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Exchange Rate Policy and Liability Dollarization: What Do the Data Reveal About Causality?

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Exchange Rate Policy and Liability Dollarization: What Do the Data Reveal About Causality?[1]

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Abstract

The paper identifies the contemporaneous relationship between exchange rate policy and liability dollarization using three different definitions of dollarization. The presence of endogeneity makes the empirical identification elusive. We use identification through heteroskedasticity to solve the endogeneity problem in the present context (Rigobon, 2003). While we find that countries with high liability dollarization (external, public, or financial) tend to be more actively involved in exchange rate stabilization operations, we do not find evidence that floating, by itself, promotes de-dollarization.

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I. INTRODUCTION

Does liability dollarization cause countries to focus monetary policy on stabilizing nominal exchange rate? Or does monetary policy that stabilizes the exchange rate lead agents to borrow in foreign currency? Or both? Despite the abundance of literature on dollarization and exchange rate regime choice, determining the two-way causality between these variables remains unresolved. Each side of the causality has been the center of discussion in various, but relatively disjoint sets of literature. On the one hand, liability dollarization is cited as one of the factors that deepen output collapses during crises in emerging market economies, which in turn have persistent effects on economic growth (Calvo, et al., 2006; Cerra and Saxena, 2008). On the other hand, the effectiveness of monetary policy as a stabilizing instrument depends on the monetary authorities' willingness to let the exchange rate float, particularly in an inflation targeting framework under open capital markets. Therefore, understanding whether dollarization is one of the factors that cause central bankers to place a higher weight on exchange rate stability as well as whether exchange rate regime choice itself is a determinant of dollarization contributes to various strands of the macroeconomics and economic development literatures.

Despite the abundance of empirical and theoretical studies on the relation between exchange rate policy and liability dollarization, most of the discussion has focused on the one-way causality and has ignored their simultaneous determination. Our contribution to the literature is, therefore, to identify the two-way causal relationship in a panel of countries using "identification through heteroskedasticity" (Rigobon, 2003).

There is a widespread belief in the literature and in policy circles that many countries have difficulties letting their exchange rate float and that many countries that claim to be floaters are actively engaged in exchange rate stabilization operations. This is the so-called "fear of floating" phenomenon discussed in Calvo and Reinhart (2002), which partly puts the blame on the adverse effects of exchange rate fluctuations when countries' liabilities are denominated in foreign currency (i.e., "dollarized"). In this context, Calvo and Reinhart (2002), Caballero et al. (2005), Calvo (2001), Gavin et al. (1999), Levy Yeyati et al.(2006), and Reinhart et al. (2003), among others, argue that if banking, public or corporate sector debts are denominated in foreign currencies, central banks may avoid exchange rate flexibility fearing financial instability and bankruptcies. This line of research takes liability dollarization as given and focuses on its effects on the exchange rate regime.

At the same time, a recent set of papers suggests that liability dollarization is in turn influenced by exchange rate policies. For example, agents who expect that the central bank will maintain the exchange rate fixed vis-à-vis a major currency may prefer to borrow in that currency to minimize portfolio risk. Then again, it is also possible that under floating exchange rates, foreign investors prefer to lend in foreign currency because of the fear of a depreciation of the local currency. In this framework, Ize and Levy Yeyati (2003), Ize and Parrado (2002), and Castro and Moron (2005) model asset and liability dollarization as a portfolio choice problem given a set of macroeconomic uncertainties and policy choices reflected in the volatility of inflation and the real exchange rate. These models predict that the exchange rate regime affects the level of dollarization to the extent that it has an effect on the relative volatilities of inflation and real exchange rate.

A recent set of papers (Chang and Velasco, 2006; Chamon and Hausmann, 2002; and Ize, 2005) have modeled endogenous determination of liability dollarization and exchange rate policy. In the Chang and Velasco (2006) set-up for example, the optimal exchange rate policy choice of the central bank depends on the severity of the dollarization, while the latter is determined, in turn, by the optimizing decisions of domestic agents on external borrowing which is influenced by their expectations of exchange rate policy. If agents expect fixing and arrange their portfolios accordingly, the central bank validates that expectation. If, on the other hand, agents expect floating, the central bank validates that too. In a similar vein, Ize (2005) builds a model to explain financial dollarization and shows that policy endogeneity can push the economy to highly dollarized state.

Despite the strong intuitive appeal of this idea, we still do not have a sense of how strong the empirical link is. The presence of endogeneity makes the empirical identification elusive. There are no obvious valid instruments that can be used for estimation, nor exclusion restrictions that can be justified in this setting.

Another complication is the endogeneity of the volatility of inflation. Models on portfolio choice show that agents' portfolio decision is affected by the volatility of inflation through its effect on expected real interest payments.[2] At the same time, volatility of inflation can be considered as a proxy for monetary policy, affecting the central bank's preference for exchange rate flexibility, and also affected by it.

There are only a few set of empirical papers that we are aware of that acknowledge the presence of endogeneity in this context. Devereux and Lane (2002) address the endogeneity problem explicitly in estimating bilateral exchange rate volatility.[3] Our paper differs from Devereux and Lane (2002) in two aspects. First, while they focus on bilateral exchange rate volatility, we focus on central banks' effort to stabilize the currency. Second, we explicitly estimate both sides of the two-way relationship between dollarization and exchange rate policy choice. Therefore, we are able to identify not only the effect of dollarized liabilities on exchange rate management, but also the reverse causality.

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[2] See, for example, Ize and Levy Yeyati (2003), Ize and Parrado (2002), and Chang and Velasco (2006).

[3] Similarly, Honig (2005) tests the effect of domestic liability dollarization (DLD) on de-facto exchange rate regime using ordered probit regressions. He finds that in his sample DLD plays a central role in determining "fear of floating". He deals with endogeneity by using lags of DLD in the regressions, but he does not deal with the reverse causality explicitly.

Arteta (2005), on the other hand, focuses on the other side of the causality. He assembles a new database on deposit and credit dollarization in developing and transition economies and finds that floating exchange rate regimes seem to exacerbate, rather than ameliorate, currency mismatches in domestic financial intermediation. He uses instrumental variables to account for the possible endogeneity problem. Our paper differs from his in the empirical methodology, and also in the focus, as we deal with the two-way causality.

Our findings support the "fear of floating" argument. Countries with high liability dollarization (external, public, or financial) tend to stabilize their exchange rate. This finding is robust to various proxies for exchange rate management. For the reverse causality, on the other hand, we do not find evidence that more active intervention in foreign exchange markets (i.e., more fixing) leads to higher liability dollarization. In the following sections, we present the data and the empirical framework, and then we report the results and robustness checks.

II. Data Description

Dollarization Measures

The term dollarization has been used to denote a diverse set of related definitions in the literature. In this paper, we focus on three variants: i) countries' foreign currency liabilities against the rest of world, ii) public sectors' domestic debt dollarization, and iii) banking sectors' liability dollarization, namely deposit dollarization. While the first definition is a form of "external liability dollarization", the other two are variants of "domestic liability dollarization".

The first variant measures total (i.e., private and public) external debt denominated in foreign currencies of the financial and non-financial sectors of the economy. The bigger this measure is, the more contractionary potential exchange rate depreciations are across the board, and, therefore, the central bank might want to stabilize the exchange rate to avoid bankruptcies and insolvency problems.[4]

To get a proxy for this variant, we combine two data sets: debt liabilities from Lane and Milesi-Ferretti (2006) and original sin index from Hausmann and Panizza (2003).[5]

Lane and Milesi-Ferretti (2006) have compiled information from various sources on aggregate foreign assets and liabilities for a set of industrial and developing countries. From their dataset we use:

[4] We choose not to net out asset holdings of domestic residents vis-à-vis non-residents (as in Goldstein and Turner, 2004) because while netting out may make sense at the level of individual agents, the aggregate net position is likely to understate the potential balance sheet problem. See Levy-Yeyati (2006) for a discussion.

[5] Original sin refers to the fact that many countries, especially developing countries, have difficulties in borrowing in their own currency.

Gross Foreign Debt (D) = stock of aggregated foreign debt liabilities.[6]

The sample consists of a panel data set of 145 countries and extends from 1970 to 2003 (Appendix 1). Since we are particularly interested in the foreign currency component of these liabilities, we multiply this variable with the "Original Sin" index from Hausmann and Panizza (2003). In particular, we use *OSIN3*, which is a measure of the proportion of the debt that is contracted in foreign currencies, for about 90 countries between 1993 and 2001. This produces a proxy for debt liabilities in foreign currencies. Given that Hausmann and Panizza's original sin data is an unbalanced panel – with only one or two years/observations for certain countries – and that for most countries time variation is rather limited, before interacting *OSIN3* with D, we take the average of *OSIN3* by country for each of the 90 countries in the dataset.[7] By doing so, we implicitly assume that the currency composition of debt remains stable over the sample period. We later relax this assumption and compute the simple interaction between *D* and *OSIN3* without taking the average by country.[8]

To make the data comparable across countries, we normalize *D* by total debt (i.e., debt assets plus debt liabilities).[9] After this normalization, and the interaction with original sin, *D* becomes:

GrossD = gross foreign debt in foreign currency as a share of total debt assets plus debt liabilities.

The second variant is a measure of the government's domestic debt dollarization, which is a subset of total government debt in foreign currency. Governments might be tempted to prevent the exchange rate from fluctuating too much if their debts are highly dollarized. It is also possible that debt dollarization is, for example, a deliberate strategy to increase the credibility of a currency peg.

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[6] "Aggregate" means that they include the private and public sectors of the economies.

[7] This implies that a single observation in the time span 1970-2003 suffices to have OSIN data for the corresponding country. This increases data availability considerably. This, however, creates some measurement error. Bordo and Meissner (2005) argue that the bias is not too problematic given that for most of the developing and small size countries, the index is 1 through out the available years and slow moving for the others.

[8] Thus, by interacting D with "$OSIN_t$" rather than "average" OSIN, we do not assume that the currency composition of debt remains stable over time. The main conclusions remain intact. The disadvantage of this procedure is that we lose almost two-thirds of the observations because for most countries we have OSIN data only for a couple of years in the 1990's.

[9] This normalization assumes that risk aversion of borrowers and lenders are the same (see Ize and Levy-Yeyati, 2003). Using debt liabilities alone would be consistent with the case in which risk aversion of borrowers is greater than lenders and would be equivalent to using OSIN3 alone. Alternatively, we normalize the proxy for debt in foreign currency by GDP. We get qualitatively similar results. See "robustness checks" section below for a discussion.

Central Government Dollarization (CGD): foreign currency domestic debt of the central government over total central government domestic debt (Jeanne and Guscina, 2006).

Jeanne and Guscina (2006) compile data on the central government's domestic debt from various local sources for 18 developing countries over the period 1980-2005 (Appendix 1).

Finally, the third variant is often referred to as "financial dollarization." Indeed, most of the discussion in the literature is centered on this definition. When banking sector has large foreign currency liabilities, exchange rate depreciations can cause financial instability even if banks have perfectly hedged portfolios (for example, using dollar deposits to lend in dollars). Thus, a central bank that cares about the cost of financial instability might choose to stabilize the exchange rate in the presence of high levels of financial dollarization.

Financial Dollarization (FD): foreign currency deposits over total deposits in local banks (Levy-Yeyati, 2006).

Levy-Yeyati (2006) compiles data reported in various central bank's bulletins and International Monetary Fund Article IV Staff Reports, as well as previous empirical work by Arteta (2005), De Nicoló et al. (2005), and Baliño et al. (1999). The dataset covers 122 industrial and developing countries over the period 1975-2002 (Appendix 1).

Exchange Rate Policy

The other key variable in our dataset is the exchange rate policy choice. We want a variable that captures the strength of the intervention in foreign exchange markets. We choose intervention in foreign exchange markets (proxied by the volatility of foreign reserves) over direct measures of nominal exchange rate volatility for our benchmark regressions because of various reasons. First, the measurement of the latter can be problematic due to existence of multivariate exchange rate regimes. Second, multiple currency crises that unexpectedly increase the nominal exchange rate volatility, create outliers that may distort the standard deviations of the estimates. Third, some countries peg their currency to a basket of currencies rather than to a single anchor. Finally, Calvo and Reinhart (2002) document that international reserves move more, from month to month, for those countries with more stable nominal exchange rates. Although there are some problems associated with the use of reserves, such as changes in reserves due to fluctuations in valuation and accrual of interest earning, the outlier problem is less severe.[10]

Our measure for the exchange rate policy choice assumes that countries that intervene more actively in foreign exchange markets (which is reflected in higher volatility of reserves) are de-facto fixers, while countries that are more passive tend to be floaters. For this purpose, we collected monthly data on reserves holdings for the entire sample period for each country in

[10] See Calvo and Reinhart (2002) for a discussion.

our dataset. Then, we computed the annual volatility of reserves as the standard deviation of monthly changes in reserves for every year. Because a given level of volatility in reserves in countries with low monetization implies a larger relative intervention, we normalize the volatility of reserves with the monetary base. The end product is

R_M0: reserve volatility as a share of M_0.[11]

For the robustness checks, we also define three alternative variables that seek to capture the exchange rate volatility more directly.[12] First, we define the volatility of nominal exchange rate (domestic currency vis-à-vis the US dollar) as the standard deviation of monthly changes in the nominal exchange rate [*std(NER)*]. Alternatively, since countries can potentially borrow in multiple vehicle currencies or fix vis-à-vis a basket of currencies, we calculate the standard deviation of nominal effective exchange rate [*std(NEER)*]. This definition is in principle superior to the first one, but it is available for fewer countries. Finally, we calculate a variety of the so-called "exchange-market pressure" (*ERMP*) defined in Eichengreen et al. (1996). We take the ratio of volatility of reserves to the sum of the volatilities of reserves and the nominal effective exchange rate (and alternatively the nominal exchange rate vis-à-vis the US dollar). This variable quantifies the extent to which central bank chooses to stabilize the exchange rate for a given level of pressure on its currency, where the extent of the pressure on the currency (or the lack of thereof) is captured by the denominator of the ratio.[13]

Volatility of Inflation

The other endogenous variable in the system is the volatility of inflation. We collect data for annual inflation rates for all the countries and compute:

$Vol(\pi)$ = standard deviation of the monthly changes in the Consumer Price Index (CPI).

[11] As a robustness check, we alternatively computed the reserve volatility as a share of M2. In addition, to make sure that different possible normalizations do not change the results, we define another measure that takes the standard deviation of the ratio of monthly changes in reserves to money: std(R_M0). The results reported below are robust to all these alternative definitions.

[12] Central Banks also use interest rate policy to smooth exchange rate fluctuations. We choose not to include measures of interest rate volatility because data on policy rates is scant for our sample of countries throughout the period of interest. Also, we do not use dummy variables that identify either *de-jure* (i.e., IMF) or *de-facto* (i.e., Levy-Yeyati and Sturzenegger, 2003) nominal exchange rates regimes, because our identification technique relies on the heteroskedastiscty found in the data. With dummy dependent variables, heteroskedasticity is hard to model.

[13] As a fourth alternative, we compute freedom to float, (FF) defined as the ratio of volatility of nominal effective exchange rate (and alternatively the nominal exchange rate vis-à-vis the US dollar) to the volatility of reserves (Eichengreen et al., 2003). Therefore, a higher number implies higher volatility of exchange rate relative to the reserves (i.e., more nominal exchange rate flexibility).

Control Variables

Our main controls for the first-stage regressions–more on this below— are:

trade openness (*trwdi*) = *Trade* / *GDP*.

capital account openness (kaopen) = constructed as an on/off indicator of the existence of restrictions to cross-border capital flows using Chinn and Ito (2006).

country size = *ln* (*real GDP*).

To check the robustness of our results, we also use other control variables including, a dummy for currency crisis from Frankel and Wei (2004), sudden stops from Cavallo and Frankel (2007), institutional quality from the International Country Risk Guide (ICRG), and US interest rates to control for changes in the international liquidity conditions over time.[14] Appendix 2 contains a detailed summary of all the variables, a detailed description of their construction, the data sources, and abbreviations. And in Table 1 below we provide the most important summary statistics.

Table 1. Summary Statistics by Variable.

	Variable	Obs.	Mean	Std. Dev.	Min	Max
Endogenous variables						
Liability Dollarization	*GrossD*	2024	0.60	0.28	0.00	1.00
	FD	1799	0.24	0.23	0.00	0.95
	CGD	382	10.41	20.66	0.00	98.43
Exchange rate policy	R_M_0	4638	0.53	2.60	-9.05	8.14
	Std(NEER)	2813	0.02	0.08	0.00	3.39
	Std(NER)	6918	0.02	0.06	0.00	1.44
	ERMP_NEER	2214	0.52	0.25	0.02	0.99
Volatility of Inflation	$Vol(\pi)$	4381	0.01	0.02	0.00	0.44
Control Variables	*Trwdi*	5785	71.74	43.42	1.53	330.60
	LnGDP	5997	22.89	2.36	17.08	29.97
	Kaopen	4600	-0.01	1.50	-1.72	2.66

III. Structural Equations

As the liability dollarization and the exchange rate policy choice affect each other simultaneously, estimating one of the equations without taking the other into account will produce biased results. In addition, both liability dollarization and exchange rate regime choice are endogenous to the volatility of inflation (π). Two strands of literature motivate the inclusion of the volatility of inflation as an additional endogenous variable in our system of

[14] For example, Caballero and Krishnamurthy (2001) argues that inelastic supply of external funds during crisis periods can cause fear of floating. This, however, has also an effect on both agents' portfolio choices and the volatility of inflation.

equations. While portfolio choice models (i.e., Ize and Levy-Yeyati, 2003; Chang and Velasco, 2006) stress that the volatility of inflation is a key determinant of the level of financial dollarization, the literature on "fear of floating" (Calvo and Reinhart, 2002) suggests that under certain circumstances the volatility of inflation can explain fear of floating. At the same time, the volatility of inflation is also influenced by the level of dollarization in the economy and by the exchange rate regime.

Our primary interest is in the relationship between the liability dollarization and the exchange rate policy, while also accounting for additional endogenous variables. Therefore, we want to run the following set of equations:

$$LD = \alpha R + \theta_{LD}\pi + \gamma_{LD}x + \eta_{LD} \tag{1}$$

$$R = \beta LD + \theta_{R}\pi + \gamma_{R}x + \eta_{R} \tag{2}$$

$$\pi = \kappa LD + \theta_{\pi}R + \gamma_{\pi}x + \eta_{\pi} \tag{3}$$

where "*LD*" is the abbreviation for one of our measures of dollarization (higher *LD* implies more liability dollarization), "*R*" is the abbreviation for our measure of exchange rate policy choice, "π" is the volatility of inflation, "x" is a set of exogenous control variables (common to all three equations) and η_i are structural innovations to each equation.

After controlling for the factors that affect all the endogenous variables simultaneously, structural innovations represent the shocks specific to each endogenous variable. For example, changes in foreigners' preference for domestic versus foreign assets, or a change in risk aversion, are examples of independent shocks to *LD*. An unexpected change in exchange rate policy as a result of a change in central bank's preferences—which is not a response to a change in *LD* or the volatility inflation—is an example for a shock to *R*. These structural shocks are possibly uncorrelated with each other. This is, as in much of the related literature, a maintained assumption.

What are the conjectured signs of the coefficients? The literature provides some guidance. Since the emphasis of this paper is on the interrelation between liability dollarization and exchange rate regime choice (i.e., coefficients α and β), we focus on the first two equations:

α can go either way. Exchange rate regime can have different impact on alternative forms of liability dollarization. With respect to the external liability dollarization, the literature briefly reviewed in the introduction suggests that expectations of fixing can lead agents to borrow in foreign currency, increasing external liability dollarization. However, some of those models also suggest that nominal foreign currency and local currency bonds become perfect substitutes under the fixed exchange rate regime. If these are the only available type of bonds, then the outcome is not uniquely determined (Velasco and Chang, 2006). Another argument is that small countries' currencies offer little diversification benefits for foreign lenders (Eichengreen et al., 2002). In this case, the link between the exchange rate regime and the choice of currency denomination in external borrowing is broken. Finally, fixing the currency can reduce the external liability dollarization because foreign lenders might be more willing to bear the risk of domestic currency denominated debt when exchange rate volatility is low.

Domestic liability dollarization, however, is likely to be more amenable to policy action. Arteta (2005) finds that floating exchange rate exacerbates bank currency mismatch in emerging markets. Similarly, Levy-Yeyati (2006) finds that countries that have pegged exchange rates have less financial dollarization. Honig (2009), however, demonstrates empirically that the key driver of domestic dollarization is the government quality, not the exchange rate regime. In short, there is no consensus on the impact of exchange rate regime on dollarization.

$\boldsymbol{\beta > 0}$. Countries with high liability dollarization (both external and domestic) are expected to fix more as suggested by the aforementioned empirical and theoretical literature on "fear of floating".

$\boldsymbol{\theta_{LD} > 0}$. Risk averse agents' loan portfolio choice is affected by inflation volatility to the extent that it has an effect on expected real interest payments. Higher inflation volatility, keeping everything else constant, would increase the volatility of interest payments of domestic currency debt and therefore would encourage liability dollarization (Ize and Levy Yeyati, 2003).

$\boldsymbol{\theta_{R} > 0}$. In countries where the exchange rate is used as nominal anchor, an increase in inflation volatility may cause more fixing. Similarly, inflation targeting countries – implying lower volatility of inflation – have to let the exchange rate go if they concurrently opt for open capital markets. Alternatively, Calvo and Reinhart (2002) show that greater commitment to an inflation target can explain "fear of floating."

Table 2 shows the simple correlation among the endogenous variables. The first three rows suggest that the correlations between the different variants of liability dollarization and the volatility of reserves are positive and significant in two out of the three cases. The last two rows suggest that volatility of inflation is also positively correlated between the other two endogenous variables. Our contribution in this paper is to disentangle the causality between them.

Table 2. Correlation of Endogenous Variables

Important Correlations	Common Observations	Value	Significance (P-value)
Corr (*Gross D* & R_M_0)	1755	0.26	0
Corr (*FD* & R_M_0)	1597	0.02	0.4
Corr (*CGD* & R_M_0)	340	0.20	0
Corr ($Vol(\pi)$ & *GrossD*)	1783	0.21	0
Corr ($Vol(\pi)$ & R_M_0)	3555	0.19	0

Similarly Figures 1 and 2 present the scatter diagram of our two key endogenous variables: liability dollarization and the exchange rate regime. To simplify the graphs we have compressed the dataset such that each observation is the median value of the corresponding variable for each country. Country codes are included to give the reader a sense of where different countries stand on each dimension. Figure 1 suggests a positive correlation between reserve volatility and liability dollarization (using *GrossD* as the proxy). This means that countries that tend to fix the exchange rate also have greater levels of liability dollarization. Similarly, Figure 2 shows a negative correlation between the volatility of the nominal exchange rate vis-à-vis the US dollar and *GrossD*. While these correlations are strong, they are uninformative about causality. We need to probe deeper into the relationship between these variables to understand what is behind these observed patterns.

Figure 1. Reserve Volatility and Liability Dollarization

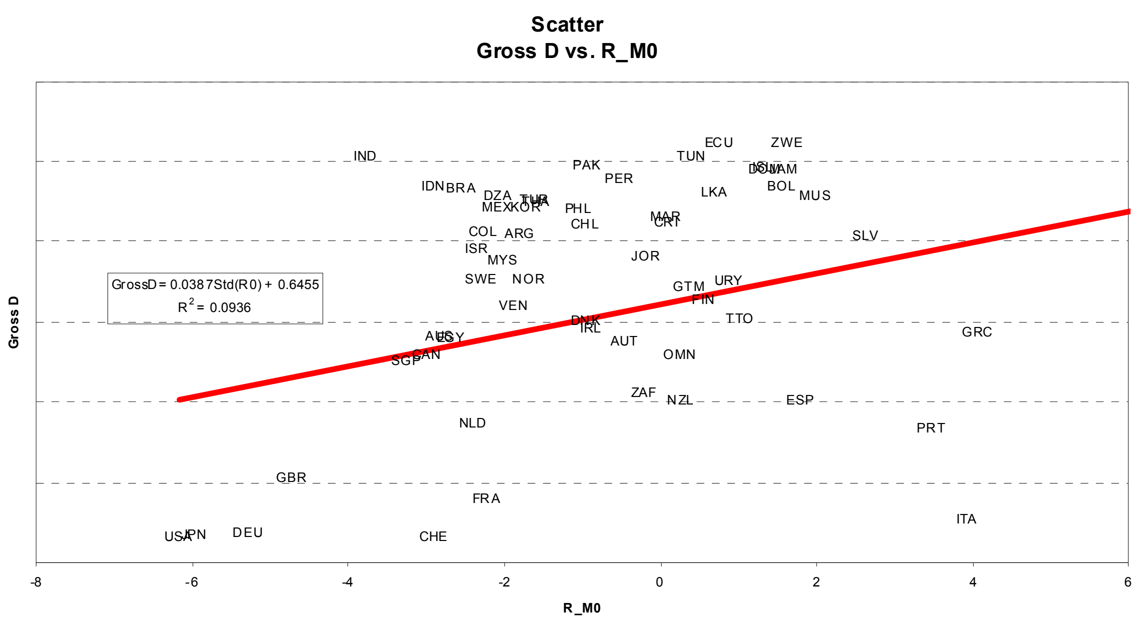
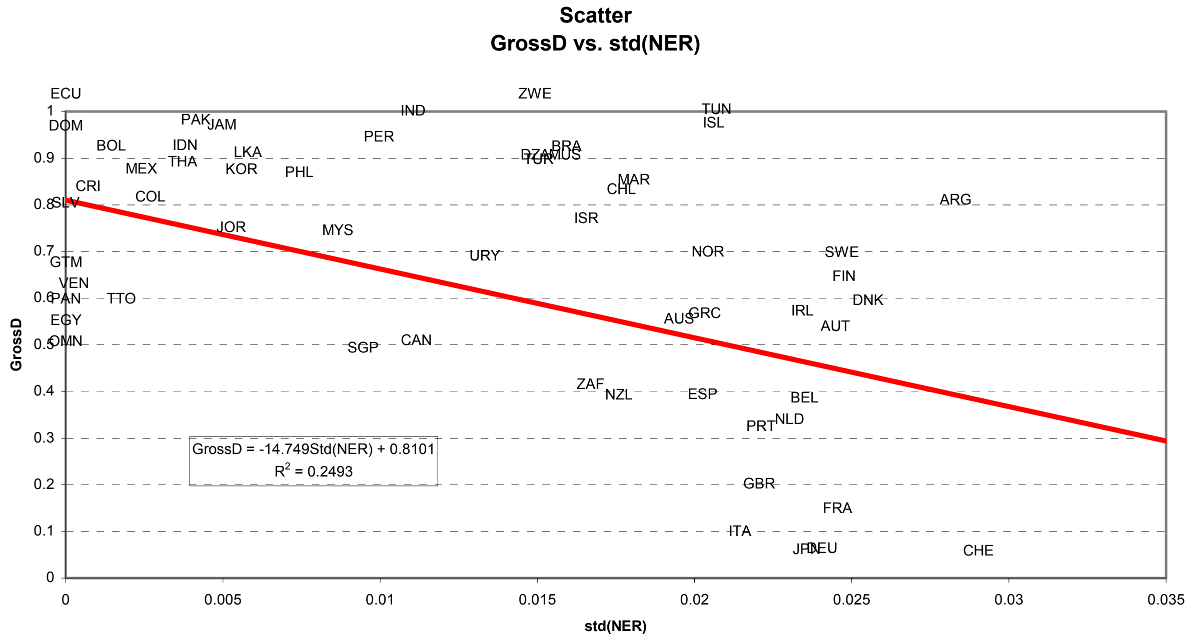


Figure 2. Nominal Exchange Rate Volatility and Aggregate Liability Dollarization



Control Variables

As for the list of common control variables in matrix "*x*", for concreteness, we discuss why we include each of them. A key identifying assumption of the empirical methodology employed in this paper is that the structural shocks are uncorrelated (more on this below). As this is a maintained assumption, it is important to control for all the possible joint determinants of the endogenous variables, since omitted variables could lead to a violation of this assumption. The controls are:

- **Lags for all endogenous variables**: to account for serial correlation in the data.

- **Fixed effects**: country and year dummies to account for unobservable effects, both across countries and over time.

- **Country size**: Size is an important factor in the choice of exchange rate regime as emphasized by the optimal currency area literature.[15] Furthermore, Ize and Parrado (2002) argue that small countries, being more exposed to world shocks, are more likely to be dollarized. In addition, Eichengreen et al. (2003) identify "size" as the main determinant of

[15] See Mundell (1961).

why most countries can not borrow abroad in their own currency. Accordingly, bigger countries can borrow in their own domestic currency, because they provide more diversification opportunities to international investors. We need to account for the possibility that original sin is a characteristic of many countries that permeates their ability to conduct monetary policy, stabilize inflation and also constrains agents' choices.

- **Capital Account Openness**: the degree of capital account openness affects the freedom of central banks to conduct monetary policy and contain inflation. It also affects agents' portfolio choices, as well as the ability of a country to borrow from and lend to the rest of the world. Its effect on the exchange rate regime choice is ambiguous depending on central banks' preferences. As capital mobility increases, central banks may let the exchange rate float if they want to preserve monetary policy independence. However, they may be willing to give-up monetary policy independence like the countries joining to European Union did.

- **Openness to trade**: countries' exposure to trade might raise trade-related volatility which permeates into other macroeconomic variables. The effect of openness on monetary policy choices is ambiguous. If the country wants to insulate against external shocks it may choose to float the exchange rate, but more open economies might also find it convenient to fix their currency to that of a major trading partner to reduce transaction costs. Ize and Parrado (2002) predict that more open economies should experience higher inflation volatility, and therefore financial dollarization should be higher.

- **Other control variables**: As a robustness check, we also control for terms of trade volatility, sudden stops, currency crises, institutional quality and the US interest rates.

IV. Estimation

The emphasis of this paper is to estimate coefficients $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ (i.e., the effect of liability dollarization on exchange rate policy and vice-versa) controlling for endogeneity. The problem with the simultaneous equation system (1-3) is that it is unidentified. Since finding good instruments is quite hard, we will use the relatively new technique of identification through heteroskedasticity (IH) proposed by Rigobon (2003). It uses the heteroskedasticity found in the data as the basis for identification. The methodology is similar to "near identification", which employs the assumption that one of the variances of the structural shocks approaches infinity (Wright, 1928). IH, rather than assuming infinite variance, only requires that the relative variances are different across regimes.

In order to explain both the problem and its solution, let us write everything in a compact form, ignoring controls and lags for the time being. Consider equation (4):

$$\underbrace{\begin{bmatrix} 1 & -\alpha & -\theta_{LD} \\ -\beta & 1 & -\theta_R \\ -\kappa & -\theta_\pi & 1 \end{bmatrix}}_{A} \underbrace{\begin{bmatrix} LD \\ R \\ \pi \end{bmatrix}}_{Y} = \underbrace{\begin{bmatrix} \eta_{LD} \\ \eta_R \\ \eta_\pi \end{bmatrix}}_{\eta}, \tag{4}$$

where *A, Y*, and η represent the coefficient matrix, endogenous variables, and structural shocks, respectively. Note that we normalize by setting the diagonal terms of A to one. In addition, we assume that structural shocks are uncorrelated – which is a common assumption in macroeconomics literature. Consequently, the covariance matrix of the structural shocks has the following form

$$\text{var}(\eta) = \begin{bmatrix} \sigma^2_{\eta_{LD}} & 0 & 0 \\ 0 & \sigma^2_{\eta_R} & 0 \\ 0 & 0 & \sigma^2_{\eta_\pi} \end{bmatrix} \tag{5}$$

This system has nine unknowns; six coefficients and three variances for the structural shocks. What we can estimate with the data, on the other hand, is the reduced form;

$$Y = \underbrace{A^{-1}\eta}_{\varepsilon}, \tag{6}$$

which provides only six moments; three variances and three covariances.

$$Var(Y) = \text{var}(\varepsilon) = A^{-1}\,\text{var}(\eta) A^{-1'}. \tag{7}$$

Therefore, there are not enough equations to estimate the unknowns.

Now, assume that there are two sub-samples, in which the variances of the structural shocks are different. Assume also that the coefficients are the same for both sub-samples. This will produce 12 moments (three variances and three covariances for each sub-sample), which is as many as necessary to solve 12 unknowns (six coefficients and six variances). As long as the relative variances are different across sub-samples, we can achieve identification.

The actual estimation process is as follows: We first estimate a reduced form VAR and recover the residuals.

$$Y = A^{-1}\Phi(L)Y_{t-1} + A^{-1}\Theta(L)X_t + \varepsilon_t, \tag{8}$$

where $\varepsilon_t = A^{-1}\eta_t$ are the reduced form residuals, $\Phi(L)$ are the coefficients of lagged endogenous variables, and $\Theta(L)$ are the contemporaneous and lagged coefficients of the control variables. As it may take time for liability dollarization and inflation to react to the changes in the volatility of reserves in previous years, we use two lags to clean the data from serial correlation.[16]

The next step is to define regimes based on the heteroskedasticity present in the data. Thus, first we need to establish that there is heteroskedasticity. This is similar in spirit to reporting the first-stage F-statistic to demonstrate instrument relevance in an instrumental variable setting. To do so, we perform White heteroskedasticity test on each reduced form equation. We reject the null hypothesis of homoskedasticity for the three equations.[17] Although there is considerable cross sectional heteroskedasticity, for simplicity, in the benchmark regressions we divide our data based on time series heteroskedasticity.[18]

For the baseline scenario, we will take three years as a regime. However, in the robustness section we will change the regime windows, and therefore the total number of regimes, to make sure that a somewhat arbitrary choice of regime is not driving the results. The reader should rest assured that even if the regimes are not correctly specified, the estimates are still consistent (Rigobon, 2003). The basic intuition relies on the fact that the covariance matrices of the misspecified regimes will be linear combinations of true covariance matrices, which produces still consistent but less efficient estimates, unless the misspecification is severe enough that the rank condition is violated.

Table 3 presents the relative variances of the structural shocks for each regime. As can be seen from the table, relative variances are different across regimes (the relative variance that prevails in each regime is highlighted), which is exactly what we need to achieve identification.

Table 3. Relative Variances across Regimes

Regimes	Var(*GrossD*) /Var(*std_R*)	Var(*GrossD*) /Var(π)	Var(*std_R*) /Var(π)
1972-1974	1.03	**1.47**	1.43
1975-1977	3.30	**14.20**	4.31
1978-1980	1.22	**4.45**	3.65
1971-1983	0.66	2.65	**4.05**
1984-1986	**0.68**	0.35	0.53
1987-1989	**0.52**	0.21	0.40
1990-1992	**0.67**	0.22	0.32
1993-1995	0.78	1.35	**1.73**
1996-1998	0.60	3.96	**6.58**
1999-2001	0.72	3.91	**5.45**
2002-2003	1.07	**7.46**	6.96

[16] However, we run the regressions with 1 and 3 lags as a robustness check.

[17] Details about these tests are available from the authors upon request.

[18] In the robustness section we use the cross sectional heteroskedasticity as an alternative method for identification. The results are reassuringly similar. See Table 8 for details.

After defining the regimes, we calculate the covariance matrix for each regime. Now we have the covariance matrix of the reduced form residuals shown in (7). When we pre and post multiply these covariance matrices with *A*, we obtain the covariance matrix of the structural shocks:

$$A\,\mathrm{var}(\varepsilon)A' = AA^{-1}\,\mathrm{var}(\eta)A^{-1'}A' = \mathrm{var}(\eta)\,.$$

Our identifying assumption is that covariance terms of the structural shocks are zero, which allows us to compute moment conditions for each regime and then to estimate *A* through GMM by minimizing these moment conditions. We try both weighted and unweighted GMM; the main conclusions remain intact.

Finally, we obtain the distribution of the estimates by bootstrapping. We create normally distributed random numbers, $N\,(0,1)$, of the size of each regime. We impose the covariance structure of the underlying data for the relevant regime to the randomly created numbers, and estimate the coefficients again 600 times.

V. Results

In this section, we apply the IH methodology to our estimation problem. We are interested in estimating the relationships between liability dollarization (*GrossD* and other variants), the exchange rate policy choice (R_M_0 and other variants), and the volatility of inflation ($vol(\pi)$). Our system includes these as endogenous variables and three exogenous variables (country size, capital account openness and trade openness). The structural model is described by:

$$AY = \Phi(L)Y_{t-1} + \Theta(L)X_t + \eta_t \qquad (9)$$

Since there are several possible variants for each endogenous variable, we chose the following measures as the baseline: with respect to the liability dollarization, we report in this section the results for *GrossD*, Financial Dollarization (*FD*), and Central Government Dollarization (*CGD*); with respect to the stance of monetary policy, we report the results for R_M_0. We leave the other definitions for robustness checks in the next section. To facilitate the evaluation of the quantitative significance of the estimated coefficients, we normalize each variable by its standard deviation in the whole sample.

In Table 4, we present the results from the first specification. The first panel reports matrix *A*. The table is organized as follows: each row is an equation, which is a function of the other two endogenous variables (i.e., the columns).[19] Thus, for example, the first row shows the determination of *GrossD* as a function of the volatility of reserves, (R_M_0), and the volatility

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[19] Each endogenous variable is also a function of the exogenous variables, but we choose not to report them because they are not the main focus of this paper.

of inflation, *vol*(π), while the second row shows the determination of the volatility of reserves as a function of the other two endogenous variables.[20] The second panel of Table 4 reports the *amplification effects* of the structural shocks, which are given by the coefficients of the inverse of matrix *A* (i.e., A^{-1}) as shown in the reduced form model, (8). The parameters of the reduced-form model capture both direct as well as indirect linkages across endogenous variables. By indirect linkages we mean spillovers of shocks that occur via the other endogenous variables in the system. Thus, the terms of the matrix A^{-1} show the amplification effect of the structural shocks to each equation. Each row is an equation, which is affected by all the structural shocks identified on the columns of the table. Finally, below the corresponding point estimates, we report the percentage of the observations from the 600 repetitions of the bootstrapping that fall below zero. In order to make the interpretation easier, we put a stars next to the coefficient if it is statistically significant.[21]

Table 4. Baseline with *Gross D*

Matrix A: point estimates of contemporaneous coefficients

Number of observations: 1340		effect of: GrossD	R_M_0	Vol(π)
Effect on:	GrossD		-0.659* 94.7%	-0.063 44.5%
	R_M_0	0.848** 2.2%		0.09 96.2%
	Vol(π)	0.041 68.7%	0.018 12.5%	

Matrix A^{-1}: amplification effects of the structural shocks

		structural shock to: GrossD	R_M_0	Vol(π)
Effect on:	GrossD	0.639*** 0.0%	-0.422* 94.0%	-0.078 1,2%
	R_M_0	0.545 10.3%	0.641*** 0.0%	0.024 89.5%
	Vol(π)	0.036 30.8%	-0.006 12.6%	0.997*** 0.0%

The results reported in the first panel of Table 4 indicate that a one standard deviation increase in the volatility of reserves decreases *GrossD* by 0.659 standard deviations. In other words, we find that countries that seek to stabilize the nominal exchange rate via more active intervention in the foreign exchange markets (i.e., more reserve volatility) have less dollarized debts. This effect is statistically significant at the 10% level since 94.7% of the

[20] The coefficients in the table are the coefficients of the A matrix multiplied by -1.

[21] *: significant at ten percent, **: significant at five percent, and ***: significant at one percent.

600 bootstrap repetitions fall below zero. This result is consistent with previous empirical findings in the literature, but seemingly at odds with the prediction of the portfolio choice models that suggest that agents have incentives to borrow in domestic currency to minimize the exchange rate risk under floating exchange rates.[22] There are several possible explanations to this interesting finding. We may be capturing indeterminacy in portfolio choice as predicted by Chang and Velasco (2006) and Ize and Parrado (2002) under situations of pegged exchange rates and limited portfolio choice. Alternatively, foreign lenders may be more willing to bear the risk of domestic currency denominated debt when exchange rate volatility is low.[23] Notwithstanding these plausible explanations, we show below that this result is not robust to different proxies of the exchange rate policy stance and of liability dollarization.

In contrast, our results support the fear of floating hypothesis: economies with more aggregate foreign currency debt tend to fix more. A one standard deviation increase in *GrossD* raises the volatility of reserves by 0.848 standard deviations. This result is statistically significant at 5 percent, as only 2.2% of the repetitions from the bootstrap have the opposite sign.

The volatility of inflation does not seem interact with the rest of the endogenous variables (i.e., either affect or be affected by the other endogenous variables) in a statistically significant way.

On the second panel of Table 4, we trace the overall effects of any given structural shock on the variables in our model, after accounting for all the spillovers through the system of equations. The results, which are the amplification effects of the structural shocks, are very similar to those reported for the direct effects in terms of both magnitude and sign. Gross debt dollarization is negatively affected by shocks to the volatility of reserves and negatively affected by shocks to the volatility of inflation, although only the former effect is statistically significant at the 10% level. Also, just as before, the volatility of reserves is positively affected by gross debt dollarization and by the volatility of inflation, but neither effect being statistically significant at standard confidence levels. Finally *GrossD* does not appear to have any significant effects on *vol(π)* even after all the indirect effects are accounted for, and neither does the volatility of reserves .

In Table 5, we run the same regression using financial dollarization (*FD*) instead of *GrossD*. The results are consistent with those reported in Table 4. In particular, it is still the case that more dollarization (in this case, financial dollarization) leads to higher reserve volatility (i.e.,

[22] For example, Arteta (2005) finds that floating exchange rate regimes seem to exacerbate, rather than ameliorate, currency mismatches in domestic financial sector.

[23] An alternative hypothesis is provided by Honig (2009) who finds that exchange rate regime does not seem to affect domestic liability dollarization although government quality does.

more fixing). Although the effect of the exchange rate policy on the level of dollarization is qualitatively the same, it is not statistically significant anymore.[24]

Table 5. Baseline with Financial Dollarization

Matrix A: point estimates of contemporaneous coefficients

		effect of:		
Number of observations: 838		FD	R_M_0	$Vol(\pi)$
Effect on:	FD		-0.028 56.8%	-0.096 10.2%
	R_M_0	0.074** 4.7%		0.19 88.3%
	$Vol(\pi)$	0.028 88.3%	-0.009 25.3%	

Matrix A^{-1}: amplification effects of the structural shocks

		structural shock to:		
		FD	R_M_0	$Vol(\pi)$
Effect on:	FD	0.995*** 0.0%	-0.027 52.0%	-0.100 9.8%
	R_M_0	0.079* 8.5%	0.996*** 0.2%	0.186 88.0%
	$Vol(\pi)$	0.027 88.3%	-0.010 25.5%	0.995*** 0.0%

In Table 6 we run the same regressions using Jeanne and Guccina's data on the share of central government's foreign currency domestic debt. The results are once again consistent with the previous ones. We find a robust and statistically significant effect of the level of liability dollarization on the exchange rate policy choice that is consistent with the "fear of floating" hypothesis. Interestingly, we find that coefficient on the reverse causality is now positive (more fixing leads to more liability dollarization), although the point estimate is not statistically significant.[25]

[24] This is consistent with Levy Yeyati (2006), who finds that countries that have pegged exchanged rates have less financial dollarization, although in his case the estimated effect is not statistically significant either.

[25] The only other difference with the previous regressions is that the estimated effect of the volatility of inflation on the volatility of reserves in now negative, albeit not statistically significant.

Table 6. Baseline with Central Government's Domestic Debt Dollarization

Matrix A: point estimates of contemporaneous coefficients

Number of observations: 278		effect of: CGD	effect of: R_M_0	effect of: Vol(π)
Effect on:	CGD		0.007 77.7%	0.128 65.0%
	R_M_0	0.080** 2.3%		-0.07 40.2%
	Vol(π)	-0.059 34.5%	0.030 48.2%	

Matrix A^{-1}: amplification effects of the structural shocks

		structural shock to: CGD	structural shock to: R_M_0	structural shock to: Vol(π)
Effect on:	CGD	0.993*** 0.0%	0.011 77.5%	0.127 65.0%
	R_M_0	0.083 19.2%	0.999*** 0.0%	-0.056 41.2%
	Vol(π)	-0.056 32.8%	0.029 49.0%	0.991*** 0.0%

In summary, using three different variants of liability dollarization we find robust evidence in favor of the "fear of floating" hypothesis. Countries with more dollarization (external, public or financial) tend to stabilize the exchange rate. On the reverse causality, the estimated effects are mixed (i.e., in two out of the three cases we get a negative sign) and unstable (in only one case the result is statistically significant). Therefore, we conclude that we do not find robust evidence of a causal link going from the exchange rate choice to the level of liability dollarization.

VI. Robustness Checks

In this section we perform a set of robustness checks: we use alternative definitions for our main dependent variables and other control variables; we change the lag structure and the regime window for our main regressions.[26]

The first set of robustness checks relates to the way in which the heteroskedasticity regimes are defined. As mentioned earlier, Rigobon (2003) establishes that even if the regimes are not correctly specified, the estimates are still consistent if the misspecification is not severe enough. We perform two types of robustness checks regarding the regimes: first, we change the number of years that are in each regime (i.e., from 3 to either 2 or 16 years per regime). As the results are very similar to the benchmark regressions, we omit reporting these tables.

[26] For concreteness, we only report a subset of all the robustness checks, but other tables are available from the authors upon request.

Alternatively, we present results based on a different method of defining the regimes. Following Lee et al. (2004), we estimate the unconditional covariance matrix for each year in our sample and split the data in four groups: high-low variance of liability dollarization, and high-low variance of the volatility of reserves, where high and low values are defined with respect to the median. This means that while still using the time-series dimension of the heteroskedasticity in the data, we let each year in the sample fall in one of four categories (or regimes) based on the actual volatilities observed in the data. This gives us a total of 4 regimes instead of the 11 of the baseline regressions. The results are reported in Table 7. These are the results using *GrossD* as the proxy for liability dollarization, so they are comparable to Table 4. For compactness, in the regressions below we omit the panel with matrix A^{-1}, as these are always consistent with the previous results.[27]

The results are qualitatively the same as in Table 4, although the point estimate of the effect of the volatility of reserves on the level of liability dollarization is quantitatively smaller. The results using the other proxies of liability dollarization are very similar.

Table 7. Robustness with New Regimes by Year

Matrix A: point estimates of contemporaneous coefficients

		effect of:		
Number of observations: 1340		GrossD	R_M_0	$Vol(\pi)$
Effect on:	GrossD		-0.025 61.7%	-0.013 37.2%
	R_M_0	0.023** 4.0%		0.06 55.5%
	$Vol(\pi)$	0.018 58.7%	-0.016 39.5%	

Next, we exploit the cross-section heteroskedasticity in the data and compute other regimes to test the validity of our results. Following the methodology outlined above, we estimate the unconditional covariance matrix for each country and split the data in four groups: high-low variance of liability dollarization, and high-low variance of the volatility of reserves, where high and low values are defined with respect to the median (Table 8). This particular robustness check is important because it allows us to test if the results are driven by the choice of the dimension of the panel that we exploit for identification.

[27] Full results are available upon request.

Table 8. Robustness with New Regimes by Country

Matrix A: point estimates of contemporaneous coefficients

Number of observations: 1340		effect of:		
		GrossD	R_M_0	Vol(π)
Effect on:	GrossD		-0.045 70.7%	-0.053 6.3%
	R_M_0	0.043** 3.5%		-0.02 9.3%
	Vol(π)	0.004 65.2%	0.018 64.5%	

Once again, the results are qualitatively the same as in Table 4, suggesting that the coefficients are stable across the different specifications of the heteroskedasticity regimes. When we use the other two variants of liability dollarization we also get very similar results.

In Tables 9 to 10, we show that our results are robust when we use alternative definitions for the stance of monetary policy. In Table 9, we use the "exchange rate market pressure index" defined in Eichengreen et al. (1996). In particular, we take the ratio of volatility of reserves to the sum of the volatilities of reserves and the nominal effective exchange rate. A higher number indicates that for a given level of pressure in the foreign exchange market, the volatility of reserves is higher implying that the monetary authority tries to stabilize the exchange rate. This specification produces the same results as our baseline model in Table 4, with the only caveat that the estimated effect of the exchange rate policy stance on the level of liability dollarization is not statistically significant. The results are very similar when we use the nominal exchange rate vis-à-vis the US dollar rather than the nominal effective exchange rate in calculating the exchange market pressure.

Table 9. Robustness with ERMP_NEER

Matrix A: point estimates of contemporaneous coefficients

Number of observations: 782		effect of:		
		GrossD	*ERMP_NEER*	Vol(π)
Effect on:	GrossD		-0.065 54.0%	0.021 45.0%
	ERMP_NEER	0.100* 5.3%		-0.11 49.0%
	Vol(π)	0.028 42.0%	-0.082 54.7%	

In Table 10 we use the "standard deviation of the nominal effective exchange rate" as a proxy for the stance of monetary policy. For concreteness we report only the results based on the nominal effective exchange rate, but the results based on the volatility of the nominal exchange rate vis-à-vis the US dollar are reassuringly similar. Note that with this alternative proxy, a higher number implies floating.

Table 10. Robustness with *Std_NEER*

Matrix A: point estimates of contemporaneous coefficients

		effect of:		
Number of observations: 960		GrossD	*Std_NEER*	Vol(π)
Effect on:	GrossD		1.466 13.5%	-0.079 69.3%
	Std_NEER	-0.348*** 100%		0.04 21.8%
	Vol(π)	0.046 30.0%	0.637 70.3%	

In line with our previous findings, higher liability dollarization implies lower exchange rate volatility in a statistically significant way. The results for the reverse causality are also similar to those of the benchmark regressions – higher volatility of exchange rate increases liability dollarization, but the coefficient is not statistically significant.[28]

In summary, all the alternative measures of exchange rate policy, either the "policy based" (i.e., the volatility of reserves), the "results based" (i.e., the volatility of the nominal effective exchange rate), or a mix of the two (i.e., the exchange rate market pressure index or the freedom to float index) yield the same results. In particular, the evidence in favor of the "fear of floating" hypothesis is very strong, while there is no evidence that the exchange rate regime by itself has an effect on the level of liability dollarization.

As additional robustness checks, we do several things:[29] first, with respect to *GrossD*, we exploit the limited time series variation of *OSIN3* in the Hausmann and Panizza's dataset by interacting *D* (the Milesi-Ferretti and Lane data) with $OSIN_t$ rather than average *OSIN*, implying that we do not impose that the currency composition of debt remains stable over time . This produces an additional variable: *GrossD_OSIN*. The disadvantage of this procedure is that we loose almost two-thirds of the observations. Despite this, the results we obtain are very similar to those in Table 4.

Next, we normalize the proxy for debt in foreign currency by GDP, rather than by total debt. This gives us a proxy of the degree of liability dollarization measured as a share of the size of

[28] An alternative measure of monetary authorities' stance towards the exchange rate is the relative volatility of the exchange rate to the volatility of reserves. Eichengreen et al. (2003) refer this ratio as the "freedom to float" (FF). A higher ratio implies that monetary authority prefers to let the exchange rate go rather than intervening intensively. The results are again very similar.

[29] Tables are available from the authors upon request.

the economy instead of the size of the relevant asset class. The disadvantage of using GDP series is that they are very volatile, which complicates our identification procedure because we cannot be sure the extent to which the time-series variation in the resulting ratio is driven by the debt series or the GDP series. To minimize this problem, we use HP-filter to smooth the fluctuations of the GDP series. Again, we get qualitatively similar results. Changing the normalization only affects the size of the estimated coefficient that captures the effect of liability dollarization on the exchange rate choice, but neither its sign nor its statistical significance. Instead, for the reverse causality, the sign is now positive (i.e., more reserve volatility leads to more liability dollarization) but the coefficient is not statistically significant.

To test whether developing countries behave differently, we split the data into developing and industrial countries for external liability dollarization. The developing country coefficients are, as expected, larger in size than the industrial country coefficients.

We also tried changing the lag structure from two lags to one and three; including additional controls such as sudden stops, currency crises, the US interest rates, and institutional quality; using net debt (i.e., gross debt minus gross assets) and aggregate liabilities as alternative dependent variables; and finally, excluding financial centers and hard-peggers from our sample. Overall, the results are consistent across different specifications.

VII. Conclusions

This paper provides novel empirical content to a topic which has been dominated by theoretical work with a strong intuitive appeal in policy circles. Our main purpose is to estimate the causal relation between liability dollarization and exchange rate policy choice. In particular, we want to estimate how severe is the presumed "fear of floating" exhibited by many countries, and to what extent domestic agents choose the currency composition of their debts based on the incentives provided by the central bank through the exchange rate choice.

We use identification through heteroskedasticity to deal with the inherent endogeneity problem. Our results provide support to the "fear of floating" argument: countries with high liability dollarization tend to stabilize the exchange rate. On the other hand, we do not find evidence of a causal effect going in the opposite direction. While this result warrants further research and more detailed analysis, at the very least, it suggests that the move towards more flexible exchange rates is not, in-and-of-itself, sufficient to promote de-dollarization. This is consistent with, for example, Ize and Levy-Yeyati (2005) who suggest that an active, market-driven de-dollarization policy agenda should cover several fronts and is not just the outcome of the exchange rate choice.

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Appendix 1. Country List

Country	GrossD[30]	FD	CGD
Source	Lane and Milesi-Ferretti (2006) & Hausmann and Panizza (2003)	Levy-Yeyati (2006)	Jeanne and Guscina (2006)
Range	1970-2003	1975-2002	1980-2005
Albania		x	
Algeria	D		
Angola		x	
Antigua and Barbuda		x	
Argentina	D	x	x
Armenia		x	
Aruba	D		
Australia	I		
Austria	I	x	
Azerbaijan		x	
Bahamas, The		x	
Bahrain		x	
Bangladesh			
Barbados		x	
Belarus		x	
Belgium	I		
Belize		x	
Bhutan		x	
Bolivia	D	x	
Bosnia & Herzegovina		X	
Brazil	D		x
Bulgaria		X	
Cambodia		X	
Canada	I		
Cape Verde		X	
Chile	D	X	x
China	D	X	x
Colombia	D	X	x
Comoros		X	
Congo		X	
Costa Rica	D	X	
Croatia		X	
Cyprus		x	
Czech Republic		x	x
Denmark	I	x	
Djibouti		x	
Dominica		x	
Dominican Republic	D	x	
Ecuador	D	x	
Egypt	D	x	
El Salvador	D	x	
Estonia		x	
Ethiopia		x	
Fiji		x	
Finland	I	x	
France	I		

[30] "D" stands for "developing countries", while "I" refers to "industrial countries".

Country	GrossD^{30}	FD	CGD
Gambia, The		x	
Germany	I		
Georgia		x	
Ghana		x	
Greece	I	x	
Grenada		x	
Guatemala	D	x	
Guinea		x	
Guinea-Bissau		x	
Haiti		x	
Honduras		x	
Hong Kong, China		x	
Hungary		x	x
Iceland	I	x	
India	D		x
Indonesia	D	x	x
Ireland	I		
Israel	I	x	x
Italy	I	x	
Jamaica	D	x	
Japan	I	x	
Jordan	D	x	
Kazakhstan		x	
Kenya		x	
Korea	D	x	
Kuwait		x	
Kyrgyz Republic		x	
Lao People's Dem.Rep		x	
Latvia		x	

Country	GrossD^{30}	FD	CGD
Lebanon		x	
Libya		x	
Lithuania		x	
Luxembourg	I		
Malawi		x	
Malaysia	D	x	x
Maldives		x	
Malta		x	
Mauritius	D	x	
Mexico	D	x	x
Moldova		x	
Mongolia		x	
Morocco	D	x	
Mozambique		x	
Myanmar		x	
Nepal		x	
Netherlands	I	x	
Netherlands Antilles		x	
New Zealand	I	x	
Nicaragua		x	
Nigeria		x	
Norway	I	x	
Oman	D	x	
Pakistan	D	x	
Panama	D		
Papua New Guinea		x	
Paraguay		x	
Peru	D	x	
Philippines	D	x	x

Country	GrossD[30]	FD	CGD
Poland		x	x
Portugal	I		
Qatar		x	
Romania		x	
Russian Federation		x	x
Rwanda		x	
Saudi Arabia		x	
Sierra Leone		x	
Singapore	D		
Slovak Republic		x	
Slovenia		x	
South Africa	D	x	
Spain	I	x	
Sri Lanka	I	x	
St. Kitts and Nevis		x	
St. Lucia		x	
St. Vincent & Grens.		x	
Sudan		x	
Suriname		x	
Sweden	I	x	
Switzerland	I	x	
Syria		x	
São Tomé & Príncipe		x	
Tanzania		x	
Thailand	D	x	x
Tonga		x	
Trinidad and Tobago	D	x	
Tunisia	D	x	
Turkey	D	x	x
Uganda		x	
Ukraine		x	
United Arab Emirates		x	
United Kingdom	I	x	
United States	I		
Uruguay	D	x	
Vanuatu		x	
Venezuela	D	x	x
Vietnam		x	
Yemen		x	
Zambia		x	
Zimbabwe	D	x	

Appendix 2. List of Variables, Abbreviations, and Data Sources

Variable Abbrev. / Name	**Frequency**	**Variable Formula**	**Definitions**	**Observations**	**Source**
GrossD Gross Foreign Debt in Foreign Currency as a share of total debt assets plus debt liabilities	Annual, 1970-2003	$\dfrac{D_L \times OSIN}{D_A + D_L}$	$\mathbf{D_A}$ = Debt Assets = portfolio debt plus other investments. $\mathbf{D_L}$ = Debt Liabilities = portfolio debt plus other investments. $OSIN = \max\left\{1 - \dfrac{\text{securities in currency}_i}{\text{securities issued by country}_i}, 0\right\}$	Data on D_A and D_L [from Milesi-Ferretti and Lane (2006)] does not specify the currency composition of debt. To proxy the foreign currency portion of debt shares, we interact D_L by OSIN [from Hausmann and Panizza (2003)], which is a measure of the proportion of the debt that is borrowed in foreign currency.	(1) D_A and D_L: Lane and Milesi-Ferretti (2006). (2) OSIN: Hausmann and Panizza (2003)
GrossD_OSIN$_t$ Gross Foreign Debt in Foreign Currency as a share of total debt assets plus debt liabilities	Annual, 1970-2003	$\dfrac{D_L \times OSIN_t}{D_A + D_L}$	$\mathbf{D_A}$ = Debt Assets = portfolio debt plus other investments. $\mathbf{D_L}$ = Debt Liabilities = portfolio debt plus other investments. $OSIN = \max\left\{1 - \dfrac{\text{securities in currency}_i}{\text{securities issued by country}_i}, 0\right\}$	Data on D_A and D_L as above. To proxy the foreign currency portion of debt shares, we interact D_L by $OSIN_t$ [from Hausmann and Panizza (2003)] as above. But instead of taking the average OSIN by country (to increase sample size, as in GrossD), here we use the very limited time series variation of OSIN.	(1) D_A and D_L: Lane and Milesi-Ferretti (2006). (2) OSIN: Hausmann and Panizza (2003)

Variable Abbrev. / Name	**Frequency**	**Variable Formula**	**Definitions**	**Observations**	**Source**
FD Financial Dollarization	Annual, 1975-2002	Foreign Currency Deposits / Total Deposits in Banks			Levy-Yeyati (2006)
CGD Central Government Dollarization	Annual, 1980-2005	Foreign Currency Debt of the Central Government / Total Central Government Debt			Jeanne and Guscina (2006)
R_M_0 Reserve Volatility as a share of M_0	Annual, 1960-2003	$Ln\left(\frac{std(\Delta RES)}{M_0} * 10000\right)$	**std (ΔRES)** = the standard deviation of *monthly* changes in "total reserves minus gold" (reserves is US$) $\mathbf{M_0}$ = Reserve money, converted to US$	To generate an annual series of $\mathbf{M_0}$ in dollars, we begin by converting the monthly data of M_0 in local currency by dividing each observation by the end of period bilateral nominal exchange rate vis-à-vis the US$. We then take the 12 month average of the converted numbers to get yearly observations.	(1) Total Reserves minus Gold: IFS line 1L.DZF (2) Reserve Money: IFS Line 14.ZF (3) Nominal Exchange Rate: IFS Line AE.ZF

Variable Abbrev. / Name	Frequency	Variable Formula	Definitions	Observations	Source
R_M$_2$ Reserve Volatility as a share of M_2	Annual, 1960-2003	$Ln\left(\frac{std(\Delta RES)}{M_2}*10000\right)$	**std (ΔRES)** = idem above $\mathbf{M_2}$ = Money + Quasi-Money, converted to US$	To generate an annual series of $\mathbf{M_2}$ in dollars, we begin by converting the monthly data of $\mathbf{M_1}$ in local currency by dividing each observation by the end of period bilateral nominal exchange rate vis-à-vis the US$. We do the same thing for **Quasi-Money**. Next, we add Money and Quasi-Money. Finally, we take the 12 month average of the converted numbers to get yearly observations.	(1) Total Reserves minus Gold: IFS line lL.DZF (2) Money: IFS Line 34.ZF (3) Quasi-Money: IFS Line 35.ZF (4) Nominal Exchange Rate: IFS Line AE.ZF
Std_NER Nominal Exchange Rate Volatility	Annual, 1960-2003	$std(\Delta NER)$	**std(ΔNER) =** the standard deviation of *monthly* changes in nominal exchange rate (local currency per U.S. dollar)		Nominal Exchange Rate: IFS Line AE.ZF

Variable Abbrev. / Name	Frequency	Variable Formula	Definitions	Observations	Source
Std_NEER *Nominal Effective Exchange Rate*	Annual, 1960-2003	*std(ΔNEER)*	**std(ΔNER) =** the standard deviation of *monthly* changes in nominal effective exchange rate		Nominal Effective Exchange Rate: IFS Lines NECZF and NEUZF.
ERMP_NER Exchange-Market Pressure	Annual, 1960-2003	$\frac{\frac{std(\Delta RES)}{M_0}}{\left(\frac{std(\Delta RES)}{M_0}+std(\Delta NER)\right)}$	As above	This variable is defined and used in Eichengreen, Rose and Wyplosz (1996)	As above
ERMP_NEER Exchange-Market Pressure	Annual, 1960-2003	$\frac{\frac{std(\Delta RES)}{M_0}}{\left(\frac{std(\Delta RES)}{M_0}+std(\Delta NEER)\right)}$	As above	As above	As above.

Variable Abbrev. / Name	**Frequency**	**Variable Formula**	**Definitions**	**Observations**	**Source**
FF_NEER Freedom to Float	Annual, 1960-2003	$\dfrac{std(\Delta NEER)}{\dfrac{std(\Delta RES)}{M_0}}$	**std(ΔNEER) =** the standard deviation of *monthly* changes in nominal effective exchange rate **std (ΔRES)** = the standard deviation of *monthly* changes in "total reserves minus gold" (reserves is US$) $\mathbf{M_0}$ = Reserve money, converted to US$	This variable is constructed and used in Eichengreen, Hausmann and Panizza (2003). The difference is that we use the nominal *effective* exchange rate.	(1) Nominal Effective Exchange Rate: IFS Lines NECZF and NEUZF. (2) Total Reserves minus Gold: IFS line 1L.DZF (3) Reserve Money: IFS Line 14.ZF
Vol(π) Inflation	Annual 1970-2003	std (Δπ)	std(Δπ) **=** the standard deviation of *monthly* changes in the CPI.	Changes in consumer prices (CPI). Percent per annum	IFS Line 64.XZF
trwdi Trade to GDP ratio	Annual, 1960-2003	$\dfrac{X+M}{GDP}$			WDI CD-ROM

Variable Abbrev. / Name	**Frequency**	**Variable Formula**	**Definitions**	**Observations**	**Source**
KAopen Index of Capital Account openness	Annual 1970-2004		KAOPEN is an index to measure a country's degree of capital account openness. It is based on the binary dummy variables that codify the tabulation of restrictions on cross-border financial transactions reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER).		Chinn-Ito (2006)
csize Country size	Annual, 1960-2003	Ln (Real GDP)	Real GDP = GDP in constant (2000) US$		WDI CD-ROM.