)*	**23.6** *(3.1)*	**35.9** *(2.9)*	**37** *(2.7)*
Avg Inflation in the 1990s	**5.4** *(2.7)*	**5.8** *(2.9)*	**5.1** *(2.4)*	**59.7** *(2.3)*		**-6.2** *(-.5)*
Avg. 1990s Inflation sqrd		**-11.2** *(-1.8)*		**-12.7** *(-1.9)*		
Avg Inflation in the 1980s	**42.7** *(3.04)*	**12.9** *(1.3)*	**39.8** *(2.6)*	**12.9** *(1.3)*	**98.6** *(2.1)*	**96.5** *(2.5)*
Avg. 1980s Inflation sqrd	**-7.8** *(-1.4)*		**-6.9** *(-1.2)*		**-26.5** *(-2.1)*	**-25** *(-1.8)*
Nominal PPP GDP 1990 (country size)	**-3.6** *(-3.0)*	**-3.1** *(-2.3)*	**-3.8** *(-2.3)*	**-3.8** *(-2.3)*	**-12.1** *(-2.2)*	**-12** *(-2.1)*
Number of Observations	52	48	40	37	17	17
Adjusted R^2	0.56	0.37	0.5	0.27	0.59	0.56
SE regression	15.1	14.5	16.7	16.4	19.1	19.7
Mean dependent variable	*22.2*	18.1	27.1	22.8	36	36

1/ The high inflation four (HI4) include and Peru, Bolivia, Argentina, Nicaragua

Table 3: Past Inflation and policy Determinants of Dollarization

	Dependent Variable: Dollarization Ratio late 1990s							
Sample:	**3.1** All ctys exc. HI4	**3.1A** All ctys exc. HI4	**3.2** LDCs exc. HI4	**3.2A** LDCs exc. HI4	**3.4** All Ctys	**3.5** All LDCs	**3.6** Latin America	**3.6A** Latin America
Constant	**34.6** *(3.8)*	**35** *(4.7)*	**32** *(3.8)*	**21** *(2.5)*	**27** *(4.2)*	**14** *(1.4)*	**12** *(1.8)*	**12** *(1.9)*
Country Size ($PPP GDP 1990)	**-4.8** *(-3.3)*	**-4.7** *(-3.7)*	**-4.5** *(-2.4)*	**-4.4** *(-2.3)*	**-2.9** *(-2.4)*			
Avg Inflation in the 1980s	**40** *(2.3)*	**36** *(2.4)*	**34.2** *(2.2)*	**17** *(1.8)*	**22** *(6.7*	**32** *(7.9)*	**24** *(8.9)*	**25** *(9.4)*
Policy Reversals in 1990s[2/]	**4.7** *(1.4)*	**4.9** *(1.4)*	**11.1** *(2.5)*	**10** *(2.4)*	**9.1** *(2.3)*	**14** *(2.3)*	**15** *(2.3)*	**16** *(2.3)*
Financial integration 1990s[3/]	**-7.6** *(-2.4)*		**-6.4** *(-1.9)*				**-13** *(-2.6)*	
Financial Integration 1980s	**8.1** *(3.8)*		**8.3** *(2.0)*				**17** *(4.1)*	
Capital Account Liberalilization		**-7.8** *(-2.4)*		**-8.4** *(-2.4)*		**-12** *(-2.3)*		**-15** *(-6.9)*
Private Capital Flows					**-.34** *(-2.3)*	**-1.94** *(-2.5)*		
Floated Exchange Rate 1990s						**20** *(2.5)*	**14** *(1.5)*	**17** *(2.2)*
Government Deficits (1980s) (% of GDP average 1980s)						**1.7** *(2.4)*		
Number of Observations	44	44	34	34	*46*	27	16	16
Adjusted R^2	0.36	0.38	0.3	0.34	0.61	0.76	0.7	0.72
SE regression	14.8	14.6	16	15.4	14.2	13.3	15.9	15.3
Mean dependent variable	*19.3*	*19.3*	*23.5*	*23.5*	21	29	38	38

1/ The high inflation four (HI4) include and Peru, Bolivia, Argentina, Nicaragua

2/ This variable counts the number of times in the 1990s and 1980s the country "reversed course" by moving to close its capital or current account. Argentina, Uruguay, Peru, Costa Rica, Honduras, Trinidad and Tobago had single reversals. Ecuador had two reversals in the 1990s.

3/ This "financial integration" index adds current and capital account restrictions to "seize export proceeds" all 0/1 indicatore reported in various issues of the IMF's "Annual Report on Exchange Arrangements and Exchange Restrictions." These measures are created as ten-year averages of the three component index. A country that reported no restrictions any of these three areas for 10 years earns a "3" for this index. If it had capital and current account controls for five of ten years, for example, its average openness index would be "2". In Table 4 capital account openness measure was used also used alone, separately from the "current account" and "seize export proceeds" index.

Table 4: Dollarization and Inflation

	Dependent Variable: Disnflation 1980s to 1990s[5/]							
Sample:	**4.1** All Ctys	**4.1A** All Ctys	**4.2** Latin America	**4.2a** Latin America	**4.3**[1/] All ctys exc. HI4	**4.3a**[1/] All ctys exc. HI4	**4.4** All Ctys	**4.5**[4/] All ctys exc. HI4
Constant	**.2** *(2.1)*	**.02** *(.2)*	**.03** *(1.5)*	**.06** *(0.4)*	**.14** *(2.1)*	**.14** *(2.0)*	**.18** *(4.0)*	**.10** *(2.0)*
DDR: Dollar Deposit Ratio (early 1990s)	**-.02** *(-4.0)*	**-.01** *(-1.2)*	**-.03** *(-5.4)*	**-.024** *(-3.4)*			**-.03** *(-6.9)*	
DDR* OCA 1990s (OCA: open capital account)		**-.03** *(-3.4)*		**-.03** *(-3.4)*				
DDR* OCA 1980s (OCA: open capital account)					**-.004** *(-2.5)*	**-.004** *(-2.5)*		**-.003** *(-2.4)*
Open Capital Acount 1990s[2/]	**-.97** *(-3.0)*	**-.41** *(-2.2)*	**-1.04** *(-2.9)*	**-.36** *(-1.7)*	**-.14** *(-2.5)*		**-1.0** *(-4.0)*	
Open Capital Account 1980s	**1.2** *(3.6)*	**1.2** *(5.2)*	**1.8** *(3.5)*	**1.8** *(4.8)*	**.16** *(2.5)*		**1.4** *(4.2)*	
Policy reversals in the 1990s	**.12** *(.7)*		**.56** *(3.0)*	**.42** *(3.0)*				
Latitude (distance from equator)	**.57** *(2.7)*	**.40** *(2.4)*			**.12** *(1.8)*	**.17** *(2.2)*	**.45** *(1.8)*	**.14** *(2.2)*
Capital Account Liberalilization (1990s vs 1980s change in)						**-.14** *(-2.6)*		**-.11** *(-2.4)*
Country Size ($PPP GDP 1990)					**-02** *(-1.5)*	**-02** *(-1.4)*	**-07** *(-1.6)*	**-024** *(-2.2)*
Number of Observations	37	37	15	15	31	31	34	30
Estimation Method	OLS	OLS	OLS	OLS	OLS	OLS	GMM-2SLS	GMM-2SLS
Adj. R^2	0.63	0.77	0.80	.92	.39	.41	.51	.36
SE regression	0.36	0.28	0.38	0.26	0.106	0.105	0.42	0.11
Sargan Test (prob value) [3/]							0.78	.50
Mean of the dependent variable	-20%	-20%	-46%	-46%	-2.1%	-2.1%	-22%	-2%

1/ The high inflation four (HI4) include and Peru, Bolivia, Argentina, Nicaragua which are excluded for some estimates. These countries experience triple digit average inflation rates in the 1980s.

2/ See Table 3 footnote 3 for a definition of these capital account openness indices. For all equations except 4.3 the only the capital account liberaliztion index was used. Equation 4.3 the broader financial integration index including capital account and current account restrictions plus "seize export proceeds". Capital account liberalization alwasy refers the the change in this three component index, averaged for the 1980s and 1990s.

3/ This is the p-value of rejecting the GMM overidentifying restriction that the instrument set is orthogonal to the dependent variable, analogous to the Sargan test for suitible instruments. Instruments include average inflation in the 1980s, fuel export dummy, log country size in square miles, and the capital account liberalization and geograpy variables included about-- only the DD ratio was considered endogenous.

4/ This regression also included a "floating exchange rates in the 1990s" index, with coefficent of 1.6 (1.8). The index measures the number of years a given country had a floating exchange rate, as reported in the IMF's survey on Exchange Rate Arrangements.

5/ Disinflation is natural $\log(1+\pi_{90s}) - \log(1+\pi_{80s})$ but the change in $\log(\pi)$ yeilds similar results. The 1980s are 1981-1990 while the 1990s are 1991-2000. Data on CPI inflation came from the WDI 2002.