Does Moving to a Flexible Exchange Rate Regime Reduce Currency Mismatches in Firms’ Balance Sheets?

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Does Moving to a Flexible Exchange Rate Regime Reduce Currency Mismatches in Firms’ Balance Sheets?

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Abstract

To what extent do exchange rate regimes affect private sector’s incentives to hedge currency risk? The goal of this paper is to analyze the effect that the change from a pegged to a floating exchange rate regime had on the currency denomination of corporate debt and associated currency imbalances in firms’ balance sheets. For these purposes, we construct a new firm-level dataset on the currency composition of firms’ assets and liabilities across seven Latin American countries, between 1992 and 2005. We identify the effect of the exchange rate regime by examining how debt currency choices varied across firms depending on their differing levels of dollar denominated debt and their different exposures to devaluation risk (i.e., exporters versus non-exporters). The key result in the paper is that the adoption of a floating exchange rate regime leads to a higher degree of currency matching in firm’s balance sheets, thus reducing the corporate sector’s financial vulnerability to exchange rate fluctuations. This result is robust to alternative identification methods of exchange rate regimes and different measures of currency exposure at the firm-level. Overall, the results suggest that under a floating exchange rate regime, firms (or their creditors) become more aware of exchange rate risk, and thus mitigate their foreign exchange exposure by closing their foreign currency positions.

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I. Motivation

The financial vulnerabilities that may arise when firms are highly leveraged in dollar debt have taken center stage in academic and policy debates following the recent emerging market crises. To the extent that a currency mismatch is generated between foreign currency liabilities and domestic currency revenues, foreign currency debt increases companies’ vulnerability to exchange rate depreciations.

Many observers have singled out fixed or pegged exchange rate regimes as the main culprit behind the large buildup of unhedged foreign currency borrowing leading to recent crisis in East Asia and Latin America. This commonly held view is that under fixed or predetermined regimes, firms will not fully internalize exchange rate risk and will be more likely to engage in balance sheet mismatches than under a floating regime. Other authors, however, have claimed that the problem of un-hedged foreign currency liabilities in the corporate sector has deeper roots than the exchange rate regime. Therefore—they argue—the movement towards floating regimes taking place in emerging markets will not correct this fundamental problem.

Although the debate among academics and policymakers has been intense, there are no studies that systematically look at this issue for a broad set of countries and periods. Using a unique firm-level dataset with accounting information for almost 2000 firms from seven Latin American countries, this paper sheds new light on the effect of exchange rate arrangements on firms’ liability dollarization and exchange rate exposure. In so doing, this study contributes to the existing empirical and policy literature by investigating how debt composition choices are affected when countries move from fixed to flexible exchange rate regime.

The goal of this paper is to analyze the effect that the change from a fixed to a floating exchange rate regime has on the currency denomination of corporate debt. In particular, the paper empirically investigates the hypothesis that under a floating exchange rate regime, firms (or their creditors) become more aware of exchange rate risk, and thus mitigate their exchange rate exposure by reducing currency imbalances in their balance sheets.

To examine this question, I assemble a new dataset with firm-level accounting information for 2200 firms across seven Latin American countries, between 1992 and 2005. A unique feature of this database is that presents detailed information on three key dimensions of companies’ exposure to exchange rate risk: the currency composition of assets and liabilities, the share of exports in total sales and the share of short term debt in total foreign-currency denominated debt.

The empirical analysis in this paper yields three key findings. First, results consistently indicate that the adoption of a flexible exchange rate regime has a negative impact on companies’ foreign currency-denominated borrowing, three years after the regime was adopted. This drop is significant even after controlling for a measure of interest rate differentials which typically have accompanied macroeconomic regime changes. This result provides support for the view that floating exchange rate regimes reduce liability dollarization, and is consistent with previous country-level evidence for Mexico from
Martinez and Werner (2002) and recent evidence for Chile by Cowan, Hansen and Herrera (2005). These findings are robust after controlling for survivorship bias and valuation effects brought about by fluctuations in the value of the domestic currency.

Second, the adoption of a floating exchange rate regime has an economically significant impact in the extent to which firms’ match the currency composition of assets and income flows, with liabilities. Using a precise measure of accounting currency exposure that considers the currency composition of asset and liability stocks and the exchange rate sensitivity of income flows, we find significant changes in the level of companies’ currency exposure following periods of increased exchange rate volatility. One possible interpretation of these results is due to the effect of higher exchange rate variance on the relative risk of domestic and foreign debt. This being the case, floating exchange rate regimes would reduce exposure, by eliminating implicit exchange rate insurance and forcing firms to correctly internalize exchange rate risk.

Finally, empirical evidence also indicates that the most dramatic changes in the density of firms’ currency imbalances occurs in the lower tail of the distribution representing downside risk. More generally, results provide support for the view that floating exchange rate regimes can reduce financial vulnerability in the medium-term in emerging markets.

This paper contributes to the existing empirical literature in two ways. First of all, we assemble a new database, which allows building a more comprehensive measure of currency exposure. The unique feature of the dataset is that it provides detailed and comparable information on the level and maturity of foreign currency-denominated debt contracted by Latin American firms. Second, this study contributes to the existing empirical and policy literature by investigating the effects of exchange rate regimes on debt composition choices across a broad set of countries and periods.

Second, and from a methodological point of view, this study departs from the extant literature by exploiting the information contained in the entire cross-sectional distribution of currency mismatches of the corporate sector. One advantage of our estimation procedure is that it yields a visually clear representation of where the in the distribution of dollar debt the exchange rate regime exerts the biggest impact.
II. LITERATURE REVIEW

There is no clear consensus among economists on the degree of financial vulnerability induced by different exchange rate regimes. Three basic views exist in this respect. On the one hand, proponents of hard (fixed) currency pegs argue that a strong domestic currency can provide credibility and lead to greater domestic currency financial intermediation, thereby allowing countries and firms to issue more local currency debt over time. For example, Hausmann, Gavin, Pages-Serra, and Stein (1999) argue that in economies facing important terms of trade shocks, a fixed exchange rate regime increases financial intermediation in local currency by generating a negative covariance between domestic asset prices and the income process.

On the other hand, several authors have argued that a pegged exchange rate regimes biases corporate borrowing towards foreign currency, due to an implicit exchange rate guarantee given by the government (see Burnside, Eichenbaum, and Rebelo (2001) and Schneider and Tornell (2004)). According to this majority view, under a predetermined regime, firms will not fully internalize their exchange rate risk and will be more likely to engage in balance sheet mismatches that under a floating regime. As a result, the corporate sector will end up with a large stock of un-hedged foreign currency that leaves them expose to a sudden reversion of economic conditions (Fisher (2001) and Mishkin (1996)).

The exchange rate regime might also affect the currency composition of debt by modifying the relative return volatilities of domestic and foreign currency assets, even without recourse to moral hazard considerations. Ize and Levy Yeyati (2003) show that, in a minimum variance portfolio equilibrium, financial dollarization is explained by the relative volatilities of inflation and the real exchange rate. In this context, policies that limit real exchange rate volatility, such as following a crawling peg or using monetary policy to target the nominal exchange rate, increase dollarization.

A natural implication of this line of thought is that the adoption of floating exchange rate regimes would reduce the amount of un-hedged foreign currency denominated borrowing of the private sector. The point is that floating exchange rates provide information content, namely, that exchange rates cannot be relied upon to be stable. In this case, the inherent volatility of floating regimes will create the required incentives in the private sector to hedge against it.

Finally, several authors claim that some emerging markets have a natural tendency for liability dollarization that is more ingrained in the system that can be expressed by the presence of a pegged exchange rate regime. This has been termed the “original sin” hypothesis (see Eichengreen and Hausman, 1999). According to this view, currency mismatches exist not because banks and firms lack the prudence to hedge their exposures. Rather, it is the incompleteness of the markets that is at the roots of the financial fragility. Based on this notion, Eichengreen and Hausmann (1999) dispute the fact that moving to a

\footnote{An influential early statement of the connection between floating rates and hedging by the private sector is Goldstein (1998).}
more flexible currency regime would reduce exposure to currency risk. They argue instead that the higher exchange rate volatility associated with floating rates means that hedging will be more expensive; hence, there will be less hedging under floating rates that under fixed rates.

Although the debate among academics and policymakers has been intense, and the stakes in terms of policy implications are high, there are no studies that systematically look at this issue for a broad set of countries and periods. The recent transitions from heavily managed to floating exchange rate regimes in several Latin American countries afford a unique opportunity to examine the relationship between exchange rate policies and firms’ balance sheet vulnerabilities to exchange rate fluctuations. We take on these issues in the sections below.
III. Data Construction and Basic Stylized Facts

The empirical analysis in this paper draws on a new database with detailed information on the currency and maturity composition of firms’ assets and liabilities for over 2,200 non-financial companies in seven Latin American countries, spanning the period 1992 to 2005. In addition to basic accounting data, the database also contains other key information about the firm, such as its sector of economic activity, export orientation and access to international capital markets.

The thrust of the information was collected from annual reports and audited corporate filings obtained from local stock markets and regulatory agencies in each country, both for public and non-publicly traded firms. Where appropriate, I complemented and cross-checked these country-specific sources with data obtained from commercial data providers Economatica and Bloomberg. I convert all financial and income flow data to real 1996 U.S. dollars using December-to-December changes in the country’s consumer price index and the exchange rate for December 31, 1996. Appendix A contains definitions and sources of all key variables.

Tables 1 and 2 provide summary statistics along several dimensions of the data set. Panel A in Table 1 shows the number of firm observations per country and year containing consistent balance sheet data. The size of the sample changes as new firms enter and exit the sample. Attrition is partly due to the fact that nonpublic firms are in the sample only in years they are issuing debt, or public firms that are merged or acquired and subsequently delisted. Information presented in Panel B shows the distribution of firms by sector of economic activity. We restrict the sample to non-financial companies. Given that currency mismatches are affected by banking regulation, the capital structure of banks and insurance companies is not comparable with the behavior of non-financial firms.

Table 2 reports mean values for some of the firm-level variables used in the subsequent analysis. In particular, the data reveals significant cross country differences in the level of firm-level dollar debt in Latin America. The average share of foreign currency debt during this period, for example, went from 6 percent in the case of Colombia to well above 63 percent in the cases of Argentina and Peru. Figure 1, in turn, shows the distribution of firm-level dollarization ratios within each country. Again, differences across countries are striking. The data for Argentina and Peru is consistent with the fact that dollarization in Argentina and Peru has been pervasive and common to all productive sectors. For several countries in the sample, however, the cross-sectional distribution of dollar debt ratios is highly clustered around cero and decidedly non-normal.

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3 Excluded were commercial banks, brokerage firms, financial groups, insurance companies and mutual funds.

Table 3 also summarizes the currency and maturity breakdown of total assets and liabilities, and the share of short term debt that is in foreign currency. As is clear from the table, in most countries, nearly two thirds of the outstanding debt is short-term. In turn, the percentage of long-term debt denominated in foreign currency is relatively large, suggesting that the observed dollarization of liabilities may well be motivated by a desire to extend the maturity structure of obligations. Finally, a common pattern in firms’ capital structures across Latin America is the relatively low dollarization of assets (compared to liabilities), the high share of short-term liabilities, and the lower share of short-term assets.

Figure 2 plots the time series for the average firm-level liability dollarization for each country in the sample, while Figure 3 depicts the average short term exchange rate exposure at the firm-level. In each panel, the vertical line represents the year of the exchange rate regime change, as measured by the *de facto* exchange rate regime classification of the International Monetary Fund developed by Bubula and Otker-Robe (2002). The dark shaded area in each figure corresponds to a period of fixed or pegged exchange rate regimes, while the light-shaded area represents years of managed exchange rate floating. White areas capture periods where the exchange rate regime was defined as independently floating. Table 3 provides a description of the different exchange rate arrangements for each country during the sample period, and calculates different measures of effective exchange rate flexibility within regimes.

It is tempting to conclude from this descriptive evidence that switching to a flexible regime has led both to a decrease in foreign currency borrowing and a reduction in foreign exchange open positions in the corporate sector. However, as argued below, one must be cautious to interpret this as a causal link, due to the possible presence of omitted factors correlated both with exposure at the firm-level and regime switching. The rest of the paper is devoted to exploiting the panel structure of the data-set to investigate this question.

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5 To control for changes in sample composition and missing observations, we regress firm-level dollarization ratios on a complete set of firm and year intercepts. The graphs plot estimated time dummies from these country-level regressions.

6 Differences between *de jure* and *de facto* exchange rate regimes have been the subject of a lot of research lately. There is a substantial body of evidence that suggests that stated exchange rate regimes are not always adhered to at face value (see Calvo and Reinhart (2002), Hausmann, Panizza and Stein (2001), among others). The Bubula–Otker–Robe *de facto* classification combines market exchange rates and other quantitative information with assessments of the nature of the regime drawn from discussions with IMF desk economists as a result of bilateral consultations.

7 An alternative *de facto* classification of exchange rate regimes is Reinhart and Rogoff ‘natural’ classification. The Reinhart–Rogoff (RR) classification is based on actual exchange rate behavior and has the attractive feature of distinguishing episodes of very high inflation and uncontrolled depreciation (‘freely falling’ regimes). We do not have a view of which series is more reliable; doing so is being the scope of the paper. Fortunately, it turns out that the two measures tell a broadly consistent story.
IV. EMPIRICAL SET-UP

The empirical strategy is based on estimating a pooled cross-section model of the main determinants of firms’ foreign currency borrowing in Argentina, Brazil, Chile, Colombia, Mexico, Peru and Uruguay, between 1992 and 2005:

\[
DOLL_{ijct} = \alpha_0 + \alpha_1 FLEX_{ct} + \alpha_2 EXPtoS_{jct} + \alpha_3 \left[ EXPtoS_{jct} * FLEX_{jt} \right] + x_{ijct} \beta + \phi_j + \gamma_c + \lambda_t + \varepsilon_{ijct} \quad (1)
\]

Bold Greek letters represent vectors of coefficients in equation (1). The sub-indexes \(i, j, c\) and \(t\) stand for firm, sector, country, and time, respectively. The dependent variable \(DOLL_{ijct}\) is the fraction of total liabilities denominated or indexed to a foreign currency (typically the dollar) of firm \(i\) in sector \(j\), in country \(c\) in year \(t\). Thus, \(DOLL_{ijct}\) is between 0 and 1. The indicator variable \(FLEX\) varies across countries and time, and takes on the value of 0 in all periods with fixed, pegged or managed floating regimes, and 1 in all years where a country has an independently floating exchange rate regime (including the transition year). \(EXPtoS\) is the ratio of exports (foreign currency revenues) to sales of each firm in the sample. \(x_{ijt-1}\) is a set of other firm-specific, time-varying controls (lagged one period), to be detailed below. \(\phi_j, \gamma_c, \lambda_t\) represent indicator variables that identify the main industry, year and country effects, respectively. Unobservable determinants are captured by \(\varepsilon_{ijct}\).

For our purposes, the parameters of interest are \(\alpha_2\) and \(\alpha_3\). The coefficient measures the degree of currency matching: it captures the extent to which the average firm in the sample matches the currency denomination of their liabilities (the share of foreign currency obligations in total debt) with the currency denomination of income flows (the share of foreign currency revenues in total sales). Given everything else constant, the higher is the value of \(\alpha_1\), the higher is the degree of natural currency risk hedging (the lower is the exchange rate exposure) of a firm. If firms match income streams with the currency composition of liabilities, then those firms that we observe hold higher levels of dollarized debt will also be those firms whose profits respond more favorably to a depreciation.

The central empirical question addressed in this paper is then whether \(\alpha_1\) (the degree of currency matching) is—economically and statistically—higher during periods of floating regimes. In other words, whether dollar debt in these economies gets re-distributed to export intensive firms (firms with revenues closely linked to the exchange rate). The key parameter

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8 As opposed to financial hedging, that is using forward exchange rates to cover exchange rate risk.

9 Moreover, our measure of propensity to export does not correct for imported inputs due to data limitations.
of interest is then $\alpha_3$, or the effect of the interaction of flexibility of regime and export intensity on liability dollarization. If the introduction of a flexible exchange rate regime leads to a bigger change in dollarized liabilities of export intensive firms vis-à-vis sectors with low foreign-currency revenues (relative to within countries that keep their peg during the same period), then $\alpha_3$ should be positive and economically significant. Focusing in $\alpha_3$ and not $\alpha_1$(the level effect) underscores the notion that what matters for financial vulnerability is not the level of dollarization per se, but the way it is distributed across the economy among firms with different ability to earn dollar-denominated revenues.

The crucial identifying assumption in this model is that, conditional on sector, country and time-specific dummies, the interaction between the timing of exchange rate regime introduction and exporter intensity is orthogonal to the error term. Under this assumption, our estimate of the parameter $\alpha_3$ will be directly interpretable as an estimate of the causal effect of switching to a floating regime on the degree of currency matching at the firm-level.

Several characteristics of this specification deserve further discussion. First, we do not directly exploit cross-country differences in average dollarization to identify the economic impact of exchange rate regimes on firms’ financial structures. Instead, we rely on another source of variation -- differences in export intensity across firms within countries. This makes identification of the effects more credible by reducing the unobserved heterogeneity: the relative effect of exchange rate regime reforms can be identified under weaker assumptions than those needed to identify the average effect. Second, the inclusion of country and sector fixed effects controls for any determinant of dollarization that varies across countries or industries and significantly reduces the a common concern in difference-in-differences exercises about omitted variable bias and reverse causality (policy endogeneity) that may result in this case from “fear of floating”. This differences-in-differences approach allows us to estimate the effect of exchange rate regimes while holding constant fixed characteristics of a country that affect dollarization and might also be correlated with the timing of flexible regimes introduction. Third, we include a rich set of variables to control for other influences on debt dollarization, and thus minimize the omitted variable bias in the estimated relation between the currency composition choices and exchange rate regimes.
V. EMPIRICAL RESULTS

Column 1 in Table 4 reports the results of our baseline specification. In the estimation, we include a dummy for the year of the transition of exchange rate regimes, as the collapse of the peg in several countries may generate of burst of dollarization (a valuation effect) which can be mistakenly regarded as being caused by the subsequent flexible regime. We cluster standard errors by country*year to take into account the level of aggregation of the independent variable.

Consider first the control variables. Most of these coefficients have the predicted signs and are statistically significant at standard confidence levels. Although not reported, country dummies are individually significant at conventional confidence intervals in all specifications, with firms in Argentina, Uruguay, and Peru holding the highest levels of dollar debt and firms in Colombia and Brazil holding the lowest levels of dollar debt.

Our results suggest that matching does take place among firms included in our sample. Firms with higher dollar debt are those firms whose earnings we expect to increase in the event of a depreciation. More importantly, results indicate that firms have been taking the exchange rate risk more seriously after the adoption of the floating exchange rate regime than before. This argument follows from the fact that during the free-floating regime, on average, export to sales, become a more significant determinant of the importance of dollar indebtedness (the interaction term is positive and highly statistically significant). A simple calculation illustrates the economic significance of the correlation. Our estimates suggest that a less export-oriented firm (in the first decile of the distribution) would see its level of liability dollarization drop by almost six percentage points relative to a more export-oriented firm (in the 9th decile of the distribution) on average when moving to a floating regime (-0.057=0.14*(0.0)-0.14*0.41).

Column 2 provides results for the same specification, this time using the share of dollar debt in short term debt as the dependent variable. The results remain qualitatively the same. Column 3 includes a measure of dollarization of assets, together with the interaction term with Flex regime dummy. Reassuringly, both interaction terms are economically and statistically significant, indicating that the increase in currency matching is observed both in stocks and in flows.

Having established our basic finding that default episodes lead to lower growth in export oriented industrial sectors, we now check whether our result is robust to changes in the sample or in the econometric specification (not reported).

A concern with the baseline specification is that the interaction term might be picking up time varying industry or country effects that are due to factors other than the regime change. To address this concern, we augment the baseline specification with state-year and industry-year fixed effects. The basic results are not affected. We also checked that our findings are not driven by individual countries by sequentially excluding each country from the sample and re-estimating the column (1) specification. In each case, we were unable to reject the null hypothesis that the estimated coefficient on the interaction term between
export to sales ratio and the flexible regime dummy equaled the value estimated for the full sample at the 5 percent level. This suggests that our results are capturing a general relationship between dollarization, export intensity and exchange rate regimes rather than the influence of individual countries.

Another concern with the baseline specification is that an important fraction of the firms had zero dollar debt in every year, suggesting that the dynamics governing their financial decisions could be very different from the rest of the firms in the sample. To allay concerns about sample selectivity, we excluded firms with zero dollar indebtedness throughout the sample. Dropping these firms had minor qualitative impacts on the basic results of enhanced currency matching in floating regimes.

As another robustness test, we included the interacted terms for the other control variables, to check whether moving to a flexible regime had significant effects in other determinants of firm’s currency debt choices. Our results indicate that the only interaction term that remains significant is the export intensity term, providing yet additional confirmation of our basic result. We also restricted the sample to firms that had consistent data at least two years before and two years after the regime change in each country. The results remained unaltered.

Yet another potential concern with the estimation has to do with the fact that export intensity can be itself endogenous to the exchange rate regime, as currency reforms are typically accompanied by steep increases in the nominal exchange rates which leads to gains in competitiveness. In this case, we would be violating the identification restriction that the exchange rate regimes can only have an independent effect on the dependent variable.

So far we have assumed that the policy change is exogenous. An important concern is that the decision of whether or not to regime change can be endogenous. Policy makers may choose to change when firms are doing well. Endogeneity may bias estimates of the mean effect of regime change in aggregate studies, but with cross-country, firm-level data, the bias will be picked up by the country-fixed effect. However, if the bias has also a component that is correlated with firm-specific innovations in dollarization, then point estimates may overstate the effects of exchange rate regimes on currency risk hedging.
VI. A CLOSER LOOK AT THE DATA: EXPLOITING THE INFORMATION IN ENTIRE CROSS-SECTIONAL DISTRIBUTION OF DOLLAR DEBT RATIOS

In Sections VI and VII we investigated the effects of exchange rate regimes in foreign currency borrowing solely through the effect of various covariates on the conditional mean of firm-level dollarization levels. Although important in itself, reaching conclusions on the basis only of the first moment of the (unconditional or conditional) distribution is problematic since it ignores changes in the remainder of the distribution of foreign currency borrowing and currency mismatches. This is especially important, for example, in the case of policymakers who may be especially interested in reducing the number of firms facing the down-side of exchange rate risk or, in the words of Stulz (1996), “the elimination of costly lower tail outcomes.”

A. Conditional Quantile Estimates

In this section we exploit the information contained in the entire cross-sectional distribution of liability dollarization ratios of the corporate sector, by looking at conditional quantile estimates of the effect of the exchange rate regime on firm’s debt currency choices. As argued below, explicit investigation of these effects via quantile regression can provide a more nuanced view of the stochastic relationship between variables, and therefore a more informative empirical analysis.

The Tobit estimator of the mean regression model is concerned with the dependence of the conditional mean of the dollarization ratio of debt on a given set of covariates. The quantile regression estimator tackles this issue at each quantile of the conditional distribution of the dependent variable 10. The central special case is the median regression estimator that minimizes the sum of absolute errors. The remaining conditional quantile functions are estimated by minimizing an asymmetrically weighted sum of absolute errors. Taken together, the ensemble of estimated conditional quantile functions offers a much more complete view of the effect of covariates on the location, scale and shape of the distribution of the response variable 11.

The first three panels in Figure 4 plot the estimated effects of the export to sales ratio, the flexible regime dummy and the interaction effect on debt dollarization, at different deciles of the conditional distribution of the dependent variable. Results were obtained by applying the methodology described in Chernozhukov and Hong (2001).

10 Note that quantile regression is not equivalent to segmenting the dependent variable into subsets according to its unconditional distribution and then doing least squares fitting on these subsets. Even for the extreme quantiles, all observations are actively in play in the process of quantile fitting.

11 An additional advantage of quantile regression estimates is that the method is robust to departures from normality and homoscedasticity, thus alleviating some of the concerns regarding results obtained with Tobit models.
Because the conditional quantile regression is a linear model on the covariates, the estimated coefficient on exports to sales measures the degree of currency matching in the sample during the pegged regime (that is, when the dummy Flex=0). The Figure suggests that the degree of currency matching decreases almost monotonically as we move up the conditional distribution of dollarization, indicating that firms with higher conditional levels of dollar debt (that is, after accounting for firm-specific and sectoral determinants) are more exposed to exchange rate risk.

The last figure in the Panel calculates the percentage increase in the degree of currency matching at any given decile of the distribution, by dividing the value of the decile-specific interaction effect over the corresponding value for the estimated parameter on export to sales ratio. This last result implies a very interesting observation: as countries switch to flexible regimes, the reduction in the degree of foreign exchange rate exposure in firms’ balance sheet becomes more important as we consider firms in the highest deciles of the dollarization distribution. Interestingly, the differential effect is stronger where the theory plausibly suggests the costs of exposure to devaluation risk are likely to be larger. These differential effect lends additional credibility to the hypothesis that following the adoption of a floating exchange rate regime, the private sector becomes more aware of exchange rate risk.

B. Estimating Counter-Factual Distributions

Based on a semi-parametric procedure first proposed by Di Nardo, Lemieux, and Fortin (1995), this section looks at within-country changes in the unconditional distribution of firms’ currency mismatches between pegged and floating regimes.

To account for potentially confounding factors across periods, the empirical analysis relies on the estimation of counterfactual kernel densities. This methodology allows to answer the following question: “what would the distribution of currency mismatches in the floating period would have been if firms’ attributes, such as size, leverage, export status and/or export intensity, access to external debt and equity markets had remained at their pre-floating period levels? Appendix I provides a full-fledged description of the methodology.

Based on this estimation procedure, Figure 5 compares the actual distribution of firms’ currency mismatches in the pre-floating period with the counter-factual distribution of balance sheet mismatches in the post-floating period for the cases of Brazil, Chile, Mexico and Peru. Each figure plots the estimated kernel densities (y-axis) of firm-level stock currency mismatches, defined as dollar liabilities minus dollar assets, as a percentage of total liabilities (x-axis). A rightward movement along the x-axis denotes an increase in the stock exchange rate exposure of the firm. Solid lines represent the actual distribution of pooled observations during the pegged regime in each country. The dotted lines are the reweighted distributions during the floating period, representing the distribution that would have been

12 All density estimates use an Epanechnikov kernel and a bandwidth the size of the Silverman (1986) rule-of-thumb.
obtained (counterfactual) had the distribution of firms' characteristics in the floating period remained as in the pegged regime period.

Except for the case of Peru, the figures indicate substantial changes in the cross-sectional distribution of currency imbalances across both periods. Controlling for firm-specific and sectoral variables, the adoption of a floating regime is associated to a reduction in firm-level balance sheet mismatches. In the case of Mexico, for example, the mass of the distribution becomes more concentrated around zero net open foreign exchange positions. More interestingly, most of the shift in the density occurs in the lower tail of the distribution representing downside risk. In the case of Brazil and Chile, the distribution of currency mismatches becomes much less dispersed and the lower tails become compressed.
VII. CONCLUSIONS AND POLICY IMPLICATIONS

Many observers have signaled out fixed or pegged exchange rate regimes as the main culprit behind the large buildup of unhedged foreign currency debt leading up to recent currency crisis. According to this argument, the perception of assured exchange rate stability has induced firms in those countries to borrow too much and/or underestimating future currency risk.

The debate on the effects of the exchange rate regime on firms’ liability dollarization and currency exposure, however, has been remarkably uninformed by evidence. This has been mostly due to the paucity and lack of uniformity of firm-level data on the currency and maturity composition of firms’ balance sheets.

An important contribution of this study is to start filling this information gap by assembling a new data set on annual accounting information covering roughly 2,200 non-financial firms from seven Latin American countries, spanning the period 1990–2005. The database is unique in that it presents detailed information at the firm level on the currency composition of assets and liabilities, the breakdown of domestic and export sales and the maturity profile of domestic and foreign currency denominated debt.

Drawing on this newly assembled dataset, we construct a more precise measure of currency exposure at the firm-level that takes into account the magnitude and maturity profile of foreign currency-denominated assets and liabilities and foreign sales. To understand the relationship between the choice of the exchange rate regime and companies’ exchange rate exposure, we exploit the changes in exchange rate policy arrangements that occurred in the countries in the sample between 1992 and 2005. In all these countries, a key component of the new policy regime was the abandonment of the exchange rate band and the adoption of a floating regime for the exchange rate. To our knowledge, no other study has yet examined the effect of exchange rate regimes on corporate financial policies and financial vulnerability across countries and across time.

Results presented in the paper provide support for the view that floating exchange rate regimes reduce liability dollarization. These results are also consistent with the hypothesis that fixed exchange rate regimes bias corporate borrowing towards foreign currency denominated debt. Controlling for firm-specific and sectoral variables, the adoption of a floating regime is associated to a reduction in firm-level balance sheet mismatches. One possible interpretation of these results is that floating exchange rate regimes forces firms to correctly internalize exchange rate risk, by eliminating implicit guarantees characterizing fixed or pegged exchange rate regimes.

From a policy perspective, these findings suggest that policymakers in highly dollarized economies should consider moving to a flexible exchange rate regime as part of a long-term de-dollarization strategy. Taken together, available evidence also suggests that the adoption of flexible exchange rate regimes could reduce in the medium term the financial vulnerability of emerging market economies. A gradual shift to a more flexible exchange rate policy would also make the risks of foreign currency lending more apparent. Such a policy
would, however, need to be introduced gradually to avoid the risk of abrupt changes in real exchange rates triggering bankruptcies.

Although this study sheds new light on the relationship of exchange rate regimes and corporate financial policies, other dimensions of a firm’s exchange rate risk-management practices still require further scrutiny. In particular, a complete analysis of the financial vulnerability to exchange rate fluctuations at the corporate level requires information on off-balance sheet positions, which can substantially alter the overall risk exposure of a firm. This issue is particularly important in light of the significant growth in foreign exchange rate derivative trading in recent years. As seen above, the dollar-indebted firms tended to be larger and access international financial markets. It seems possible, therefore, that they might have been savvy about anticipating exchange rate movements and perhaps experienced with the use of financial derivatives. Such instruments could have been used to hedge away balance-sheet risk.

Finally, although this paper concentrates on exposure to exchange rate fluctuations, this is by no means the only aggregate shock that impacts firm’s capital structure decisions. Alternatively, changes in firms’ financial structures could be driven by rising external capital costs that coincide with periods of depreciation. It would therefore be informative to see how changing credit conditions (domestic and foreign) have differential effects on firms with different financial structures.
Figure 1. Distribution of Firm-Level Dollarization within Countries 1/

Source: Author's calculations based on data described in the Appendix.
1/ The figures above plot histograms liability dollarization ratios for the pooled sample of firm-year observations within each country. The x-axis represent the different levels of firms' liability dollarization (in %). The y-axis measures the fraction of firm-year observations at each level of dollarization (in %).
Figure 2. Dollarization of Liabilities of the Corporate Sector in Latin America
(In percent, annual average across firms)

Source: Author’s calculations based on data described in the Appendix.
1/ Shaded areas represent different alternative exchange rate regimes.
2/ To control for changes in sample composition, we regress firm-level dollarization ratios on a complete set of firm and year intercepts. The graphs plot estimated time dummies from these country-level regressions.
Figure 3. Coverage of Short-Term Exchange Rate Exposure
(Exports as a percentage of end-of period short term dollar liabilities, annual medians) 2/

Brazil

Chile

Colombia

Mexico

Peru

Source: Author's calculations based on data described in the Appendix.
1/ Shaded areas represent different alternative exchange rate regimes.
2/ For the case of Chile, foreign currency revenues include short-term dollar assets.
Figure 4. Censored Quantile Estimates

**Interaction Effect**

- Estimated coefficient
- 95% Confidence Interval

**Flex Dummy Effect**

- Estimated coefficient
- 95% CI

**Export to Sales Effect**

- Estimated coefficient
- 95% CI

**Increase in the Degree of Balance Sheet Currency Matching in Floating Regimes 1/**

- Percent

Source: Author's calculations based on methodology described in Appendix.
1/ Percentage increase with respect to pegged regime period, at every decile of the conditional distribution of liability dollarization.
Figure 5. Distribution of Firms' Balance Sheet Currency Mismatches Across Regimes

Source: Author's calculations based on data described in the Appendix.
Table 1. Number of Firms Observations

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>Panel A. Number of Firms by Country 1/</strong></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Argentina</td>
<td>107</td>
<td>126</td>
<td>143</td>
<td>150</td>
<td>160</td>
<td>169</td>
<td>105</td>
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<td>1061</td>
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<tr>
<td>Brazil</td>
<td>43</td>
<td>62</td>
<td>130</td>
<td>190</td>
<td>218</td>
<td>227</td>
<td>242</td>
<td>235</td>
<td>241</td>
<td>209</td>
<td>172</td>
<td>158</td>
<td>119</td>
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<td>186</td>
<td>199</td>
<td>203</td>
<td>206</td>
<td>203</td>
<td>183</td>
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<td>151</td>
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<tr>
<td>Colombia</td>
<td>134</td>
<td>220</td>
<td>238</td>
<td>227</td>
<td>223</td>
<td>188</td>
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<td>190</td>
<td>78</td>
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<td>Mexico</td>
<td>211</td>
<td>210</td>
<td>201</td>
<td>177</td>
<td>163</td>
<td>154</td>
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<td>Peru</td>
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<td>124</td>
<td>138</td>
<td>131</td>
<td>119</td>
<td>115</td>
<td>109</td>
<td>79</td>
<td>84</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
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<td>1084</td>
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<td>Uruguay</td>
<td>10</td>
<td>12</td>
<td>19</td>
<td>19</td>
<td>21</td>
<td>20</td>
<td>18</td>
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<td></td>
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<td></td>
<td></td>
<td>119</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>211</td>
<td>253</td>
<td>370</td>
<td>883</td>
<td>1051</td>
<td>1120</td>
<td>1125</td>
<td>1115</td>
<td>959</td>
<td>965</td>
<td>792</td>
<td>763</td>
<td>688</td>
<td>439</td>
<td>10,734</td>
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</table>

1/ Indicates the number of firms containing consistent balance sheet and income statement data.

Panel B. Number of Firms by Economic Sector 1/**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Argentina</th>
<th>Brazil</th>
<th>Chile</th>
<th>Colombia</th>
<th>Mexico</th>
<th>Peru</th>
<th>Uruguay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dollarization of Liabilities (%)</td>
<td>57.6</td>
<td>17.4</td>
<td>22.4</td>
<td>6.9</td>
<td>37.8</td>
<td>62.1</td>
<td>77.4</td>
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<tr>
<td>Total Assets (millions of dollars)</td>
<td>180</td>
<td>536</td>
<td>78</td>
<td>10</td>
<td>204</td>
<td>40</td>
<td>22</td>
</tr>
<tr>
<td>Leverage (%)</td>
<td>50.0</td>
<td>65.6</td>
<td>41.7</td>
<td>40.2</td>
<td>50.3</td>
<td>48.1</td>
<td>59.1</td>
</tr>
<tr>
<td>Short Term Maturity of Debt (%)</td>
<td>70.6</td>
<td>55.9</td>
<td>55.7</td>
<td>70.7</td>
<td>59.7</td>
<td>69.6</td>
<td>74.3</td>
</tr>
<tr>
<td>Exports to Sales (%)</td>
<td>9.5</td>
<td>11.7</td>
<td>8.8</td>
<td>6.1</td>
<td>14.3</td>
<td>17.9</td>
<td>25.2</td>
</tr>
<tr>
<td>Access to International Capital Markets</td>
<td>23.3</td>
<td>26.0</td>
<td>15.0</td>
<td>42.3</td>
<td>31.1</td>
<td>7.3</td>
<td>0.0</td>
</tr>
</tbody>
</table>

1/ Average values across firms in each country, except for Total Assets, which is the within-country median.
Table 3. Exchange Rate Regimes and Measures of Exchange Rate Flexibility Within Regimes

<table>
<thead>
<tr>
<th>Country</th>
<th>Period</th>
<th>De Facto Regime (Coarse Classification, IMF)</th>
<th>Fear of Floating Indicator 3/</th>
<th>De Facto Flexibility Index 4/</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>1994-2001</td>
<td>Currency Board Arrangement</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td></td>
<td>2002-2005</td>
<td>Managed Floating</td>
<td>0.28</td>
<td>0.96</td>
</tr>
<tr>
<td>Brazil 1/</td>
<td>1994-1998</td>
<td>Crawling Peg</td>
<td>0.01</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>1999-2005</td>
<td>Independently Floating</td>
<td>0.97</td>
<td>0.52</td>
</tr>
<tr>
<td>Chile</td>
<td>1994-1998</td>
<td>Crawling Band</td>
<td>0.12</td>
<td>0.08</td>
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<tr>
<td></td>
<td>1999-2005</td>
<td>Independently Floating</td>
<td>0.45</td>
<td>0.25</td>
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<tr>
<td>Colombia</td>
<td>1994-1998</td>
<td>Crawling Band</td>
<td>0.18</td>
<td>0.48</td>
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<td></td>
<td>1999-2003</td>
<td>Independently Floating</td>
<td>0.14</td>
<td>0.61</td>
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<tr>
<td></td>
<td>2004-2005</td>
<td>Managed Floating</td>
<td>0.24</td>
<td>0.30</td>
</tr>
<tr>
<td>Mexico 2/</td>
<td>1990-1994</td>
<td>Crawling Band / Crawling Peg</td>
<td>0.00</td>
<td>0.06</td>
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<td></td>
<td>1995-2005</td>
<td>Independently Floating</td>
<td>0.08</td>
<td>0.32</td>
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<tr>
<td>Peru</td>
<td>1994-1998</td>
<td>Managed Floating</td>
<td>0.02</td>
<td>0.06</td>
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<tr>
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<td>1999-2001</td>
<td>Independently Floating</td>
<td>0.05</td>
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<td></td>
<td>2002-2005</td>
<td>Managed Floating</td>
<td>0.07</td>
<td>0.06</td>
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<tr>
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<td>1994-2001</td>
<td>Crawling Band</td>
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<td></td>
<td>2002-2004</td>
<td>Independently Floating</td>
<td>0.05</td>
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<td></td>
<td>2005</td>
<td>Managed Floating</td>
<td>0.17</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Sources: Author's calculations based on classification described in Bubula and Otker-Robe (2002) and updated by IMF staff through mid-2006.

1/ Crawling peg for Brazil starting from July 1994.
Table 4: Cross-Country Determinants of the Currency Composition of Firm Liabilities: 1992-2005

This table reports the pooled Tobit estimates of equation (1) in the text, for the period 1992-2005. Coefficient estimates denote marginal effects on dependent variable, evaluated at mean values of independent variables, except where noted. For dummy variables, they represent the effect of discrete changes from 0 to 1. The key independent variable is the interaction term, and the marginal effect is calculated as in Appendix 1. A constant and a full set of country, year and economic sector-specific dummy variables are also included but not reported. All explanatory variables except export to sales are one-period lagged. Standard errors adjusted for clustering by country-year are reported in parentheses. Asterisks (***, **, *) denote significance in a two-tailed test at the 1%, 5%, and 10% level, respectively, against a null of 0.0. For detailed sources and definition of variables, see Appendix.

### Dependent Variable: Total Foreign-Currency Denominated Liabilities over Total Liabilities

<table>
<thead>
<tr>
<th>Independent Variables</th>
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<th>(3)</th>
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<tr>
<td><strong>Main Effects</strong></td>
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<tr>
<td>Exports to Sales ratio</td>
<td>0.26</td>
<td>0.41</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td>(0.03)***</td>
<td>(0.04)***</td>
<td>(0.03)***</td>
</tr>
<tr>
<td>Total Foreign Currency Assets over Total Assets</td>
<td>0.46</td>
<td></td>
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<tr>
<td></td>
<td>(0.00)***</td>
<td></td>
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<tr>
<td>Flexible Regime Dummy</td>
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<td>0.01</td>
<td>-0.09</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.02)**</td>
<td>(0.02)***</td>
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<tr>
<td><strong>Interaction Effect</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export to Sales x Flex Regime</td>
<td>0.14</td>
<td>0.16</td>
<td>0.13</td>
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<tr>
<td></td>
<td>(0.04)***</td>
<td>(0.05)***</td>
<td>(0.06)***</td>
</tr>
<tr>
<td>Dollarization Assets x Flex Regime</td>
<td>0.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.01)***</td>
<td></td>
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<tr>
<td><strong>Controls</strong></td>
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<tr>
<td>Size_Medium</td>
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<td>0.10</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>(0.09)***</td>
<td>(0.01)***</td>
<td>(0.02)***</td>
</tr>
<tr>
<td>Size_Big</td>
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<td>0.14</td>
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<tr>
<td></td>
<td>(0.13)***</td>
<td>(0.02)***</td>
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<td></td>
<td>(0.18)***</td>
<td>(0.02)***</td>
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<td>Crisis Year Dummy</td>
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<td>(0.03)**</td>
<td>(0.02)***</td>
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<td>Economic Sector</td>
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<td>McFadden's R2</td>
<td>0.58</td>
<td>0.58</td>
<td>0.52</td>
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</table>

Source: Authors’ calculations, based on data described in Appendix.
REFERENCES


DATA APPENDIX

This section describes the definition and construction of microeconomic variables and corresponding data sources. The thrust of the information was collected from annual reports and corporate filings obtained from local stock markets, regulatory agencies and/or trade chambers in each country. Where appropriate, I complemented and cross-checked these country-specific sources with data obtained from commercial data providers Economatica and Bloomberg. This database has been assembled trying to ensure that variable definitions are uniform across countries, comparable across economies and consistent across time. Balance sheet data for Argentina, Chile, Colombia, Peru, and Uruguay comes from non-consolidated financial statements, while financial information for Brazilian and Mexican firms comes from consolidated statements.

For the purpose of the empirical implementation, we modified the original accounting data in three ways:

(i) We deflate all data to 1996 values using December-to-December changes in the consumer price index (CPI), and convert them to U.S. dollars using the market exchange rate for December of 1996.

(ii) We drop all firm/year observations if the accounting data are not self-consistent. In particular, we drop observations if dollar liabilities (assets) exceed total liabilities (assets) or if accounting variables do not accord with sign conventions.

(iii) We compute the change in total assets and construct a Z-score using the sample mean and standard deviation. We drop firm/year observations that have absolute value of Z>5.

Definition of Variables

Total assets. Sum of total current assets, long-term receivables, investment in unconsolidated subsidiaries, other investments, net property, plant and equipment, and other assets (Balance Sheet).

Total liabilities. Book value of total liabilities (Balance Sheet).

Foreign currency liabilities. Liabilities (bank debt, corporate debt and/or trade credit) denominated or indexed to a foreign currency (in dollars or in other non-domestic currencies), issued domestically or abroad. Consistent with accounting standards in each country, items that are in foreign currency at the end of the quarter are converted to domestic currency at the contemporaneous exchange rate. (Balance Sheet Notes).

---

13 Data for Argentina and Peru builds upon a firm-level dataset compiled by the Research Department of the Inter-American Development Bank, as indicated below.
**Short-term foreign currency liabilities.** Foreign currency liabilities coming due in the upcoming fiscal year. This measure includes foreign currency denominated debt issued at short maturities as well as long term issues whose terminal date falls in the next year (Balance Sheet Notes).

**Foreign currency assets.** Assets denominated or indexed to a foreign currency (government bonds indexed to the exchange rate or bank deposits, for example) converted into local currency using end of period exchange rate (Balance Sheet Notes).

**Exports.** Total sales in foreign markets. (Income Statement, when available or Customs data in each country).

**Sales.** Revenues from main operating activities (Income Statement).

**Asset Tangibility.** Total assets minus current assets standardized by total assets.

**Leverage.** Total liabilities as a share of total assets in the balance sheet.

**Size Dummies.** To capture firm size, we sort the sample of firms into thirds based on the book value of firm's total assets each year. Separate dummies are used for large-sized (top-third) and medium-sized (middle-third) firms. Small-sized firms is the excluded category.

**Industry Dummies.** Is the industry in which the firm has its main operations, according to the one-digit ISIC rev 2 classification. Dummy variables are set to a value of 1 if the first digit of the primary SIC code corresponds to the respective dummy variable.

**Access.** A dummy variable that takes on a value of one starting the year the firms accessed international equity markets (by cross-listing shares in foreign stock markets) and/or tapped foreign credit markets (by issuing bonds or taking loans abroad).

**Sources**

The country-specific sources are as follows:

**Argentina.** Balance sheet information up to 2001 comes from Galiani, Levy-Yeyati and Schargrodsky (2003), and from financial statements compiled from the Buenos Aires Stock Exchange. From 2002 onwards, data is from Economatica. Data on exports is matched using customs data from ExiNet (NOSIS).

**Brazil.** Data is compiled from corporate filings submitted to BOVESPA, and complemented with data from Economatica and Bloomberg for 2003-2005. Export data comes from Notes to Financial Statements, Bloomberg and LAFIS.

**Chile.** Balance sheet information is obtained from the Ficha Estadistica Codificada Uniforme (FECUS) database and notes to financial statements obtained from the SuperValores of Chile. Data on exports comes from ProChile.

**Colombia.** Balance sheet information and export data obtained from SuperFinanciera de Colombia.
Mexico. Balance sheet information and export data obtained from Mexican Stock Exchange.

Peru. Balance sheet information comes from Comision Nacional de Valores (CONASEV) and is partially based on Carranza, Cayo, and Galdón-Sanchez (2003). Data on exports comes from COMEXPERU.

Uruguay. Balance sheet information was compiled from the Bolsa de Valores de Montevideo and Auditoria General de la Nacion. Export data obtained from ExiNet (NOSIS).

For access to equity markets, we used Bank of New York data to identify those firms whose shares listed in a foreign stock exchange in the form of American Depositary Receipts (ADRs). Firm-level issuance data on private bonds and syndicated loans was extracted from Dealogic Bondware and Loanware. Firms’ main sector of operations was identified using Economatica and Lexis Nexis.
This section presents a semi-parametric procedure to analyze the effects of changes in
the exchange rate regimes on firm-level distribution of balance sheet currency mismatches of
Latin American firms. The effect is estimated by applying kernel density methods to
appropriately “re-weighted” samples. The procedure provides a visually clear representation
of where in the density of currency mismatches the regime change has exerted the greatest
impact.

The intuition of the Di Nardo et al. (henceforth, DFL) approach is that a density of
any distribution can be viewed as a weighted average of densities conditional on
characteristics, where the weights assigned to each conditional density is proportionate to the
share of the population with that set of characteristics. Distributional changes over time can
then be viewed as the outcome of two distinct forces: changes in the group weights brought
about by changes in the “characteristics composition” of the population and changes in the
conditional densities.

Formally, we can consider each observation of a firm \(i\) as a vector \((y,x,t)\) consisting of
a currency mismatch \((y)\), a vector of firm characteristics \((x)\) and a date \((t)\). This vector
belongs to a joint distribution \(F(y,x,t)\) of mismatches, characteristics and dates. Note that the
observed densities of currency mismatches, \(y\), in periods \(t_0\) ("pre-floating") and \(t_1\) ("post-
floating") may be written as:

\[
 f(y \mid t = t_0) = \int_{x \in \Omega} dF(y,x \mid t = t_0) = \int_{x \in \Omega} g(y \mid x, t = t_0) h(x \mid t = t_0) \, dx
\]

(A.I.1)

and

\[
 f(y \mid t = t_1) = \int_{x \in \Omega} dF(y,x \mid t = t_1) = \int_{x \in \Omega} g(y \mid x, t = t_1) h(x \mid t = t_1) \, dx
\]

(A.I.2)

respectively, where \(g(y \mid x, .)\) is the density of currency mismatches \((y)\) given the observable
attributes of the firm (the vector \(x\)) and the year \(t\); \(h(x \mid .)\) is the density of characteristics of
the firm given a certain year and \(t\) is a random variable describing the year (or period) from
which a given firm in the pooled dataset of observations from both periods is drawn. Finally,
\(\Omega\) is the domain of definition of individual characteristics.

It is helpful to think of \(g(y \mid x, .)\) as the function that translates observable attributes
of the firm into currency mismatches. Were this a traditional parametric regression of income
on individual firm’s “endowments” for a given year \(t\), then the density of currency
mismatches, \(f(y \mid t)\), would be analogous to the dependent variables, a measure of currency
mismatches; \(h(x \mid t)\) would be analogous to the observed explanatory variables; and
\(g(y \mid x,t)\) would be analogous to the estimated coefficients (elasticities or semi-elasticities of
independent variables in a regression-based framework).
First, suppose that we are interested in how the density of balance sheet currency mismatches in period $t_1$ would differ, were the observables as they were in period $t_0$. That is, what if firms’ characteristics were those that obtained in period $t_0$ (“pre-floating”) instead of the actual $t_1$ (“post-floating”) firm attributes?

This counterfactual, which we can denote $f_{h_{i t_1 \rightarrow t_0}}|D_{t_0}$, is defined by:

$$f_{h_{i t_1 \rightarrow t_0}}|D_{t_0} \equiv \int g(m \mid x, t = t_1) h(x \mid t = t_0) \, dx$$  \hspace{1cm} (A.I.3)

Notationally, the subscript $h$ indicates that it is the density of attributes, $h(x)$, that is being changed from an actual to a counter-factual density. The superscript “$t_1 \rightarrow t_0$” indicates that in this counterfactual we are going to substitute the actual $h(x)$ from period $t_1$ and instead use the density from period $t_0$. The entire exercise uses the actual data $D$ from period $t_1$, hence the conditioning on $D_{t_1}$.

The fundamental insight from DFL is that this counterfactual is easy to implement using a re-weighting idea. We illustrate the re-weighting by first noting that Bayes’ Axiom implies that:

$$\frac{h(x \mid t = t_0)}{h(x \mid t = t_1)} = \frac{P(t = t_1)}{1 - P(t = t_1)} \equiv \tau_{h_{i t_1 \rightarrow t_0}}(x)$$  \hspace{1cm} (A.I.4)

In words, $\tau_{h_{i t_1 \rightarrow t_0}}(x)$ is just the ratio of the unconditional odds to the conditional odds.

We can rewrite the object of interest as:

$$f_{h_{i t_1 \rightarrow t_0}}|D_{t_0} \equiv \int g(m \mid x, t = t_1) h(x \mid t = t_0) \, dx = \int g(m \mid x, t = t_1) h(x \mid t = t_1) \, dx = \frac{P(t = t_1)}{1 - P(t = t_1)} \equiv \tau_{h_{i t_1 \rightarrow t_0}}(x)$$  \hspace{1cm} (A.I.5)

The counterfactual density (A.I.5) is identical to (A.I.2) except for the re-weighting function. So that once an estimate of this function is obtained, the counterfactual density can be estimated by weighting kernel methods. That is, for the sub-sample of observations for period $t_1$, we use a weighted kernel density routine to estimate the counter-factual density:

$$\hat{f}_{h_{i t_1 \rightarrow t_0}}(y \mid t = t_1) = \frac{1}{b} \sum_{j=1}^{b} K\left(\frac{Y_i - y}{b}\right) \hat{\tau}_{i, h_{i t_1 \rightarrow t_0}}(x)$$  \hspace{1cm} (A.I.6)
where $K[]$ is the kernel function, $b$ is a bandwidth parameter and $n$ is the number of observations from period $t_1$. It differs from the (A.I.2) only by the weight $\tau_h^{t_1\rightarrow t_0}(x)$. Consequently, if we could estimate the weighting function $\tau_h^{t_1\rightarrow t_0}(x)$ then we could compute the counterfactual (A.I.3) easily using a weighted density estimate of income (with a density estimation technique of our choosing).

Considering the structure of the weighting function, we realize that the predicted probabilities $\hat{P}(t = t_1 | X)$ may be obtained from a binary choice model (such as a binary logit) that uses individual attributes $X$ to predict the probability of an observation coming from year $t_1$ in the pooled data set of observations for both years (or periods). The predicted probability $\hat{P}(t = t_1)$ may be obtained from the relative frequency, and we may re-weight the data using a plug-in version of (A.I.4). That is, the latter is the unconditional probability than an observation is in period $t_1$ (the weighted share of the pooled sample that is in period $t_1$).

Intuitively, the method re-weights the empirical distribution of the outcome variable using weights that equalize the empirical distributions of the explanatory variables. In other words, each observation in the post floating sample is re-weighted so as to give the same distribution of individual characteristics as in the pre-floating sample. One advantage of this semi-parametric approach is that it does not require assumptions on the functional form of the relationship between firm-characteristics and stock currency mismatches.
The magnitude of the interaction effect in Tobit models does not equal the marginal effect of the interaction term, can be of opposite sign, and its statistical significance is not calculated by standard software or derived in the literature. This section presents the correct way to estimate the magnitude of the interaction effect in nonlinear Tobit models, and the expressions for the marginal effects of the variables involved in the interaction term.

Consider the Tobit panel data model:

\[ y_{it} = \max(0, x_{it}^\beta + u_{it}), \quad t = 1, 2, \ldots, T \]

\[ u_{it} \mid x_{it} \approx \text{Normal}(0, \sigma^2) \]

To simplify the derivations below, we re-express the index \( x^\beta \) in terms of the relevant interacting variables (\( x_1 \), export to sales, and \( x_2 \), the flexible regime dummy), their associated coefficients \( \beta_1 \) and \( \beta_2 \) and the rest of the controls captured in matrix \( X \) and vector of coefficients \( \beta \):

\[ y^* = x^\beta + u = \beta_1 x_1 + \beta_2 x_2 + X \beta + u \]

To find an explicit expression for \( E(y \mid x) \), note that:

\[
E(y \mid x) = P(y = 0 \mid x)0 + P(y > 0 \mid x) E(y \mid x, y > 0)
\]

\[
= P(y > 0 \mid x) E(y \mid x, y > 0)
\]

Using the expressions derived in Wooldridge (2005):

\[
E(y \mid x) = P(y = 0 \mid x)0 + P(y > 0 \mid x) E(y \mid x, y > 0)
\]

\[
= \Phi\left( \frac{x^\beta}{\sigma} \right) x^\beta + \sigma \left[ \frac{\phi\left( \frac{x^\beta}{\sigma} \right) x^\beta}{\Phi\left( \frac{x^\beta}{\sigma} \right)} \right] = \Phi\left( \frac{x^\beta}{\sigma} \right) x^\beta + \sigma \phi\left( \frac{x^\beta}{\sigma} \right)
\]

(A.II.1)

Marginal Effects of Variables in Levels and Interaction Term on \( E(y \mid x) \)

The marginal effect on the conditional expectation of debt dollarization of a 1% change in the export to sales ratio (\( \gamma_1 \)), is computed in the Tables as:
\[
\gamma_1 = \frac{\partial E(y \mid x)}{\partial x_1} = \frac{\partial P(y > 0 \mid x)}{\partial x_1} \cdot E(y \mid x, y > 0) + P(y > 0 \mid x) \frac{\partial E(y \mid x, y > 0)}{\partial x_1}
\]

\[
= \left( \frac{\beta_1 + \beta_{12} x_2}{\sigma} \right) \left( \frac{x \beta}{\sigma} \right) + \sigma \left[ \frac{\phi \left( \frac{x \beta}{\sigma} \right)}{\Phi \left( \frac{x \beta}{\sigma} \right)} \right] + \Phi \left( \frac{x \beta}{\sigma} \right) \left( \beta_1 + \beta_{12} x_2 \right) - 1 - \frac{\phi \left( \frac{x \beta}{\sigma} \right)}{\Phi \left( \frac{x \beta}{\sigma} \right)} - \frac{\phi \left( \frac{x \beta}{\sigma} \right)^2}{\Phi \left( \frac{x \beta}{\sigma} \right)}
\]

\[
\left( \beta_1 + \beta_{12} x_2 \right) \left( \frac{x \beta}{\sigma} \right) \phi \left( \frac{x \beta}{\sigma} \right) - \left( \beta_1 + \beta_{12} x_2 \right) \left[ \frac{\phi \left( \frac{x \beta}{\sigma} \right)^2}{\Phi \left( \frac{x \beta}{\sigma} \right)} \right]
\]

After some cancellations:

\[
\gamma_1 = \frac{\partial E(y \mid x)}{\partial x_1} = \Phi \left( \frac{x \beta}{\sigma} \right) \left( \beta_1 + \beta_{12} x_2 \right)
\]

(A.II.2)

The marginal effect of the dummy variable Flex, \( \gamma_2 \), is given by:

\[
\gamma_2 = \frac{\Delta \left( \Phi \left( \frac{x \beta}{\sigma} \right) x + \phi \left( \frac{x \beta}{\sigma} \right) x_2 \right)}{\Delta x_2} = \Phi \left( \frac{\beta_1 x_1 + \beta_2 + \beta_{12} x_1 + x B}{\sigma} \right) \left( \beta_1 x_1 + \beta_2 + \beta_{12} x_1 + x B \right) + \Phi \left( \frac{\beta_1 x_1 + x B}{\sigma} \right) \left( \beta_1 x_1 + x B \right) - \Phi \left( \frac{\beta_1 x_1 + X B}{\sigma} \right) \left( \beta_1 x_1 + X B \right) - \Phi \left( \frac{\beta_1 x_1 + x B}{\sigma} \right) \left( \beta_1 x_1 + x B \right) - \Phi \left( \frac{\beta_1 x_1 + X B}{\sigma} \right) \left( \beta_1 x_1 + X B \right) - \Phi \left( \frac{\beta_1 x_1 + x B}{\sigma} \right) \left( \beta_1 x_1 + x B \right)
\]

(A.II.3)

\( \gamma_2 \) measures the marginal effect on the conditional expectation of dollar debt ratios of discrete changes from 0 to 1 (fix to float).
Finally, the marginal effect of the interaction term, \( \gamma_3 \), is given by:

\[
\gamma_3 = \frac{\Delta}{\Delta x_2} \left[ \frac{\partial E(y \mid x)}{\partial x_1} \right] = \Phi \left( \frac{\beta_1 x_1 + \beta_2 + \beta_{12} x_1 + XB}{\sigma} \right) \left( \beta_1 + \beta_{12} \right) - \Phi \left( \frac{\beta_1 x_1 + XB}{\sigma} \right) \left( \beta_1 \right) \\
\text{(A.II.4)}
\]
For firms in Indonesia, unhedged foreign currency liabilities accounted for 65 percent of the consumer good sector and 95 percent of the agricultural, mining, and financial sectors. What followed after for both Mexico and East Asia was an unprecedented decline in economic growth. In comparison, a flexible exchange rate regime with is thought to have the opposite effect in that it provides incentives for more cautious management of currency exposure, thereby reducing the financial risks associated with currency mismatches. Policies that reduce currency mismatch may be key to reduce a country’s vulnerability to future crises. Secondly, currency mismatches are thought to render monetary policies ineffective in the event of a crisis. The key constraint on allowing exchange rate considerations to influence interest rate decisions is that such external considerations not put in jeopardy the primary objective of monetary policy: the achievement of a publicly announced inflation target.1 Second, I call the regime “floating” to signify that the authorities would have no publicly

They examine the currency composition of corporate debt for firms listed on the Mexican Stock Exchange during the 1992-2000 period. By now, we have a set of theoretical models that demonstrates how the combination of large unhedged financial liabilities denominated in foreign currency (i.e., a large currency mismatch) and a large depreciation can play havoc with balance sheets, lead to a fall

An example flexible exchange rate critics use to demonstrate that depreciation increase price inflation, rather than boosting exports and reducing imports, is that between 1985 and 1988, when the US dollar decreased in value by 40 percent, that depreciation did not correct the US trade deficit.