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De-dollarizing the Peruvian Economy: A Portfolio Approach *

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Abstract

Financial dollarization creates design problems for economic policy as increases the level of financial vulnerability. However, countries with high levels of dollarization have done almost nothing to reduce it. In this paper we study two ways to do it and we evaluate them within a model that emphasizes a portfolio approach. We calibrate the model to replicate the Peruvian economy. The two policy options that we consider are: (i) increasing the risk of dollar deposits, reducing the level of coverage in the safety net mechanism; (ii) increasing the relative volatility of inflation vis-à-vis real depreciation. Our results show that the former has the potential risk of lowering the level of financial intermediation, whereas the second might be more effective to de-dollarize the economy.

Key words: Liability dollarization, dedollarization, Perú.

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1 Why we care about de-dollarizing the Peruvian economy?

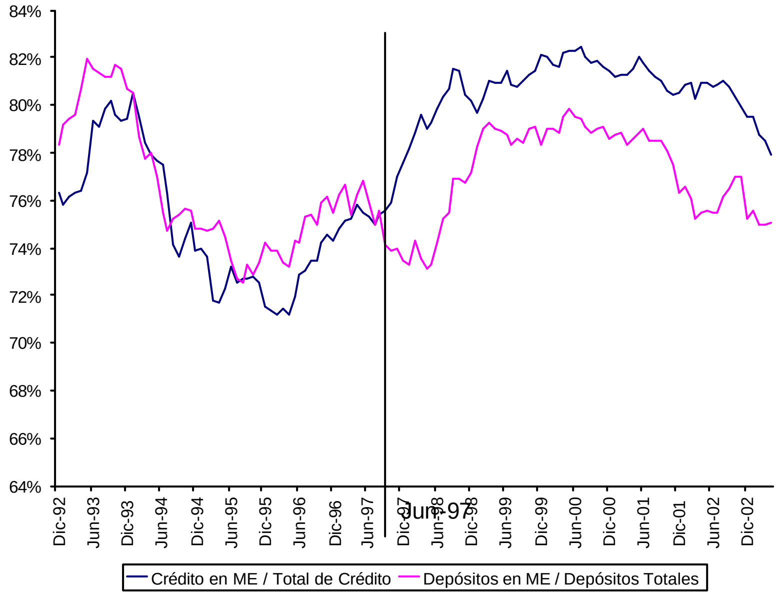
Peru is a highly dollarized economy (see Figure 1.1) and this fact imposes a series of restrictions to the monetary policy design and other aspects of economic policy in general (Baliño *et al.* (1999), Ize y Levy Yeyati (1998)). Notwithstanding, in the last decade in which a successful stabilization program was implemented, there were no special policies aimed to reduce the level of dollarization of the economy. This policy decision, that was clearly understandable at the beginning of the stabilization program as the country had no forex reserves, was maintained unaltered in the following years when the reserve position improved substantially. Even though inflation has been successfully controlled, the ratios of asset and liability dollarization remained almost the same (see Figure 1.2).

This brings a point of which are the unintented consequences of a policy aimed to prop up the forex reserves position of the economy. As dollar deposits were encouraged, banks were forced in some sense to offer credits in dollars. The economy whose long term markets in soles were wiped out by the hyperinflation, were replaced by long term markets in dollars. In this sense, the persistence of the asset substitution process might lead to the liability dollarization of firms. Financial intermediaries will easily match maturity and denomination of assets and liabilities, leading to an unsustainable high liability dollarization of firms.

The dollarization literature has frequently suggested the need to tackle this issue given the entrenched risk for macroeconomic stability. In particular, one of the main risks associated with a high and persistant financial dollarization is the balance sheet effect in the monetary transmission mechanism (Eichengreen, *et al.* (2002)). A large group of agents in the economy hold a high degree of dollarized liabilities, despite their earnings are denominated in domestic currency. In this group are not only firms producing non-tradable goods, but also the banking system and the government. Therefore, the exchange rate risk could easily transform into default risk, increasing the stress for the financial system and enhancing the output effects of an external shock. An example of this was the combined impact of the

Asian and Russian crisis. As a consequence of the crisis, seven banks (out of 25) were intervened and closed. This closed correlation between the real exchange rate and the bad-loans ratio supports our hypothesis (see Figure 1.3).[2]

Figure 1.1
Peru 1992-2003: Asset Substitution and Liability Dollarization Ratios



Another unintended consequence of the dollarization process is the set of *trade-offs* that imposes on the monetary policy design. Peru has recently opted for an inflation targeting framework. Does this policy decision will clash with the policy restrictions originated by the presence of balance sheet effects? The Central Bank will always have to consider the possibility that a fully floating exchange rate might trigger devastating balance sheet effects.

Despite all that, the analysis of dedollarizing options has been scant in the literature. Even in countries like Peru the issue has not been discussed analytically. Among the set of available options to face this situation we have on one side of the spectrum, policies aimed

[2] A detailed account of the financial crisis of those years could be found at Morón and Loo-Kung (2003).

to live along with the problem, either through setting explicit or implicit insurance mechanisms (a formal deposit insurance vs reducing the exchange rate volatility or ex-post bailing-out of banks in trouble). The optimality of these options is questionable given that they do not solve the problem, or increase it as they block an adequate appraisal of from economic agents.

Figure 1.2
Peru 1975-2002: Dollarization Ratio and Monthly Inflation Rate

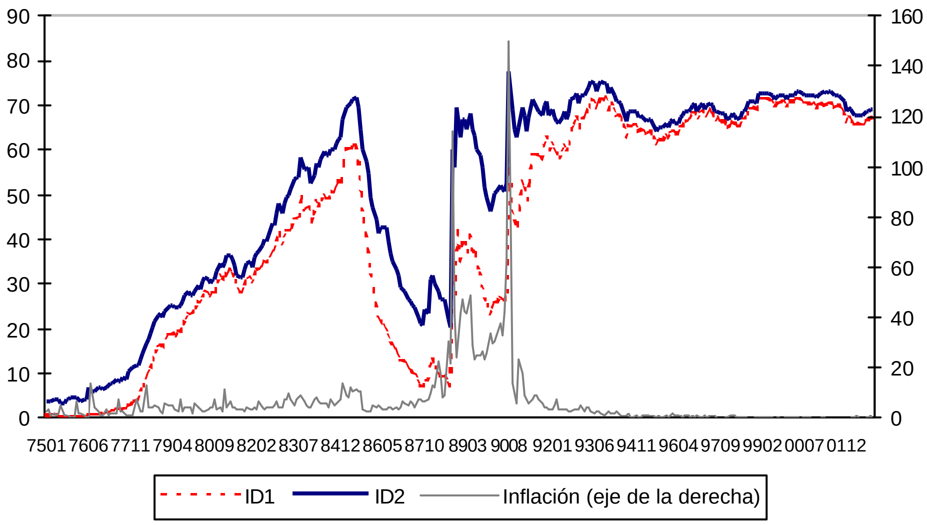
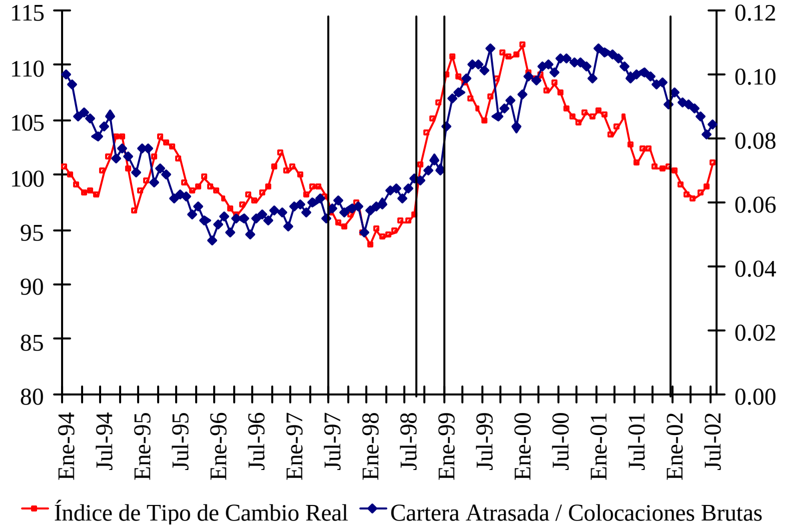


Figure 1.3
Peru 1994-2002: Real Exchange Rate and Bad-Loans Ratio



On the other side, we have policies with an explicit dedollarizing objective. As these are complex policies with many downside risks –in particular, reduce the level of financial intermediation-, countries have been reluctant to use them. The objective of this paper is to understand the causes of financial dollarization and evaluate policies oriented to reduce it within the context of the Peruvian economy.

The paper is organized in the following way. In Section 2 we discuss the two main approaches to implement a dedollarization strategy. In Section 3 we present a simple analytical model to trace the fundamental causes of financial dollarization. In Section 4 we calibrate the model and simulate two policy options: altering the deposit insurance and increasing the relative volatility of inflation vis-à-vis real depreciation. Finally, in Section 5 we conclude and suggest policy recommendations.

2 How to de-dollarize an economy?

A de-dollarization strategy should come from a good understanding of which factors caused the dollarization process. The literature emphasizes two approaches to understand the causes of financial dollarization[3]. The first branch suggests that portfolio considerations are behind agents' decisions to maintain a dollarized portfolio of assests and liabilities. In the second approach, the main culprit are currency-blind regulations which fall short of distinguishing currencies, establishing a wrong set of incentives which generates a dollarized portfolio of assets and liabilities.

The portfolio approach stresses the importance of the relative volatility of the inflation compared to real depreciation as a key determinant of financial dollarization. Ize y Levy Yeyati (1998) use an asset substitution model, CAPM (*Capital Assets Portfolio Model*), to formalize the previous statement. In particular, their model predicts that the degree of deposit and credit dollarization (given by the equilibrium in the loanable funds market) is given by the portfolio that ensures minimum variance. This portfolio is a function of the

[3] The recent policy review written by Levy-Yeyati (2003) provides a good summary of both approaches.

inflation and real depreciation volatilities. Thus, the minimum variance portfolio (MVP) is the natural reference point to measure the degree of financial dollarization and to link it with macroeconomic variables which might be influenced by policy decisions.

Given the importance of second moments of the returns to explain the composition of depositors and creditors portfolio, an increase in the relative volatily of inflation (with respect to real depreciation volatility) will increase the dollarization ratio. This happens as this increase will reduce the coverage benefits rendered by assets denominated in domestic currency. Focusing the analysis in this relative volatility it is possible to explain a persistant and high financial dollarization ratio after a successful stabilization program. In fact, the MVP should not change if the stabilization policy comes with an exchange rate shock mitigation policy.

The second approach underlines the role of the regulatory framework. If there is no discrimination against dollar deposits and a relatively high coverage under the deposit insurance scheme, the banking system will not internalize correctly the exchange rate risk in their pricing policy decisions.

From the standpoint of a bank which finance part of its operations with dollar-denominated deposits in an environment marked by a high correlation between the exchange rate risk and the solvency of banks, the existence of a deposit insurance for dollar denominated deposits will lead to too-high passive interest rates for those liabilities. Those interest rates should be priced netting out of the higher risk that comes with a larger exposition to exchange rate sudden depreciations.

Moreover, and recognizing a highly significant correlation between exchange rate risk and the probability of default of creditors[4], the existence of this type of insurance will create an incentive for financial intermediaries to avoid transfering all the exchange rate risk. Again, the result will be a lower active interest rate.

[4] Which is compatible with a high liability dollarization despite the presence of a large non-tradeable sector.

If the insurance covers a good part of the bank liabilities, the subsequent undervaluation of the exchange rate risk will lead to a lower spread for foreign currency operations, enhancing the attractiveness of deposits and credits in dollars.

Besides the explicit coverage provided by the deposit insurance fund, the scenario described above could also be the end result of an implicit insurance provided by government bail-outs implemented to avoid systemic risk. This argument (so-called *too-many-to-fail,* (Levy Yeyati (2003)) relies, precisely in the assumption that the government will have to intervene ex post (through debt buyout programs or capital strenghtining programs) to avoid a financial crisis.

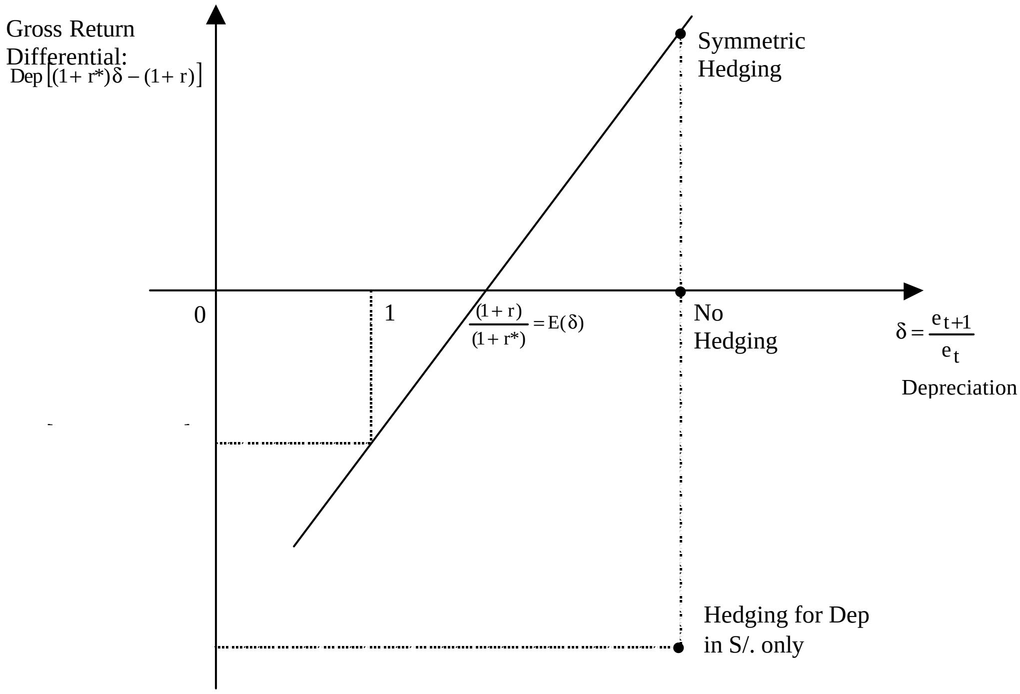
Besides the effect on the financial spreads, a symmetric regulation regarding asset denomination could have a direct impact on the portfolio decisions of depositors. If we focus only on the level of returns (hence assuming risk neutrality), the symmetric coverage for foreign and domestic currency deposits might introduce asymmetric effects in the expost return for both currencies. Once again, if we consider the high correlation between exchange rate risk and the financial system stability, a symmetric coverage would be guaranteeing that those saving in dollars perceive the higher capital gain associated with the exchange rate shock which precisely caused the need to use the insurance.

The previous argument could be shown in Figure 2.1. The vertical axis measures the difference between the gross realized return of dollar and soles, whereas the horizontal axis the realized depreciation. Lets define δ^* as the critical level of depreciation that triggers a default in the creditors, the liquidation of the bank and the need to use the insurance. A symmetric coverage would be guaranteeing a higher capital gain for dollar-denominated assets[5]. In such a setting, where bad states usually are associated with large depreciations, there are clear incentives to save in foreign currency.

[5] It should be expected that the critical level of depreciation will be diferent to the expected depreciation as we are considering an abrupt shock in the exchange rate. That is why we can talk about a ex post return differential of dollars vs soles different from zero.

If we introduce risk adverse agents, the presence of insurance (implicit or explicit) will change the perception about the exchange rate risk linked to the returns of dollar-denominated assets. We will analyze this setup in detail in the next section as we will extend the model suggested by Ize and Levy-Yeyati (1998).

Figure 2.1



3 The Portfolio Approach

In this section we present some econometric evidence that enable us to focus on the dollar deposits instead of considering dollar credits. Given that we found a cointegration relationship between these two variables with the causality going from deposits to credits, we discuss a modified version of the Ize and Levy-Yeyati (1998) model incorporating some elements that will allow us to discuss some policy options to de-dollarize an economy.

3.1 From Asset Substitution to Liability Dollarization: A Cointegration Analysis

Before discussing ways to de-dollarize an economy it is important to attempt to distinguish between demand and supply considerations behind the fact that Peru is a highly dollarized economy. With the exception of Ize and Levy-Yeyati (1998) the issue of financial dollarization has not been analyzed asset and liability dollarization at the same time.

An empirical evaluation of this issue can be found in Barajas and Morales (2003). Using panel estimation with a sample of 14 Latin American countries, these authors find that deposit dollarization is a relevant variable when explaining the degree of loan dollarization.

Taking the above into consideration, the objective of this section is to go beyond the assessment of deposit dollarization's explanatory power and explore the existence of a stable relationship between this variable and credit dollarization and, most importantly, provide some evidence about the direction of causality between them. Regarding this issue, and if banks are to keep their balance sheets matched, one can argue that deposit and loan dollarization should exhibit not only a high correlation but that the former should cause the latter (in the sense of being a good predictor). A graphical exploration of their relationship seems to validate the first result related to this intuition (see Figure 3.1).

In order to formalize this empirical regularity, a cointegration analysis was performed for the period December 1992 – March 2003 (see Appendix I and II). As revealed in the graph above, the presence of a stable relationship and the existence of a consistent error correction representation could only be identified for the period December 1992 – June 1997. In particular, the Johansen test indicated the existence of a cointegration vector[6] of the form (after normalizing for loan dollarization):

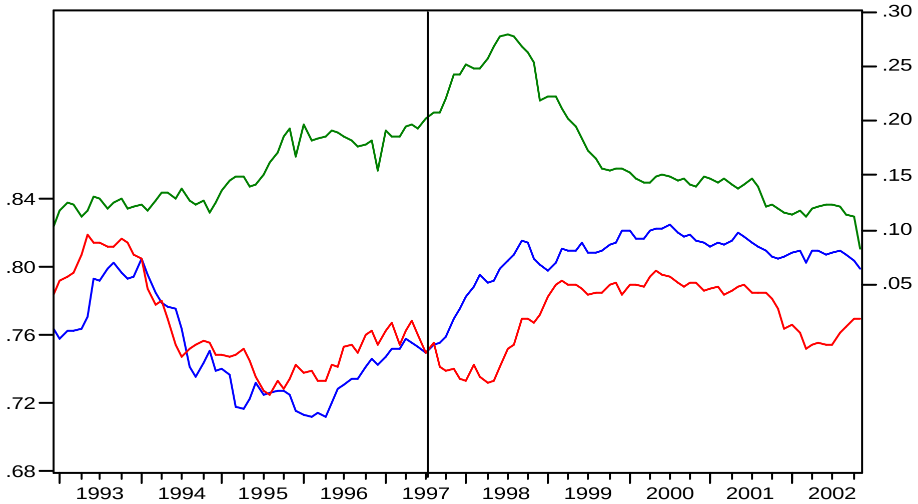
$$FCCRED_t = -0.035 + 1.028\,(FCDEP_t) + e_t \qquad (1.)$$

[6] The null of zero cointegration vectors was rejected at the 1% significance level; the null of at most one cointegration vector was accepted at the 5% significance level.

where:

$$FCCRED \equiv \text{Foreign Currency Credit / Total Credit}$$
$$FCDEP \equiv \text{Foreign Currency Deposits / Total Deposits}$$

Figure 3.1
Deposit dollarization, loan dollarization and external liabilities



The related error correction model was specified including the relative volatility of inflation to real depreciation (VOLAT), the first difference of the GNP annualized growth rate (GNP) and the first difference of the soles-dollar loan rate spread (SPRACT), as exogenous I(0) variables.

$$\begin{aligned} D(FCCRED_t) &= \alpha_{10} + \alpha_{11} e_{t-1} + \alpha_{12} D(FCCRED_{t-1}) + \alpha_{13} D(FCDEP_{t-1}) + \\ &+ \alpha_{14} D(Volat_t) + \alpha_{15} D(Volat_{t-1}) + \alpha_{16} D(GDP) + \alpha_{17} D(SPRACT) + \varepsilon_{1t} \end{aligned} \quad (2.)$$

$$\begin{aligned} D(FCDEP_t) &= \alpha_{20} + \alpha_{21} e_{t-1} + \alpha_{22} D(FCCRED_{t-1}) + \alpha_{23} D(FCDEP_{t-1}) + \\ &+ \alpha_{24} D(Volat_t) + \alpha_{25} D(Volat_{t-1}) + \alpha_{26} D(GDP) + \alpha_{27} D(SPRACT) + \varepsilon_{2t} \end{aligned}$$

As reveled in Table 3.1, all exogenous stationary variables appear significant and with the expected sign when explaining the evolution of credit dollarization. The most important result, however, is that the lagged error term from the cointegration vector is only significant (and with the correct sign) in the equation for credit dollarization. In other words, and in the event of a shock that deviates either variable from their equilibrium relationship, only credit dollarization will adjust to reestablish this equilibrium. Formally, the presence of a significant error correction term in the FCCRED equation only, implies that Granger causality could only be verified from deposit to loan dollarization.

Table 3.1
Estimated coefficients in the VEC
(December 1992 – March 1997)

Variable	C	e_{t-1}	D($Fccred_{t-1}$)	D($Fcdep_{t-1}$)
D(FCCRED)	0.0010 (0.001)	**-0.3791** **(0.075)****	0.1052 (0.103)	-0.1171 (0.142)
D(FCDEP)	-0.0012 (0.001)	-0.048 (0.1055)	-0.0940 (0.145)	0.0902 (0.199)
Variable	**D($Volat_t$)**	**D($Volat_{t-1}$)**	**D(PBI_t)**	**D(SPRACT)**
D(FCCRED)	0.0110 (0.005)*	0.0110 (0.005)*	0.0433 (0.021)*	0.0006 (0.0003)*
D(FCDEP)	0.0024 (0.317)	0.0010 (0.008)	0.0013 (0.030)	-0.0003 (0.0004)

* Indicates rejection of the null at the 5% significance level.
** Indicates rejection of the null at the 1% significance level.

As mentioned above, the existence of a stable relationship and the evidence about causality from deposit to loan dollarization could only be validated for the sub-sample December 1992 – June 1997. Not surprisingly, this cut-off period coincides with a significant acceleration in the evolution of the ratio of external liabilities (of the banking sector) to dollar denominated credit (see Graph 3.1). In fact, and to the extent in which external liabilities grow in importance as a source of funds for dollar denominated credit, one can expect that the relation between the latter and dollar deposits will become weaker.

The results shown in this section serve our research effort in two ways. In terms of policy implications, evidence seems to support the claim that reducing our dependence on foreign funding will not only prevent external turmoil (as the one triggered by the Russian crisis in the second half on 1998) from translating into a local credit crunch, but will also allow us to restrict our attention to the supply side when implementing a dedollarization strategy.

3.2 A portfolio model of deposit dollarization

In this section we slightly modify the Ize and Levy-Yeyati (1998) minimum variance portfolio model. The fundamental change is to include in their specification the role of the deposit insurance in the portfolio decision of depositors. What we will show is how does this decision is modified compared to the benchmark model without deposit insurance. If the model is able to replicate the stylized facts of the Peruvian economy we will be able to simulate changes in the deposit insurance coverage, and in the relative volatility of inflation vis-à-vis real depreciation.

We focus on the dollar deposits based on the results of the previous section. Given a stable long-term relationship between deposit and credit dollarization, the ECM results show us that credit dollarization adjusts to changes in the deposit dollarization. And this causality goes only in this direction. Therefore, our analytical focus would be on the incentives faced by fund suppliers.

In addition, we consider that the model based on Ize and Levy Yeyati (1998) is a good starting point not only as links the optimal portfolio composition to fundamental variables, but also as includes the possibility of holding assets outside of the country. This is a key element if we are trying to adequately evaluate the possible effects of changes in the deposit insurance discriminating by currency denomination of domestically held deposits.

In this sense, and following the definitions of the original model, the depositors' portfoilio could be held in three assets: local currency deposits in the domestic banking system (DMN: H), foreign currency deposits in the domestic banking system (DME: F), and crossborder foreign currency deposits abroad (EME: C). The real returns of these three assets are given by: r^H, r^F y r^C, respectively.

The original model includes a risk component associated with the stability of the financial system for all domestic deposits. However, this risk is considered to be orthogonal with respect to the exchange rate risk. As the authors recognize, we should expect that the degree of liability dollarization set the level of exposure of the financial system to a systemic risk in the event of sudden movements in the real exchange rate. By the same token, and given the high degree of liability dollarization in Peru, we linked the risk associated with the stability of the financial system to the exchange rate risk. We will see that the coverage of the deposit insurance will affect this risk component.

With this is mind, the realized returns for each asset is given by:

$$
\begin{aligned}
r^H &= E(r^H) - \mu_\pi + \mu_{CH} \\
r^F &= E(r^F) + \mu_S + \mu_{CF} \\
r^C &= E(r^C) + \mu_S
\end{aligned}
\qquad (3.)
$$

where, $\mu_{CH} = \mu_C - \alpha_H \mu_S$ and $\mu_{CF} = \mu_C - \alpha_F \mu_S$. Besides the shocks associated with inflation and real depreciation (μ_π) and (μ_S), which affect DMN and DME, respectively, the returns over domestic deposits are subject to an additional risk component (μ_{CH}) and μ_{CF}), which is the local risk. This risk is the combination of two components: the first one is an autonomous component (μ_C) which captures the confiscation risk; the second component directly depends of the exchange rate risk and its influence will be relevant as far as financial system stability depends on real exchange rate fluctuations. As mentioned above, we will simulate changes in deposit insurance coverage. In particular, and for a given exchange rate risk exposure of the financial system, changes in the coverage (α_H and α_F), will alter the impact on domestic asset returns.

As in the original model, and for simplicity we assume that all perturbations are distributed with mean zero and variance-covariance matrix equal to S_{ij}, that satisfies $S_{SC} = S_{\pi C} = 0$. Within the context of our model, this implies that the confiscation risk component is orthogonal with inflation or real depreciation shocks. However, and in contrast with the original model, this does not mean that there is no relationship between the exchange rate risk and the financial system stability risk. As we already mentioned, this relationship exists and it is captured by the second component of shocks affecting domestic deposits only.

The next step is to define the depositors' preferences, which are:

$$U = E(r) - c_D Var(r)/2 \tag{4.}$$

where **r** is the real average return of the portfolio and $c_D > 0$ captures the degree of risk aversion of depositors. Therefore, the optimization problem consists in choosing the shares of each asset that maximizes U.

Defining x^F, x^C and $x^H = 1 - x^F - x^C$ as the shares of DME, EME, DMN, respectively, the first and second moments of the distribution of **r** are given by:

$$\begin{aligned} E(r) &= x'w + r^H \\ Var(r) &= x'Bx + 2Cx + Var(r^H) \end{aligned} \tag{5.}$$

where:

$$x = \begin{bmatrix} x^F \\ x^C \end{bmatrix}; \quad w = E\begin{bmatrix} r^F - r^H \\ r^C - r^H \end{bmatrix}$$

$$B=\begin{bmatrix} Var(r^F-r^H) & Cov(r^F-r^H, r^C-r^H) \\ Cov(r^F-r^H, r^C-r^H) & Var(r^C-r^H) \end{bmatrix}$$

$$C=\begin{bmatrix} Cov(r^F-r^H, r^H) \\ Cov(r^C-r^H, r^H) \end{bmatrix}$$

Using these expressions, the first orden condition is exactly as the one in the original model: $-w/c_D + Bx + C = 0$. From this expression it is possible to find the optimal shares of dollar deposits, both domestically as abroad:

$$\begin{bmatrix} x^F \\ x^C \end{bmatrix} = -B^{-1}C + (1/c_D)B^{-1}w \tag{6.}$$

The first term of (6.) correspond to the share of foreign currency deposits in the MVP (or the degree of underlying dollarization) and it will be the center of our attention in the following análisis. Lets define this underlying dollarization as λ* and see which are its components alter we modified the model[7].

$$\begin{aligned} \lambda^* &= -B^{-1}C \\ &= \begin{bmatrix} \lambda^*_F \\ \lambda^*_C \end{bmatrix} = -\frac{1}{|B|}\begin{bmatrix} Var(r^C-r^H) & -Cov(r^F-r^H, r^C-r^H) \\ -Cov(r^F-r^H, r^C-r^H) & Var(r^F-r^H) \end{bmatrix}\begin{bmatrix} Cov(r^F-r^H, r^H) \\ Cov(r^C-r^H, r^H) \end{bmatrix} \end{aligned} \tag{7.}$$

In (7.), the solution for λ^*_F and λ^*_C correspond to the shares of DME and EME in the minimum variance portfolio, respectively.

Considering (3.), each of the elements in (7.) is given by:

[7] It is worth noticing that in the base model λ* is given by $\lambda^* = \frac{S_{\pi\pi} + S_{\pi S}}{S_{\pi\pi} + S_{SS} + 2S_{\pi S}}$. This expression let us ling the degree of dollarization to the relative volatility of inflation with respect to real depreciation.

$$
\begin{aligned}
&Var(r^F - r^H) = V = (1 + 2(\alpha_H - \alpha_F) + (\alpha_F - \alpha_H)^2)S_{SS} + S_{\pi\pi} + 2(1 + \alpha_H - \alpha_F)S_{\pi S} \\
&Var(r^C - r^H) = V + S_{CC} - (\alpha_F{}^2 - 2\alpha_F - 2\alpha_F\alpha_H)S_{SS} + 2\alpha_F S_{\pi S} \\
&Cov(r^F - r^H, r^C - r^H) = V + (\alpha_F + \alpha_F\alpha_H - \alpha_F{}^2)S_{SS} + \alpha_F S_{\pi S} \\
&|B| = V(Var(r^C - r^H) - (Cov(r^F - r^H, r^C - r^H))^2 \\
&C_1 = Cov(r^F - r^H, r^H) = (\alpha_F - 1 - 2\alpha_H)S_{\pi S} + (\alpha_H(\alpha_F - 1) - \alpha_H{}^2)S_{SS} - S_{\pi\pi} \\
&C_2 = Cov(r^C - r^H, r^H) = -(1 + 2\alpha_H)S_{\pi S} - (\alpha_H + \alpha_H{}^2)S_{SS} - S_{\pi\pi} - S_{CC} \qquad (8.)
\end{aligned}
$$

As could be derived from these expressions, including a local risk tied to the real exchange rate fluctuations has complicated the functional relationship between underlying dollarization and the volatilities of inflation and real depreciation[8]. Instead of showing an analytical solution we calibrate the new model and simulate it to analyze the effects of changes in the deposit insurance coverage and the relative volatility of the macroeconomic variables involved.

4 Calibration and model simulation

A numerical solution of the model requires to compute the variance of inflation ($S_{\pi\pi}$), the variance of the real depreciation (S_{SS}), the covariance between these two variables ($S_{\pi S}$), the variance of the confiscation risk shock (S_{CC}), and setting a value for α_H and α_F.

The first three were computed using annual variations of CPI, the real exchange rate for 1993-2003. The confiscation risk and the coverage were calibrated to obtain consistent values of λ^*_F and λ^*_C.

Considering that the simulation exercises will be based in assigning different values of α_H and α_F, we show how these parameters influence the variance of each component of the MPV.

[8] In order to obtain the expressions of the original model just set $\alpha_H = \alpha_F = 0$.

By definition, the portfolio variante is given by[9]:

$$\begin{aligned}\mathrm{Var}(r) = (x^F)^2\mathrm{Var}(r^F) + (x^C)^2\mathrm{Var}(r^C) + (1-x^F-x^C)^2\mathrm{Var}(r^H) + 2x^F x^C\mathrm{Cov}(r^F, r^C) + \ldots \\ \ldots + 2x^F(1-x^F-x^C)\mathrm{Cov}(r^F, r^H) + 2x^C(1-x^F-x^C)\mathrm{Cov}(r^C, r^H)\end{aligned} \tag{9.}$$

where:

$$\begin{aligned}&\mathrm{Var}(r^H) = S_{\pi\pi} + S_{CC} + \alpha_H{}^2 S_{SS} + 2\alpha_H S_{\pi S} \\ &\mathrm{Var}(r^F) = (1-\alpha_F)^2 S_{SS} + S_{CC} \\ &\mathrm{Var}(r^C) = S_{SS} \\ &\mathrm{Cov}(r^F, r^H) = -(1-\alpha_F)S_{\pi S} - \alpha_H(1-\alpha_F)S_{SS} + S_{CC} \\ &\mathrm{Cov}(r^C, r^H) = -S_{\pi S} - \alpha_H S_{SS} \\ &\mathrm{Cov}(r^F, r^C) = (1-\alpha_F)S_{SS}\end{aligned} \tag{10.}$$

Considering that the current deposit insurance offers a symmetric coverage for assets denominated in soles or dollars, we take as the starting point a scenario in which $\alpha_H = \alpha_F = \alpha$. If we consider values of α such that $\alpha > 1$, it is easy to verify looking at the first equation of (3.), that we will be increasing the exposure to exchange rate risk for those deposits in domestic currency. That is why the numerical results yield an underlying dollarization (λ^*_F + λ^*_C) close to one, with a share for EME too high compared to historical data. Under this setup, a large part of the effects of different confiscation risks (S_{CC}, the other variable that has to be calibrated) altered the distribution of dollar deposits (DME and EME). As expected, a higher S_{CC} has almost no effect over (λ^*_F + λ^*_C) and it only translates into a transfer of dollar deposits from the domestic banking system to abroad.

That is the reason why we establish a base scenario in which $1 > \alpha > 0$. In particular, and setting $\alpha_H = \alpha_F = \alpha = 0.4$ and $S_{CC} = 8.3$ we calibrate our base scenario with λ^*_F = 0.712 and λ^*_C = 0.118. Both values are consistent with current data.[10].

[9] The reader will notice that this expression is equivalent to (5.).

4.1 *The role of deposit insurance*

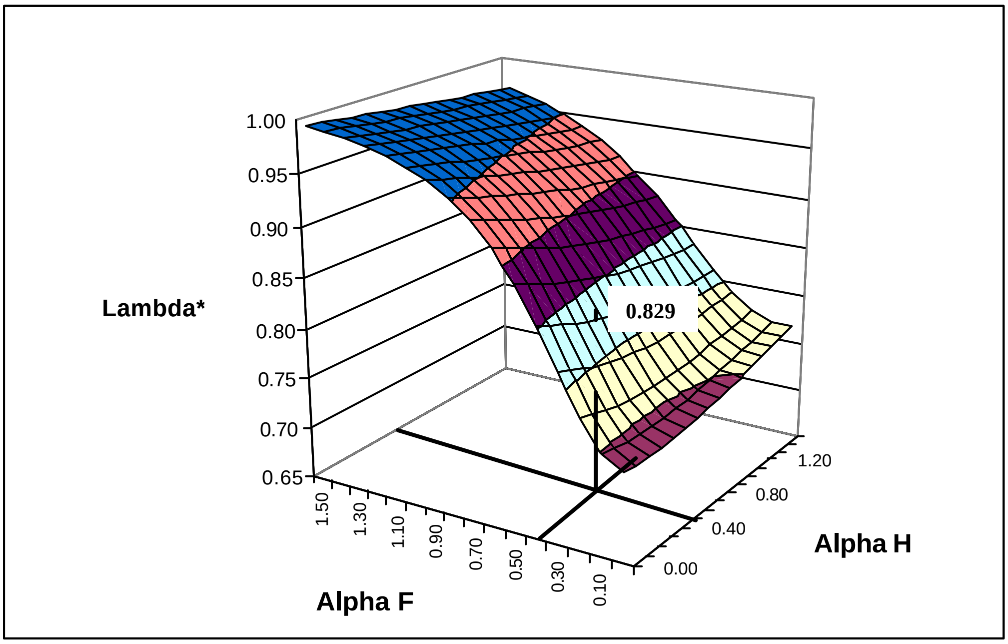
Before analyzing in detail the consequences of a symmetric coverage, it might be useful to summarize the effects on the underlying dollarization ratio ($\lambda^*_F + \lambda^*_C$) using a surface response as depicted in Figure 4.1.

As the graph shows, a symmetric reduction in the coverage offered by the deposit insurance (a higher value of $\alpha_H = \alpha_F = \alpha$) will increase the underlying dollarization ratio. In fact, and using (10.), a higher α implies increasing the exposure to domestic currency deposits to the exchange rate risk. This effect (which increases the volatility of the domestic currency assets return) is unambiguous and for any value of α. However, the sign of the effect on the volatility of the DME returns is not always the same and it depends on the value of α. In particular, and for changes in the vicinity of the base scenario, increases in α will reduce the exposure of DME to exchange rate risk[11]. That is why there is a positive relationship between α and the underlying dollarization ratio.

[10] The average observed shares of DME and EME between December 1994 and October 2002 are 69.9% and 6.65%, respectively. It should be said that the data used to compute the share of EME only considers deposits held by Peruvians in the USA. Therefore, the estimate has a clear downward bias.

[11] The reader will notice that a higher exposure of the local risk to the exchange rate risk for foreign currency deposits could (as α gets close to 1) isolate the volatility of returns to real exchange rate fluctuations. This result comes from the fact that a higher profitability associated with a real depreciation gets compensated by a negative shock on the local risk component. For risk averse agents, this will increase the attractiveness of DME as a hedging mechanism against exchange rate risk.

Figure 4.1
Underlying dollarization ratio: Surface response

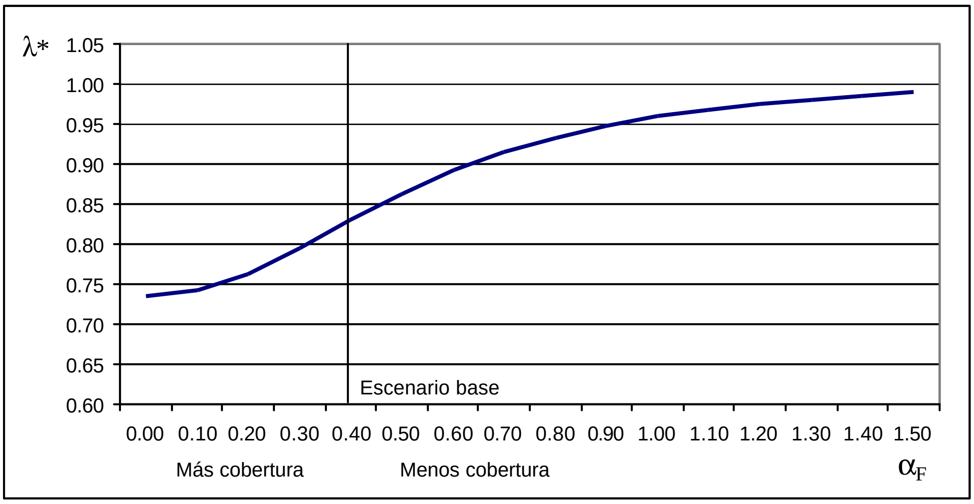


Based on the previous argument, it is posible to extract a first conclusion: focusing on risk considerations a currency-blind regulation does not have to necessarily introduce a bias in favor of foreign currency denominated assets. In fact, the model predicts an inverse relationship between the degree of symmetric coverage and the dollarization ratio[12].

One of the main objectives of formulating this model was to explore the consequences of changing the symmetry of the deposit insurance. If we hold the coverage for domestic currency deposits inaltered ($\overline{\alpha}_H = 0.4$), we plot in Figure 4.2 the response of the underlying dollarization ratio.

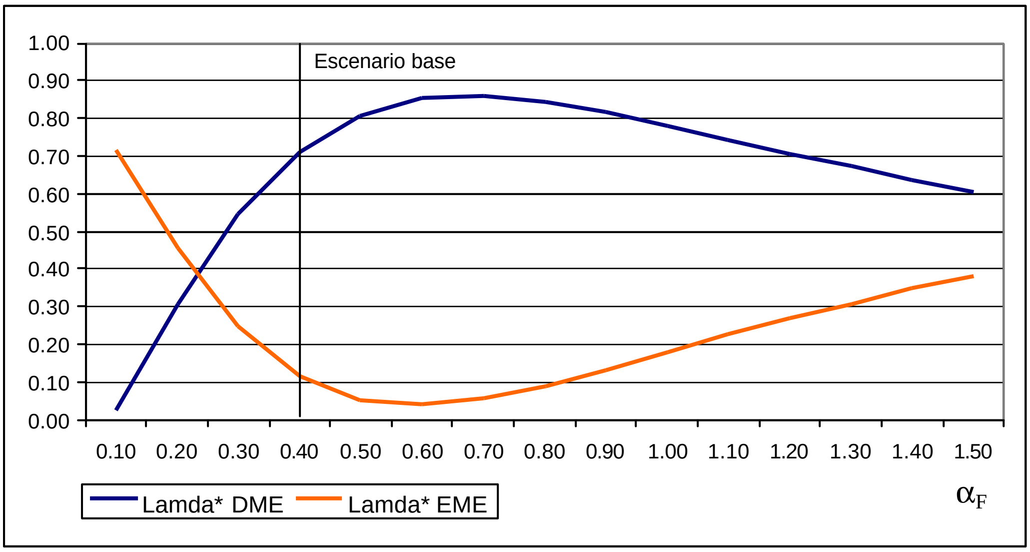
[12] Instead of contradicting the conclusions of Figure 3.1, the previous argument implies the existence of different responses depending on the level of risk aversion of depositors. If it increases, and variance considerations matter more, the results will be more in line with those predicted by this model.

Figure 4.2
Response of dollarization ratio to different values of foreign currency deposits coverage



The reported results in Figure 4.2 might seem not very intuitive. When we increase the degree of exposure of DME to exchange rate risk, the representative (risk-averse) agent deemed as an optimal policy to increase the share of foreign currency deposits in his asset portfolio. However, if we look at each asset (λ^*_F and λ^*_C) separately we will see that deposits are being funneled out of the country (see Figure 4.3).

Figure 4.3
Shares of DME and EME for different values of foreign currency deposits coverage



The above graph captures one of the main risks linked to a non-symmetric deposits insurance coverage: the disintermediation risk. In particular, the model predicts that, instead of reducing the ratio of dollarization, a lesser coverage for foreign currency deposits in the domestic banking system will end up in a massive deposit flight.

As expected, when α_F gets close to 1, a lower coverage for DME will reduce the share of DME (λ^*_F)[13]. However, that reduction will not increase domestic currency denominated deposits but increase deposits held abroad. To understand whis result is crucial to consider the role of α_F in the variance-covariance of each term (see (10.)) in the total portfolio volatility[14]. In general, we could say that given the increase in α_F, the EME would become a more attractive destination for all the DME withdrawn if the covariance of r^H and r^F increase more (in absolute terms) than the covariance of r^C and r^F.

[13] Starting from the base scenario ($\alpha_F = 0.4$), the initial increase in λ^*_F responds to the argument mentioned in footnote 11.

[14] When α_F changes, the composition of the MPV will change in order to guarantee that the partial derivative of the portfolio variance with respect to each share (x^F, x^C y x^H) be the same (taking into account the contribution in variance and covariance). In other words, the new optimal portfolio will guarantee that there are no net profit (or loss) in variance terms of withdrawing one unit of wealth of an asset to be invested in another.

It is necessary to mention the role of including a third asset to obtain the above results. In a different setting in which it is only possible to save in soles or dollars in the domestic banking system, a reduction in deposit insurance coverage for dollars would have induced a change in the denomination of assets.

4.2 The role of relative volatilities

One of the main contributions of this model is that we can recover a simple functional form which relates directly the level of underlying dollarization with the relative volatility of inflation vis-à-vis real depreciation. The purpose of this exercise is to verify if this relationship holds after including the modifications of the model. In such a way, we would be able to determine if the policy recommendations of the original model are still valid within a context in which the local risk is tied with the exchange rate risk.

The simulation was done multiplying the real depreciation volatility by a factor in order to lower the relative variance ($S_{\pi\pi}/S_{SS}$) by 10% in each new point[15]. With these new series we recalculate the value of S_{SS} and $S_{\pi S}$ and obtain the associated dollarization ratios using the deposit coverage of the base scenario ($\alpha_H = \alpha_F = \alpha = 0.4$).

The results (see Figure 4.4) indicate that the conclusions of the base model hold. There is still a positive relationship between the underlying dollarization ratio and the ratio $S_{\pi\pi}/S_{SS}$. In particular, and coming from the base scenario ($S_{\pi\pi}/S_{SS}$ = 3.97, λ^* = 0.829), for each 10% reduction in the relative variance, the dollarization ratio fall 0.5 percentage points. Even though this elasticity is not constant, it is possible to verify that the economy needs a three times more volatile real exchange rate to observe a 10% fall in the underlying dollarization ratio (see Table 4.1).

[15] The base scenario has a relative volatility ratio of 3.97.

Figure 4.4

Underlying dollarization for different values of relative volatilities ($S_{\pi\pi}/S_{SS}$)

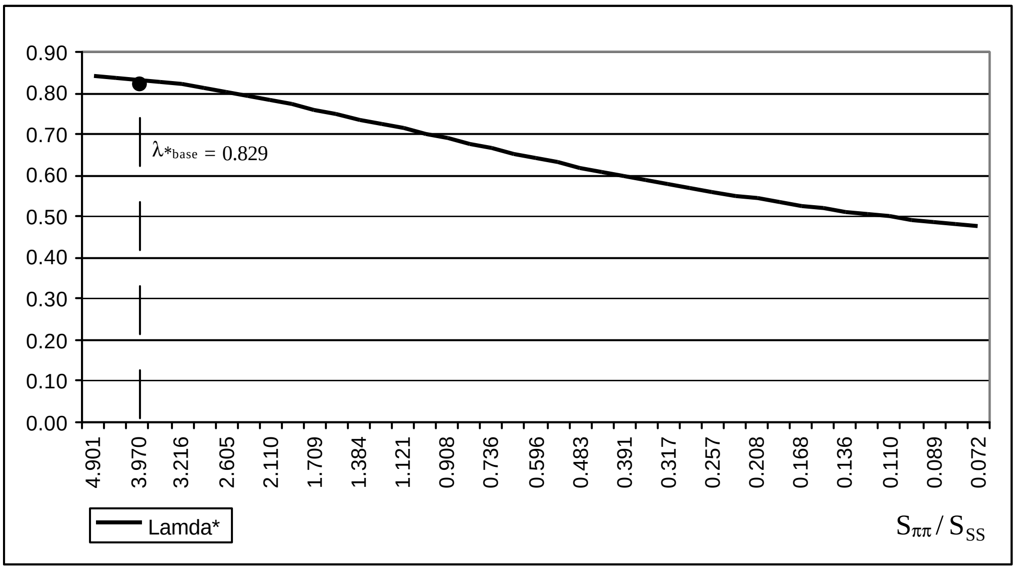


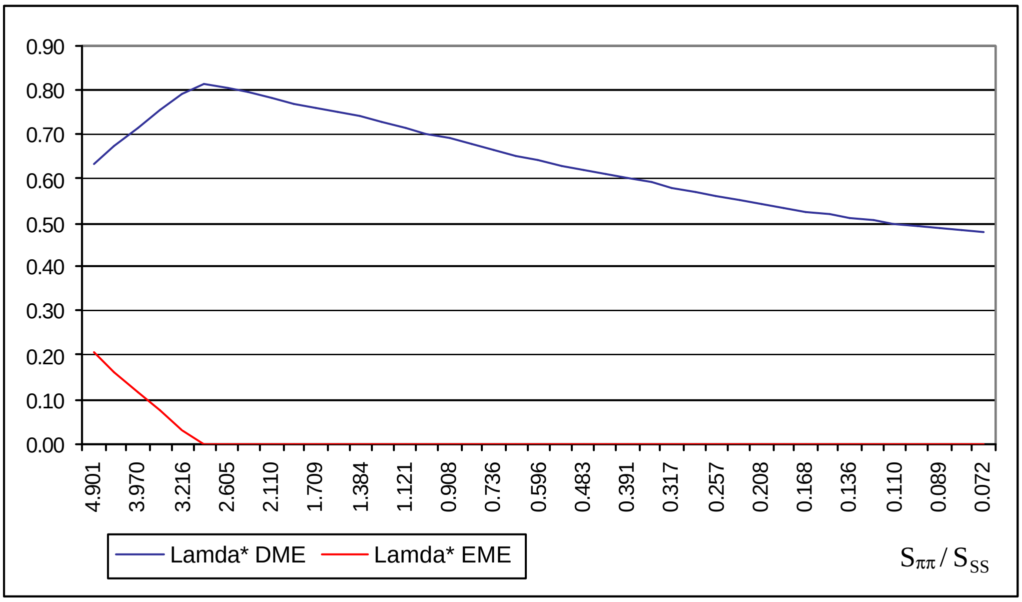
Table 4.1

Factor (x) Spp / xSss	Relative variance	l*
1.00	3.970	0.829
3.19	1.246	0.725
7.40	0.536	0.631
23.59	0.168	0.526

Finally, it is important to analyze the behavior of each component of the underlying dollarization ratio. In Figure 4.5, when the relative volatility is lower than the base scenario initially there is a portfolio reshuffle towards deposits denominated in dollars: wealth is transferred from EME to DME. As this transfer is not complete, the total dollarization ratio falls. If we abstract from the effects associated with covariance terms, and given the full exposure of EME to the exchange rate risk, it is easy to see that an optimal strategy when S_{SS} increases is to reduce the share of assets abroad. Once those funds are depleted, and given the greater exposure of DME to exchange rate risk, any further increases in S_{SS} will lead to a net gain in variance terms (lower portfolio volatility) if we move our wealth to domestic currency denominated deposits (DMN).

Figure 4.5

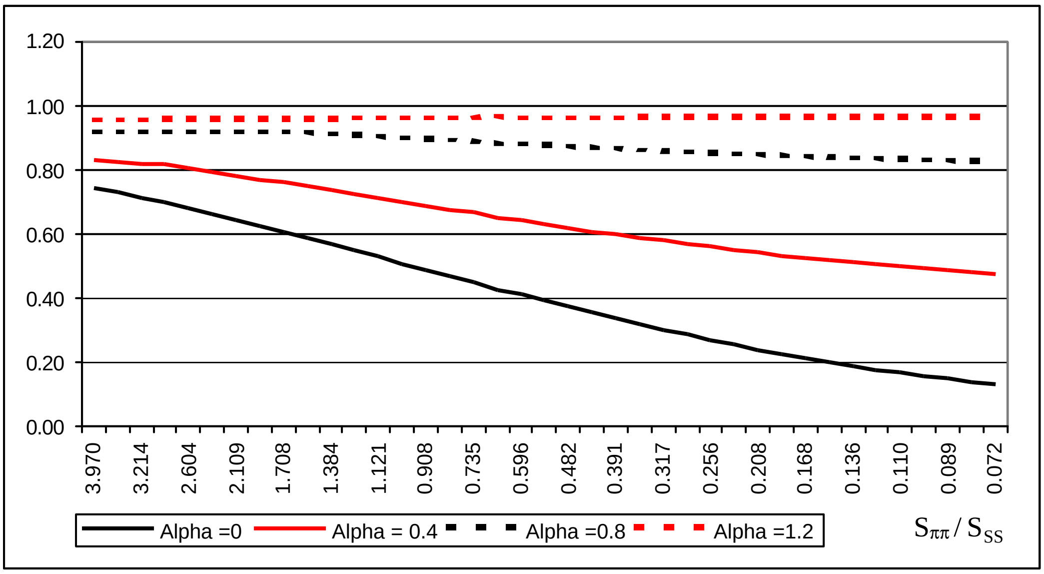
Shares of DME and EME for different values of relative volatilities ($S_{\pi\pi}/S_{SS}$)



If we consider the variance terms in (10.) and the previous reasoning, the results will be sensititive to the level of deposit coverage offered by the deposit insurance. In fact, the potential effects of an increase in the volatility of the real exchange rate will depend on the exposure of each asset to the exchange rate risk. At that exposure will depend, in turn, on the value of α. Therefore, when domestic currency deposits face a higher exposure to the exchange rate risk (a higher α), increasing its share in the portfolio will augment the portfolio variance.

This is shown in Figure 4.6, where we plot the sensitivity of λ^* when we change $(S_{\pi\pi}/S_{SS})$ for different levels of deposit coverage. According to the reasoning exposed, such sensitivity will depend positively on the level of coverage. In particular, and for $\alpha_H = \alpha_F = \alpha = 0$ we can see that the underlying dollarization ratio responds more drastically to changes in the relative variance. That is exactly the case of the original model[16]. Domestic currency assets are completely isolated from the exchange rate risk, that is why the agent decides to transfer his wealth to DMN when $S_{\pi\pi}/S_{SS}$ falls. Exactly the opposite happens when $\alpha_H = \alpha_F = \alpha = 1.2$, where the higher exposure of DMN to the exchange rate risk make those a less attractive safe haven when S_{SS} increases.

Figure 4.6
Underlying dollarization for different values of relative volatilities and coverage



Before closing this section, it is important to explore how easy is to modify the $S_{\pi\pi}/S_{SS}$ ratio by policy decisions. As inflation is one of the components of the real depreciation, the margin to influence the ralitive volatility will depend on the degree of association of both variables.

Lets define e as the nominal depreciation and assuming that the external inflation rate is constant, the log-linear version of the real exchange rate could be expressed as:

$$s = e - \pi \qquad (11.)$$

[16] Vale la pena notar que el ratio de dolarización subyacente reportado por el modelo en este caso (λ^* =0.74) es muy similar al presentado por Ize y Levy Yeyati (0.78) al trabajar con datos históricos para el período 1991-1995.

In order to link the variance terms of each variable, lets suppose that the inflation rate could be expressed by:

$$\pi = \beta e + (1-\beta)\varepsilon \qquad (12.)$$

where β is the *pass-through* coefficient (from the nominal exchange rate to the domestic price inflation) and ε measures the impact of real and monetary shocks over the domestic currency component of the consumption bundle of the representative agent.

Using (11.) and (12.), and assuming $\mathrm{Cov}(e,\varepsilon) = 0$, it is easy to shown that:

$$\begin{aligned} \mathrm{Var}(\pi) &= \beta^2 \mathrm{Var}(e) + (1-\beta)^2 \mathrm{Var}(\varepsilon) \\ \mathrm{Var}(s) &= \mathrm{Var}(e) + \mathrm{Var}(\pi) - 2\mathrm{Cov}(e,\pi) \\ &= \mathrm{Var}(e) + \beta^2 \mathrm{Var}(e) + (1-\beta)^2 \mathrm{Var}(\varepsilon) - 2\beta \mathrm{Var}(e) \\ &= (\beta-1)^2 \mathrm{Var}(e) + (1-\beta)^2 \mathrm{Var}(\varepsilon) \end{aligned} \qquad (13.)$$

Based on (13.) the effect of the *pass-through* coefficient on the possibility of influence the ratio $S_{\pi\pi}/S_{SS}$ by policies oriented to change the volatility of the nominal exchange rate. In particular, when the *pass-through* is high ($\beta \to 1$), increases in the variance of the nominal exchange rate will be transferred as increases in the inflation variance. The ensuing increase in $S_{\pi\pi}/S_{SS}$ will increase (instead of reduce) tbe underlying dollarization ratio. The opposite will happen in an scenario characterized by low *pass-through*, when the nominal exchange rate variance will be inversely related to the $S_{\pi\pi}/S_{SS}$ ratio[17].

5 Concluding remarks

When addressing the implications of high and persistent financial dollarization in emerging markets, the recent focus has turned to its negative prudential implications. In particular, and due to the currency mismatch that widespread deposit and loan dollarization brings into the economy, the main concern is the risk that the so-called "balance sheet effects" will amplify the impact of adverse external shocks on real variables.

[17] The Peruvian economy is characterized by a low pass-through coefficient. However and as noted by Morón and Winkelried (2003), that coefficient is not stable.

The need to pursue a dedollarization strategy is based on the above premise and the current literature provides us with a broad menu of policy options to counter this phenomenon. Regarding this issue, the preceding analysis has allowed us to focus our attention on the drivers of deposit dollarization and to privilege hedging considerations when explaining the composition of the depositors' portfolio.

In particular, and according to the intuition that suggests that supply considerations will dominate if banks are to keep their balance sheets matched, the empirical evidence favors the existence of causality from deposit to loan dollarization. This result was statistically validated with a cointegration analysis for the sub-sample December 1992 – June 1997, period in which a significant acceleration in the ratio of external liabilities (of the banking sector) to dollar denominated credit was observed. In this sense, a regulatory framework that prevents an excessive dependence on foreign funds will not only reduce our vulnerability to external shocks, but will also allow us to turn our attention towards depositor's portfolio decisions when talking about the drivers of financial dollarization.

Regarding these decisions, our extensions to Ize and Levy-Yeyati's (1998) model show that a regulatory framework that differentiates among currencies via a reduction in the deposit insurance coverage for dollar assets, is not necessarily the best way to counter financial dollarization. In particular, and instead of luring depositors towards assets denominated in soles, funds will be transferred abroad. This implies not only that dollarization (in its broader sense) will not be reduced but that we face the risk of financial disintermediation.

Policy recommendations that stem from our analysis point instead towards reducing the relative volatility of inflation to real depreciation. In this sense, it must be said that the first steps to achieve a reduction in this variance ratio have already been taken with the implementation of an inflation targeting scheme. However, and considering that the Peruvian evidence doesn't favor the existence of a high pass-through coefficient, dedollarization efforts should now focus on reducing the implicit insurance granted by the existence of little real exchange rate volatility. The risk of this strategy stems from the fact that the increase in real exchange volatility (required to reduce the attractiveness of dollar deposits) could end up triggering now the "balance sheet effects" which our dedollarization effort seeks to avoid in the future.

In the light of the contrasting policy implications that stem from the different approaches that one can favor when implementing a dedollarization strategy, further research is required in order to determine the extent in which the proposed instruments, channels and associated risks can interact. In this sense, and to the extent in which we posses an analytical tool that explicitly addresses these policy options in an economy characterized by the presence of "balance sheet effects", we would be able to account for both the need to pursue a dedollarization strategy and the effects of the available options that serve this objective.

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Appendix I

Included observations: 53 after adjusting endpoints
Trend assumption: No deterministic trend (restricted constant)
Series: FCCRED FCDEP
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None *	0.338469	24.23491	19.96	24.6
At most 1	0.043107	2.335379	9.24	12.97

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 1 cointegrating equation(s) at the 5% level
Trace test indicates no cointegration at the 1% level

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.338469	21.89953	15.67	20.2
At most 1	0.043107	2.335379	9.24	12.97

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

FCCRED	FCDEP	C
96.78973	-92.94764	-1.538279
13.5912	20.7734	-25.67931

Unrestricted Adjustment Coefficients (alpha):

D(FCCRED)	-0.003937	0.000152
D(FCDEP)	-0.00097	-0.00138

1 Cointegrating Equation(s): Log likelihood 389.61

Normalized cointegrating coefficients (std.err. in parentheses)

FCCRED	FCDEP	C
1	-0.960305	-0.015893
	-0.07478	-0.05723

Adjustment coefficients (std.err. in parentheses)

D(FCCRED)	-0.38102
	-0.076
D(FCDEP)	-0.093869
	-0.09287

Appendix II

Sample(adjusted): 1993:02 1997:06		
Included observations: 53 after adjusting endpoints		
Standard errors in ( ) & t-statistics in [ ]		
Cointegrating Eq:	CointEq1	
FCCRED(-1)	1	
FCDEP(-1)	-1.028009	
	(0.080540)	
	[-12.7634]	
C	0.035423	
Error Correction:	D(FCCRED)	D(FCDEP)
CointEq1	-0.379135	-0.048029
	(0.075040)	(0.105510)
	[-5.05263]	[-0.45520]
D(FCCRED(-1))	0.105206	-0.094038
	(0.102910)	(0.144700)
	[1.02233]	[-0.64987]
D(FCDEP(-1))	-0.117091	0.09017
	(0.141530)	(0.199010)
	[-0.82733]	[0.45309]
C	0.000978	-0.00117
	(0.000860)	(0.001210)
	[1.14078]	[-0.97061]
D(VOLAT)	0.010572	0.002369
	(0.005310)	(0.007470)
	[1.99110]	[0.31728]
D(PBI)	0.043341	0.001269
	(0.021250)	(0.029880)
	[2.03950]	[0.04247]
D(SPRACT)	0.000641	-0.000306
	(0.000260)	(0.000360)
	[2.47240]	[-0.83839]
D(VOLAT(-1))	0.010881	0.000944
	(0.005470)	(0.007690)
	[1.98852]	[0.12266]
R-squared	0.582323	0.067104
Adj. R-squared	0.517351	-0.078014
Sum sq. resids	0.00121	0.002392
S.E. equation	0.005185	0.007291
F-statistic	8.962691	0.46241
Log likelihood	208.0184	189.9534
Akaike AIC	-7.547863	-6.866164
Schwarz SC	-7.250461	-6.568762
Mean dependent	-1.00E-04	-0.000603
S.D. dependent	0.007463	0.007022
Determinant Residual Covariance		1.41E-09
Log Likelihood		398.3748
Log Likelihood (d.f. adjusted)		389.7024
Akaike Information Criteria		-14.02651
Schwarz Criteria		-13.35735