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Abstract

I explore an empirically robust but previously undocumented association between the foreign exchange reserves accumulated by central banks of emerging market economies and dollar-denominated debt held in the balance sheets of non financial sector firms. Borrowing in dollars can have damaging effects on corporate balance sheets in the event of exchange rate depreciation. However, firms may discount such risk because of the implicit insurance provided by the central banks ex-ante reserve accumulation: in the event of a currency depreciation, firms may expect the central bank to stabilize the exchange rate using its stock of reserves. Using a novel firm-level balance sheet database, I investigate this possibility for close to 1500 firms in six of the largest Latin American economies, Argentina, Brazil, Chile, Colombia, Mexico and Peru. Results suggest that over the sample period, 1995-2007, an increase in the level of reserves is statistically and economically associated with an increase in the dollar borrowing of non financial sector firms of these economies. This could hint at a possible paradox: a higher level of reserves need not necessarily signify an economy that is more resilient to shocks. While reserve accumulation enables governments to weather macroeconomic risks arising from sudden stops in international capital flows, it can also increase the vulnerability of the corporate sector to currency risks by distorting incentives. Thus central banks, while formulating their foreign exchange intervention policies, may need to take into consideration the impact of the resultant reserve stockpiling on the private sector.

Keywords: Foreign exchange reserves, foreign currency denominated debt, exchange rate regimes, currency crisis

JEL Code: F3; F4

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ABSTRACT

I explore an empirically robust but previously undocumented association between the foreign exchange reserves accumulated by central banks of emerging market economies and dollar-denominated debt held in the balance sheets of non financial sector firms. Borrowing in dollars can have damaging effects on corporate balance sheets in the event of exchange rate depreciation. However, firms may discount such risk because of the implicit insurance provided by the central banks ex-ante reserve accumulation: in the event of a currency depreciation, firms may expect the central bank to stabilize the exchange rate using its stock of reserves. Using a novel firm-level balance sheet database, I investigate this possibility for close to 1500 firms in six of the largest Latin American economies, Argentina, Brazil, Chile, Colombia, Mexico and Peru. Results suggest that over the sample period, 1995-2007, an increase in the level of reserves is statistically and economically associated with an increase in the dollar borrowing of non financial sector firms of these economies. This could hint at a possible paradox: a higher level of reserves need not necessarily signify an economy that is more resilient to shocks. While reserve accumulation enables governments to weather macroeconomic risks arising from sudden stops in international capital flows, it can also increase the vulnerability of the corporate sector to currency risks by distorting incentives. Thus central banks, while formulating their foreign exchange intervention policies, may need to take into consideration the impact of the resultant reserve stockpiling on the private sector.

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1 Introduction

One of the most significant economic developments of the last two decades has been the widespread liberalization of international financial markets. The resultant explosion of cross-border capital flows has also been associated with capital flow reversals, as witnessed during the disruptive currency crises in Mexico, Thailand, Indonesia, Russia, Brazil, Turkey and Argentina, in the 1990s and early 2000s. Several analysts have suggested that the spate of financial crises in the emerging market economies (henceforth EMEs) were of a new kind, reflecting fragilities in the balance sheets of firms and banks.[2] One source of balance-sheet fragility often emphasized is that of foreign currency denominated debt held in the corporate sector in EMEs.[3] On one hand, interest rates on dollar debt are lower than on domestic currency debt.[4] On the other hand, dollar debt exposes firms to a currency mismatch between foreign currency liabilities and domestic currency revenues, thereby increasing the vulnerabilities of firms to exchange rate depreciations.[5]

Over the past couple of decades, foreign exchange reserves of EMEs have exhibited a staggering increase. Reserves are accumulated by the central banks of EMEs to provide insurance against financial instability triggered by potential sudden-stops in international capital flows. A large stockpile of reserve assets can act as a public demonstration of a commitment to exchange rate stability.[6] Such country-level insurance in turn may induce dollar-debt issuing corporates in EMEs to perceive that they are implicitly insured against currency fluctuations. Consequently corporate firms of EMEs may ignore the risk inherent in issuing dollar-debt arising from a currency depreciation. In this paper, using balance sheet information for close to 1500 firms in six largest Latin American economies (Argentina, Brazil, Chile, Colombia, Mexico and Peru) over the period 1995-2007, we investigate how the corporate dollar borrowing behavior may be affected by the foreign exchange reserve accumulation of central banks in EMEs. In particular, we explore the following question: What could be the potential impact of international reserves accumulated by the central banks of EMEs on the foreign currency debt used by the non-financial sector firms of these economies?

Many observers argue that the large buildup of unhedged foreign currency liabilities in the corporate sector of East Asian and Latin American (LATAM) economies is caused mainly by fixed or pegged exchange rate regimes. Other authors, however, have claimed that the problem of private

[2] See, for example, Dornbusch (2001) and Krugman (1999).

[3] As noted in Caballero and Krishnamurthy (2003), while observers continue to debate the causes underlying the crises, one factor they converge on is that contracting external debt in foreign currency as opposed to domestic currency, by domestic firms, creates balance sheet mismatches that lead to bankruptcies.

[4] Henceforth, dollar debt and foreign currency debt to be used interchangeably.

[5] The role played by currency mismatch in corporate balance sheets in particular, has been theoretically explored, among others by, Chang and Velasco (1999), Krugman (1999b), Aghion, Bacchetta and Banerjee (2001a, b), Schneider and Tornell (2001) and Caballero and Krishnamurthy (2003). Hausman, Panizza and Stein (2001) also provide evidence that most contracts between lenders and borrowers in emerging markets take the form of dollar debt.

[6] See Federal Reserve Bank of NY (October 2004).

sector dollar indebtedness extends across EMEs, regardless of exchange rate regimes.[7] Although the debate among academicians and policy makers has been intense, hardly any consensus has been reached on the issue of firm-level dollar borrowing in EMEs and the determinants thereof. While during a fixed exchange rate regime, firms have a higher incentive to borrow in dollars, as the economy shifts to a flexible regime, ideally dollar debt should decrease. However, the central bank of the economy may exhibit a lower credibility of maintaining a regime of float. In other words, the central bank may use its stock of foreign exchange reserves and actively intervene in the foreign exchange market to stabilize the exchange rate. [8] Exchange rate stabilization helps avoid damaging effects of a major currency depreciation on the balance sheets of financial and non-financial sectors of the economy. Foreign exchange reserves of EMEs have increased dramatically despite the shift away from fixed exchange rates (see, for example, Aizenman and Lee, 2007 and Aizenman, 2007). Such ex-ante reserve accumulation may provide an implicit guarantee to the firms who in turn may consider themselves insulated against the currency risk associated with incurring dollar debts and continue to borrow in dollars. [9] In other words, as a result of this 'false' perception of insurance or security firms' share of liability dollarization (share of dollar denominated debt in total debt) may go up as central bank's stock of reserves increases.

Our paper makes two important contributions to our understanding of the external financing choices of EME firms. Firstly, the association between central bank's foreign exchange reserves and EME firms' foreign currency denominated debt has not been empirically explored before in the relevant literature. (Wei and Tong) Several studies, mostly theoretical, endogenize the currency composition of private sector debt. According to one approach, foreign currency debt arises in the banking sector because of the moral hazard created by systemic bailout guarantees doled out by the central bank as a lender of last resort.[10] Dooley (2000) points out that fixing the exchange rate offers free insurance to firms that borrow in dollars, thereby encouraging dollar borrowing and creating moral hazard. Distortion of private sector incentives owing to implicit free insurance is also behind the government-bailout-type models, such as in Burnside, Eichenbaum and Rebelo (2001). In their view, stabilizing the exchange rate creates moral hazard. It conveys the impression that the government is socializing the exchange risk, thereby encouraging the private sector to accumulate unhedged exposures. What has largely been neglected in the relevant literature is the possibility

[7]See, for example, the evidence in Hausman et al (2001) of the prevalence of dollar denominated debt in economies with fixed as well as flexible exchange rate systems. They argue that this problem arises due to the fundamental inability of EMEs to borrow abroad in their own currencies, a problem they refer to as the 'original sin'.

[8]Hausmann et al. (2001) argue that given the persistence of dollar liabilities in the private sector, central banks will float, but with a life jacket, i.e. they let the exchange rate float over some range but aggressively intervene if a certain threshold is reached.

[9]See, for example, Chamon and Hausmann (2005) who argue that if every atomistic firm expects all other firms to borrow in dollars, then it will also expect the central bank to stabilize the exchange rate at the expense of higher volatility of the interest rate (and hence hold higher reserves, as a precaution against a mass bankruptcy). Consequently, the firm itself will end up borrowing in dollars as well.

[10]See, for example, McKinnon and Pill (1998); Burnside, Eichenbaum and Rebelo (2001) and Schneider and Tornell (2001).

that recourse to self-insurance or precautionary policies by central banks may have diminished the incentives for firms in EMEs to reduce the extent of their dollar borrowing. The reserves-literature does not explore impact of central banks' reserve hoarding policies on corporate risk-taking behavior. The currency mismatch literature looks into the the dynamics of dollar-debt but not the response of corporates to reserve accumulation and neither does the corporate nance literature. The line of thinking expressed in our paper can also be linked to the famous 'fear of floating' hypothesis as proposed by Calvo and Reinhart (2002). (cite papers that for each strand of lit aka tong and wei)

The second contribution of our paper is the use of a novel firm-level balance-sheet database to explore the possible association between central bank's reserves and EME firms' dollar debt.[11] Most of the existing work in the relevant literature remains theoretical, primarily owing to dearth of appropriate data on firm-level dollar denominated assets and liabilities. Yet, this issue in essence remains one that merits careful examination of suitable data. According to Krugman (1999), there exists a sort of external diseconomy to borrowing in foreign currencies. The decision by an individual firm to borrow in dollars imposes costs on the rest of the economy. This is because such borrowing magnifies the real-exchange-rate impact of adverse shocks, and also because real depreciation interacts with capital-market imperfections to cause economic distress. Hence the issues to be considered have crucial implications for academic researchers and policy makers, alike.

At the macro level there is a substantial literature documenting the high levels of foreign currency debt in EMEs.[12] However, EME firm-level studies on dollar debt have mostly documented the impact of currency depreciations on firms' investments or net worth in the presence of dollar-debt, to understand whether depreciations have a contractionary impact on these firms.[13] There is much less empirical work on the determinants of dollar debt at the micro level. Schmukler and Vesperoni (2001) analyze the effect of financial liberalization on firms' financing choices during the 1980s and 1990s, for a sample of seven emerging economies (LATAM and East Asian). However in absence of data on the currency composition of firms' assets and liabilities, they are unable to examine the factors influencing the use of foreign currency denominated debt, by the firms of these economies. Our paper sheds light on the effects of reserve accumulation and other firm-level and country-level determinants, on firm-level dollar borrowing. Our focus on corporate balance sheet data is useful in understanding the effect of country-level insurance on dollar borrowing from the point of view of the firms and also allows us to exploit the heterogeneity across firms in our sample.

[11] Cite Herman's paper .... In 2002, the Research Department of the Inter-American Development Bank (IDB) spearheaded a LATAM research project called 'Debt Composition and Balance Sheet effects of Exchange Rate Fluctuations in Latin America: A firm-level Analysis'. One of the main goals of this project was to collect firm-level data on liability composition for a large sample of LATAM companies. As a result of this project, new firm-level information was collected by the IDB for major LATAM economies such as Argentina, Brazil, Chile, Colombia, Mexico and Peru (Kamil, 2004). The database is henceforth referred to as the IDB database.

[12] See, for example, Arteta (2002), Ize and Yeyati (2003), Cespedes et al (2004).

[13] See, for example, Bleakley and Cowan (2008). Cite more papers...Also cite Shang Jin and Bordo

Regression analyses conducted on the panel data-set containing all firms of all six economies yield several key findings. Increase in foreign exchange reserves is found to have a positive impact on the share of dollar debt held in the non-financial sector firms of these economies. This effect is significant even after controlling for firm-level characteristics as well as macroeconomic factors such as exchange rate volatility and differential borrowing cost between domestic and foreign economies. Secondly, firm specific features such as share of exports in sales, firm size, foreign ownership and access to international equity markets, are found to have significant impact on firm dollar borrowing, across all economies in our sample, much more than the country-level control variables. Our results also survive a series of robustness checks.

2 Data and Methodology

2.1 Empirical Model

We use annual data for the non-financial sector firms of six LATAM economies namely, Argentina, Brazil, Chile, Colombia, Mexico, and Peru to assess the effect reserve accumulation on corporate dollar debt in EMEs. Our analysis covers the time period from 1995 to 2007, chosen primarily on the basis of firm-level data availability. Our baseline specification is given by the following regression model:

$$D_{ict} = \beta_0 + \beta_1 FXR_{ct-1} + X'_{ict}\beta_2 + Z'_{ct}\beta_3 + \gamma_{ct} + \epsilon_{ict}, \tag{1}$$

(i=1..N;c=1..K;t=1..T) where i denotes firms (N=1573), c denotes countries (K = 6), and t denotes time (T = 16). D_{ict} is the ratio of dollar liabilities to total liabilities of firm i in country c at time t, FXR_{ct} is the ratio of reserves to GDP of country c at time t, X'_{ict} is a vector of firm-level control variables, Z'_{ct} denotes a vector of country-level control variables and γ_{ct} are country-year dummies. According to our hypothesis, the implicit guarantee provided by ex-ante reserves accumulation may result in firms increasing the share of dollar-denominated liabilities in total liabilities. Thus, we would expect β_1 to have a positive sign in our estimations.

One problem with the baseline specification is that a large fraction of firms have zero dollar debt every year (roughly 23 percent in total). In other words, observations for dollar debt are *left-censored at 0*. In order to account for this kind of a corner solution in the choice problem of firms, we estimate equation (1) using a Tobit (censored) model for limited dependent variable.[14] The structural equation of our Tobit model is as follows:

$$D^*_{ict} = \beta_0 + \beta_1 FXR_{ct-1} + X'_{ict}\beta_2 + Z'_{ct}\beta_3 + \gamma_{ct} + \epsilon_{ict} \tag{2}$$

[14]Fixed effects regressions run on a panel data set of all firms of all 6 countries in the sample are reported in Table A1 in the Appendix. For further details on the Tobit model, see Technical Appendix in section (6.2)

where D^*_{ict} is a latent variable observed for values greater than 0. Then observed D_{ict} is defined by the following equations:

$$D_{ict} = D^*_{ict} \; if \; D^*_{ict} > 0 \tag{3}$$

$$D_{ict} = 0 \; if \; D^*_{ict} \leq 0 \tag{4}$$

Accordingly, the structure of our Tobit model would be:

$$D_{ict} = \quad D^*_{ict} = \beta_0 + \beta_1 FXR_{ct-1} + X'_{ict}\beta_2 + Z'_{ct}\beta_3 + \gamma_{ct} + \epsilon_{ict} \; if \; RHS > 0 \tag{5}$$

$$D_{ict} = \qquad\qquad 0 \; otherwise, \tag{6}$$

where the residuals are *iid* and normally distributed with mean 0 and variance σ^2.[15]

Our dependent variable is firm-level dollar debt normalized by total debt to facilitate comparison across heterogenous firms with varying degrees of leverage. Later on we also estimate using equation (1) using an alternative measure of firms' liability dollarization. The explanatory variables can be grouped into two main categories: (i) firm-level microeconomic variables, and (ii) country-level macroeconomic indicators. The variables in the first category focus on key characteristics of firms. These variables have mostly been identified by the corporate finance literature as important factors influencing firm financing choices.[16] The group of firm-level variables consists of the ratio of exports to sales for each firm, firm size (proxied by the natural logarithm of total assets of each firm expressed in US dollars), foreign ownership dummy variable that takes a value 1 if the firm in question is foreign-owned, and access to international equity markets, captured by a dummy variable that takes the value 1 from the year that a given firm starts trading (or raising capital) in a foreign equity market, and 0 otherwise.

The second category comprises country-level macroeconomic variables that may affect firms' dollar borrowing. This includes international reserves to GDP ratio of each country, which is the focal point of our analysis, volatility of real exchange rate (measured using the annual standard deviation of monthly real exchange rates) interacted with two dummies respectively representing depreciation and appreciation of the exchange rate, differential borrowing cost measured using the difference between lending rates of each country and the LIBOR of similar duration and financial openness measured by the ratio of foreign assets and liabilities to GDP. We also incorporate a dummy variable, crisis that takes a value 1 for the years 1995 to 2002 i.e. the period during which these LATAM countries experienced a series of financial crises. [17]

[15] Since the dependent variable is censored and Tobit is a non-linear model, it is not technically feasible to use the fixed effects estimator (Hsiao, 2003). Moreover fixed effects estimator in non-linear models are inconsistent (Greene, 2002), with the exception of Logit and Poisson Models.

[16] See, for example, Booth, Demirguc-Kunt, and Maksimovic (2001), Myers (1977) and Graham and Harvey (2001).

[17] We also consider a few additional country_level explanatory variables such as political risk and a measure of financial depth of the country proxied by the M2 to GDP ratio and our results remain the same. Moreover, most

2.2 Data Sources

Data on firm-level dollar denominated debt, total debt and total assets, as well as other firm-level explanatory variables such as exports and sales of firms, and dummies indicating access to international equity markets, have been collected from the database described in Kamil (2004).[18] All publicly traded firms that are listed or have been listed in these economies stock exchanges are included, rather than only the most liquid firms or firms with the highest market capitalization, as has been common in other related cross-country studies.[19] Most of the information has been collected from annual reports and audited corporate filings obtained from local stock markets and regulatory agencies in each country. Prior to using the data we check for accounting inconsistencies. While there is no clear distinction regarding the specific currencies in which the debt is denominated, following Kamil (2004) we assume that majority of the debt is issued in US dollars.

Among the macroeconomic variables, data on international reserves as well as foreign assets and liabilities of economies has been collected from International Financial Statistics (IMF). International reserves are measured by total reserves minus gold, as reported by the IMF, for each country. Data on exchange rates have been put together from the Global Financial Database (GFD). Finally GDP data are from the World Development Indicators (WDI) and share of domestic credit in GDP is from the Financial Structure Database of the World Bank.

Tables 1 and 2 respectively report the number of firms and descriptive statistics (mean and standard deviation) of the important variables (both firm-level and country-level) used in our analysis. Table 2 Panel A reveals the extent of diversity in the average firm-level dollar debt among the economies in our sample. Average share of dollar debt in total debt of firms is reasonably different between Argentina, Mexico and Peru on one hand (more than 50 percent) and Brazil, Chile and Colombia on the other (15 percent). The overall average across all economies is 29 percent. With regard to reserves, Chile has the highest reserves to GDP ratio (19.1) followed by Peru(17.3). The evolution of the reserve to GDP ratio for each country over time as well as of the respective country's firm-level liability dollarization ratios can also be seen from Figure 1. Figure 3 shows the time-series evolution for both variables but for the pooled-sample of all six countries taken together. Figure 2 further elaborate on the distribution of firm-level liability dollarization within each country.

of the explanatory variables may themselves be affected by the share of dollar debt in firm balance sheets (such as reserves, exchange rate volatility, exports to sales ratio etc). To control for potential feedback effect, we lag all variables by 1 period as a robustness check at a later stage.

[18] The database does not include commercial banks, brokerage firms, financial groups, insurance companies and mutual funds. Capital structure of financial-sector firms is not comparable with behavior of non financial firms, due to banking regulations impacting currency mismatches on balance sheets. For other studies that have used this database, see, Galindo, Panizza and Schiantarelli (2003), Cowan, Hansen and Herrera (2004), Pratap, Lobato and Somuano (2003), Benavente, Johnson and Morande (2003) and Bonomo, Martins and Pinto (2003).

[19] See, for example, Allayanis, Brown and Klapper (2003).

3 Estimation Results

The results of the Tobit estimations on the panel data set of all firms of all six countries in our sample, based on equation (1) are presented in Table 3. These are our baseline results on the effect of reserves on firms' dollar debt and their robustness is examined in subsequent analyses. The effect of reserves to GDP ratio and firm-level control variables are reported under the Columns labeled (1) and (2). Column (3) shows the contributions of other country-level variables. The estimated coefficients reports the marginal effects on the dependent variable evaluated at mean values of independent variables.

In absence of any control variable, the coefficient estimate of the reserves to GDP ratio (*reserves/GDP*) is highly significant with a p-value less than 0.001. It has a negative impact on firm-level dollar debt to total ratio in line with our moral hazard hypothesis. Without controlling for the effects of other determinants, a decrease in reserves to gdp ratio by 1 standard deviation (or 0.06 acc. to Table 2) is associated with a higher dollar-debt ratio by 1.2 percentage points (-0.21*0.06). This effect attests to our hypothesis that a lower level of reserves i.e. a higher exposure of an economy to a potential crisis may still lead the EME firms to borrow more in dollars, possibly due to the underlying implicit guarantee of exchange rate stabilization using the reserves and resultant insulation from currency risk. Reserves to GDP ratio alone accounts for around 36% of the variation in the share of dollar denominated debt in firms' balance sheets.

All the firm-level explanatory variables are highly significant with the expected positive signs. Exports to sales ratio (*exports/sales*)is statistically significant and the sign of its estimated coefficient is in accordance with theoretical predictions. For instance, as discussed in Caballero and Krishnamurthy (2003), producers of tradable goods may be in a better position to access external financing opportunities, by virtue of their foreign currency denominated revenues. They are likely to be able to better hedge their currency exposure using their dollar denominated export earnings. Also, they may have better access to international credit markets, as they can pledge their export receivables as collateral to foreign lenders (Jeanne 2003). Hence, firms producing tradable goods may be expected to issue higher dollar debt as compared to firms in the non-tradable sectors. Hence in our case, the significant and positive coefficient of the exports to sales ratio across all specifications implies that an exporting firm is more likely to borrow in dollars as opposed to a non-exporting firm.

Firm size (*firm_size*) measured by the natural log of total assets is also positive, and statistically significant in all of the specifications in Table 3. This is consistent with the hypothesis that larger firms are likely to have more assets to pledge as collateral and hence will be able to issue more dollar debt (Allayanis, 2003). Access to international equity markets (*adr_gdr*) captured by a

dummy variable, is also significant with a positive sign indicating that foreign stock market listing enables a firm to signal its superior quality to creditors (Allayanis, 2003) and hence facilitates the issuance of dollar debt. In presence of these firm-level variables, the effect of the reserves to GDP ratio continues to remain significant and negative and in fact increases in magnitude. The adjusted R-squares estimate also goes up quite a bit.

In Column (3), we report the effects of adding exchange rate volatility interacted with a depreciation and an appreciation dummy (*ex-vol*dep* and *ex-vol*app*), ratio of private domestic credit to GDP (*domcredit/GDP*) and financial openness (*finopen*), to the baseline regression specification. Higher exchange rate volatility when interacted with the depreciation dummy implies higher currency fluctuations in the direction of currency depreciation and hence higher risk associated with issuing dollar debt–hence it should lead to a lower dollar debt to total debt ratio.[20] This is consistent with our result that exchange rate volatility has a negative sign when interacted with the depreciation dummy- however, it is not significant. On the other hand, the same exchange rate volatility variable when interacted with the appreciation dummy is positive and significant implying that firms are willing to tolerate higher volatility of the exchange rate and continue to borrow in dollars, if the exchange rate is appreciating. This too is intuitive because an appreciating exchange rate eases the dollar-debt burden of leveraged firms (just as a depreciation worsens the burden). Domestic credit to GDP ratio although negative (a higher level of domestic financial development should be associated with a lower level of dollar borrowing) is not significant, neither is financial openness.

The choice between local and foreign currency debt should be an increasing function of the benefits of each type of debt and a decreasing function of the costs of debt, as predicted by the static trade-off theory (Allayanis et al, 2003). The most obvious cost, is the difference between interest rates in the domestic and the foreign borrowing markets.Graham and Harvey (2001) find that 44 percent of firms responding to their survey report that lower foreign interest rates are 'important or very important' in the decision to use foreign debt. Thus, we hypothesize that the difference between domestic and foreign interest rates should be positively associated with the use of foreign currency denominated debt. In the absence of precise data on corporate bond spreads, we proxy the differential borrowing cost in domestic and foreign capital markets (r-r^*) using the difference between the lending rates of respective economies and LIBOR of same maturity. We also used the difference between yields on domestic sovereign bonds and US Treasury Bonds of the same maturity, with data from Datastream the Macroeconomic Databases For Emerging And Developed Markets (CEIC). Results were the same and have not been reported here for brevity but are available upon request. Our results as seen in Table xx validate our hypothesis-the differential borrowing cost vari-

[20]See, for example, Burnside et al (2001a). The depreciation dummy is constructed such that it takes a value = 1 when change in the exchange rate from last year is positive and 0 otherwise. An increase in exchange rate here means depreciation. The appreciation dummy takes a value = 1 when change in the exchange rate from last year is negative and 0 otherwise.

able does have a positive sign, however it is not significant.

The inclusion of the macroeconomic controls strengthens the impact of the reserves to GDP ratio on firm-level dollar debt though marginally. After controlling for the effects of the micro and macro determinants of dollar debt, a decrease in reserves to gdp ratio by 1 standard deviation (or 0.06 acc. to Table 2) is associated with a higher dollar-debt ratio by 1.5 percentage points (-0.25*0.06). This is non-trivial since standard deviation of dollar-debt ratio in the pooled sample is 0.31. Hence in addition to statistical significance, the effect of the reserves to GDP ratio is of practical relevance as well. Finally, firm-level control variables seem to have a better explanatory power in our estimation as opposed to the country level factors. The explanatory variables overall explain about 54 percent of the variation in firm-level dollar-debt ratios.

In addition to the ones mentioned here, a few other explanatory variables were also included in the regressions, such as the ratio of M2 to GDP to control for the depth of financial markets, and a proxy for political risk given the high degree of political instability of the LATAM economies in general. Moreover, the choice between local and foreign currency debt should be an increasing function of the benefits of each type of debt and a decreasing function of the costs of debt, as predicted by the static trade-off theory.[21] The most obvious cost, is the difference between interest rates in the domestic and the foreign borrowing markets.[22] Thus, we hypothesize that the difference between domestic and foreign interest rates should be positively associated with the use of foreign currency denominated debt. In the absence of precise data on corporate bond spreads, the differential borrowing cost in domestic and foreign capital markets (r-r^*) is proxied using the difference between the lending rates of respective economies and LIBOR of same maturity.[23] Results of these additional estimations are reported in Table A2 in the Appendix. Our results validate our hypothesis-the differential borrowing cost variable is significant with a positive sign.[24]

4 Robustness Checks

In this section we report the results of several robustness checks performed to validate the effect of central bank reserves on firm's dollar borrowing across different scenarios.

[21] See, for example, Allayanis et al (2003).

[22] Graham and Harvey (2001) find that 44 percent of firms responding to their survey report that lower foreign interest rates are 'important or very important' in the decision to use foreign debt.

[23] We also used the difference between yields on domestic sovereign bonds and US Treasury Bonds of the same maturity, with data from Datastream the Macroeconomic Databases For Emerging And Developed Markets (CEIC). Results were the same and have not been reported here for brevity but are available upon request.

[24] Full estimation results with all control variables are available upon request. We also tried incorporating differential borrowing cost proxied by the difference between sovereign bond yields of the US and LATAM economies of similar maturities-however time series data availability for the entire sample period was a major issue. We intend to deal with this later perhaps using EMBI country spreads as and when we can access the data.

4.1 Alternative Measures of International Reserves

So far we normalized international reserves by an economys GDP to facilitate comparison across economies of different sizes. While this normalization scheme is quite standard in the empirical literature on international reserves, it may understate the role of other economic variables in assessing the adequacy of international reserve holding. For instance, Obstfeld, Shambaugh and Taylor (2008) argue that a considerable share of reserve accumulation in recent years can be explained as central banks' attempt to insure against internal sources of financial instability. This implies that when a country has open financial markets and aims to stabilize the exchange rate system, it needs to hold reserves proportional to the size of its banking system, proxied by M2 or broad money supply. Thus, reserves normalized by M2 would facilitate comparison across our sample of LATAM economies that display varying sizes of their respective banking systems. To assess the robustness of the association between reserves and fir-level dollar debt to an alternative method of normalizing international reserves, we re-estimate equation (1) using the ratio of reserves to M2 as our primary independent variable. The estimation results are presented in Table 4.

The effect of reserves is robust to the alternative normalization. It is negative and statistically signicant across most of the specifications, though with a p-value less than 0.005. Also its estimated coefficient is now much smaller than before (-0.020 as opposed to -0.248 in Table 3). The estimated impact of most of the other explanatory variables remains more or less the same, both in terms of magnitude and sign. Thus, compared with results in the previous Table, it is more difficult to explain the variability of firm-level dollar debt when reserves are normalized by M2 than by GDP.

4.2 Alternative Measures of Liability Dollarization

We have so far normalized dollar denominated debt of firms by their total debt to facilitate comparison across firms of different magnitudes of liabilities. As additional robustness checks, we also estimate equation (1) using different measures of liability dollarization, namely the ratio of short term dollar debt to total short term debt and the ratio of net dollar debt (i.e. dollar liabilities - dollar assets) to total debt. The estimation results are presented in Table 5.

Column (1) shows the results for short-term dollar debt share and Column (2) for net dollar debt share. The effect of the reserves to GDP ratio is consistently robust across both specifications. However its estimated coefficient is larger when short term dollar debt is the dependent variable (this magnitude is similar to the coefficient in Column (3) of Table 3). The estimated impact of the firm level explanatory variables is also fairly similar to Table 2, in terms of sensible signs and statistical significance. The estimated coefficients are however mostly smaller in magnitude with both short term dollar debt and net dollar debt as the dependent variables, as opposed to those in Column (3) of Table 3. Country-level factors are once again mostly insignificant. The adjusted R-squares estimates however are now relatively lower than before.

4.3 Lagged Explanatory Variables

It is possible that most of the explanatory variables (other than reserves to GDP ratio) in equation (1) may themselves be affected by the share of dollar debt in firm balance sheets (such as exports to sales ratio of firms, firm-size, exchange rate volatility, domestic credit to GDP ratio etc). Hence to control for potential feedback effects from the dependent to the independent variables, we lag all variables by 1 period and check the robustness of our results. Estimated coefficients are presented in Table 6. We do this for each of the three measures of liability dollarization, i.e. share of dollar debt in total debt, share of short term dollar debt in total short term debt and share of net dollar debt in total debt. Results are respectively presented in Columns (1), (2) and (3) of Table 6. Each column includes the same explanatory variables as discussed in the previous section. In addition to the control variables discussed above, we also incorporate country, sector and year specific dummy variables.

Reserves to GDP ratio lagged by 1 period consistently has the expected negative sign across all three specifications and is significant as well. Magnitude of its impact however varies to some extent depending upon how liability dollarization is measured. Hence once again we find evidence that when level of reserves decreases and hence an economy is possibly more exposed to a speculative currency attack, firms are induced to borrow more in dollars, perhaps owing to the moral-hazard related expectation that central bank will use its reserves to stabilize the exchange rate.

Firm-level explanatory variables all have the expected positive sign and are of statistical importance too. Country-level controls hardly contribute much to the estimation. Lagged ratio of domestic credit to GDP has the expected negative sign when significant (i.e. when net dollar debt is the dependent variable)-higher level of domestic financial development in the previous period ought to reduce the share of dollar debt in firms' balance sheets in the current period, given the inherent currency risk associated with such dollar borrowing. With a more developed financial system, firms of these EMEs will perhaps be better off borrowing in local currencies. In general around 47% of the variation in the dollar debt ratio seems to be explained by the control variables which is not negligible especially given the large number of observations. In addition to the variable mentioned above, we also tried incorporating a few other controls as additional robustness checks (such as differential borrowing cost, political risk etc) but these do not come out to be statistically significant in our estimations and results remain more or less the same.[25]

5 Conclusion

In this study, we explore the possibility of moral hazard on the part of EME firms, resulting from the implicit guarantee provided by the ex-ante accumulation of foreign exchange reserves by EME Central Banks. Using novel firm-level balance sheet data for close to 1500 firms across six major

[25] See Table A2 in Apendix.

LATAM economies, we estimate a simple model with Tobit regression technique and present evidence that could provide support for our moral hazard hypothesis under the scenarios investigated. At the same time, the results could hint at macroeconomic mismanagement on part of the authorities of these LATAM economies over the sample period.

A decrease in international reserves indicates a higher vulnerability of an economy to speculative currency attacks and capital flow reversals accompanied by exchange rate depreciation which can be damaging for firms borrowing in dollars. However we find that when reserve levels are low, firms still continue to borrow in dollars, possibly because they expect that the central bank will use its stock of reserves to stabilize the exchange rate. This could be interpreted as evidence in favor of a potential moral hazard situation wherein firms take advantage of the implicit protective insurance provided by reserves.

Our results hold when controlled for firm-level determinants of dollar debt, such as exports to sales ratio, variable firm size, and access to international equity markets. The results are also robust to the inclusion of nominal exchange rate volatility, financial openness and domestic financial development. Furthermore, the impact of reserves on firm dollar debt is sustained when we account for the fact that a significant fraction of the firms in our sample issue zero dollar debt i.e. possibility of corner solutions in the firms' financing choices. The result also holds when we incorporate country, sector and year specific effects.

Although this study shed new light on the relationship between central banks' reserve accumulation and corporate firms' financial decision-making with regard to using dollar denominated debt, other dimensions of a non-financial sector firm's dollar-borrowing still need further investigation. In particular, a better and more complete understanding of the effect of central bank's reserve hoarding policy on firms' risk-taking behavior requires information on off-balance sheet items that can significantly alter the overall currency exposure of a firm. This is particularly relevant in light of the substantial growth and development of foreign currency derivative trading in EMEs in recent years. Hence we would need more information on instruments possible used by these firms to hedge away currency risk.

The results presented here are new findings which contribute substantially to our understanding of the impact of EME international reserve accumulation on firms' financing decisions as well as on the factors determining firms' foreign currency borrowing. Future work will shed light on the mechanism underlying the possible moral hazard effect. It may also be worthwhile to conduct economy-specific analysis of the impact of reserves on the firm-level dollar borrowing of each economy. Such an exercise will provide insights into the differential responses of firms of different economies to their respective central bank's reserve accumulation policies. The global financial crisis of 2008-09 is in many ways a watershed event, not only for the developed nations but also for major EMEs such as

those in the LATAM region. In this context, an exercise such as the current one or future work in this direction maybe highly informative regarding the impact of the crisis on non-financial sector firms of EMEs.

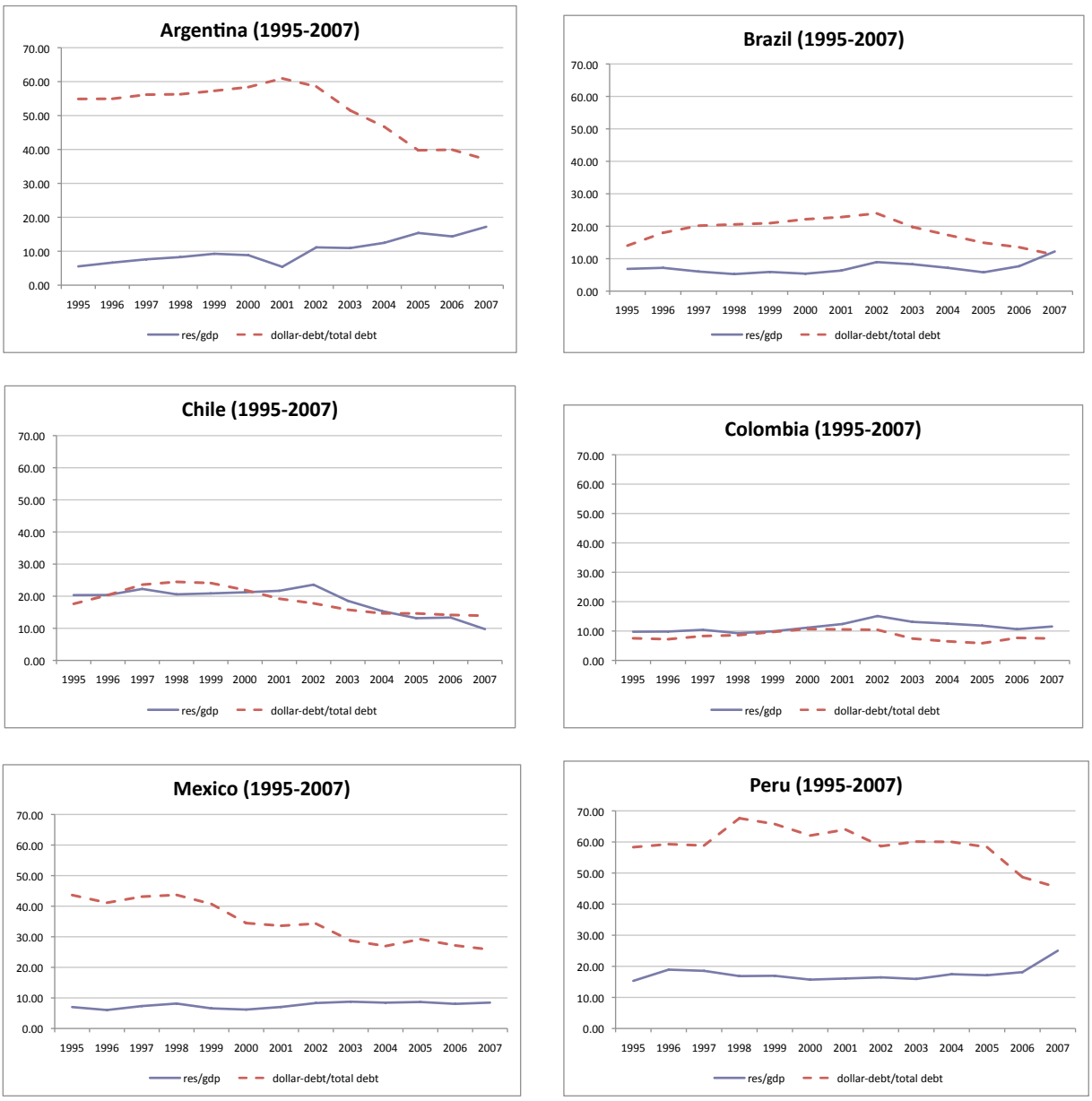

FIGURE 1: The figures above plot the reserve to GDP ratios of Argentina, Brazil, Chile, Colombia, Mexico, and Peru respectively and also the annual average liability dollarization ratios across all firms in each country.

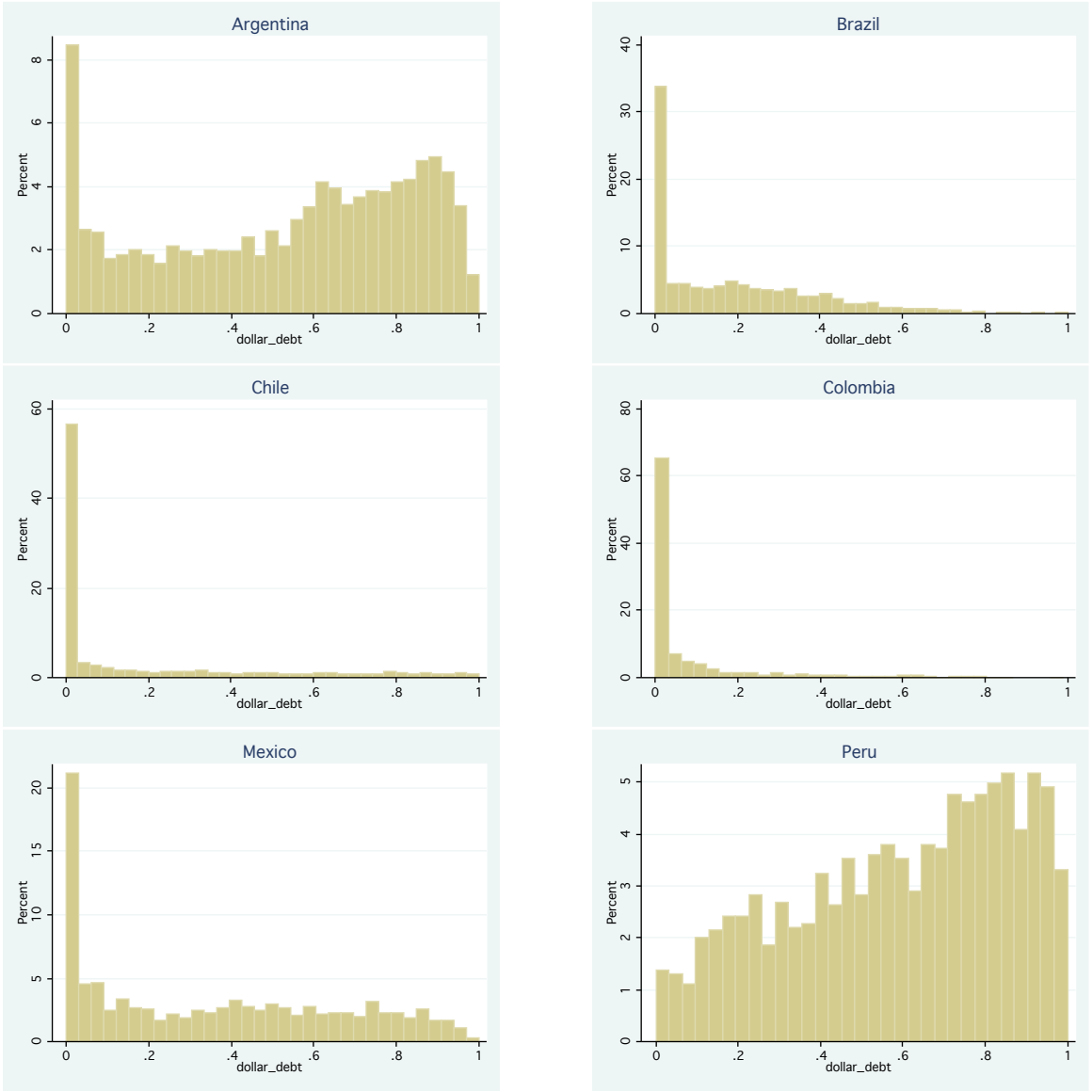

FIGURE 2: The figures above plot histograms of liability dollarization ratios for the pooled sample of firm-year observations within each country. The x-axis denotes the different levels of firms' share of dollar debt in total debt (in fraction) and the y-axis measures the fraction of fimr-year observations at each level of liability dollarization.

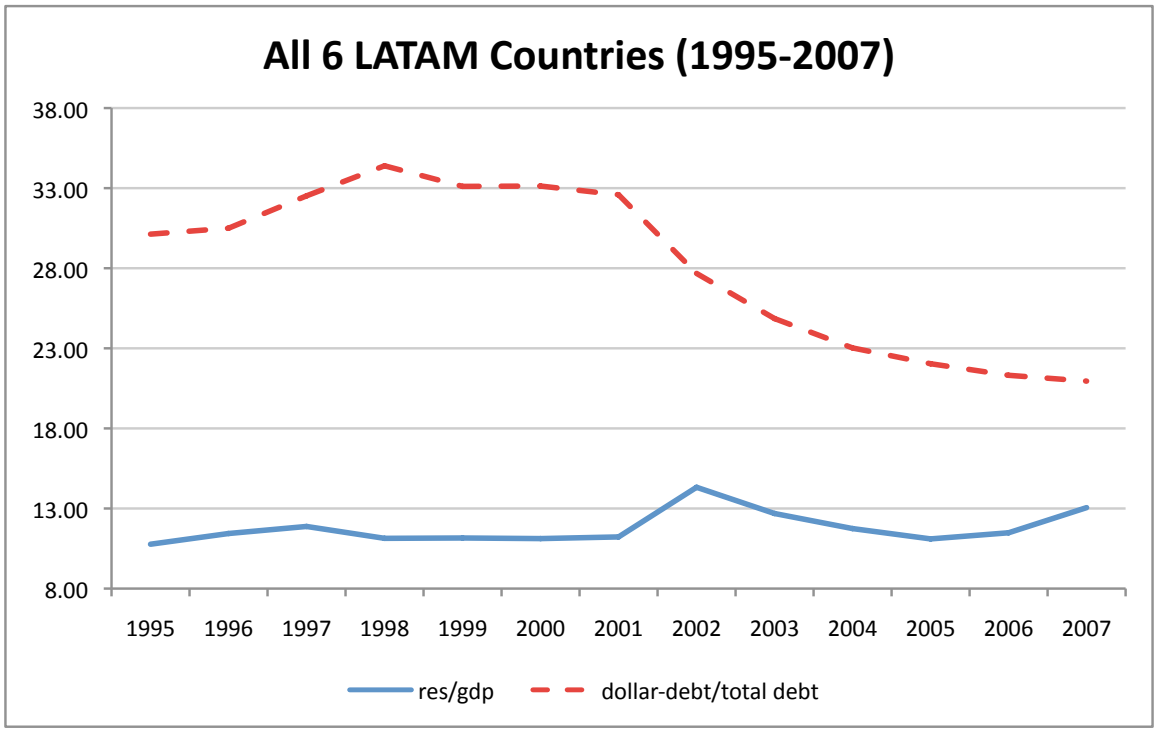

FIGURE 3: This figure shows the average reserve to GDP ratio of the pooled sample (Argentina, Brazil, Chile, Colombia, Mexico, and Peru) over the period 1993-2007, and the annual average firm-level dollar liabilities to total liabilities ratio of the non-financial sector firms of these 6 countries taken together.

TABLE 1: Number of Firms by Year

Countries	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Total
Panel A: Number of Firms by Country																	
Argentina		137	158	179	187	200	214	215	213	199	92	80	82	82	78	78	2194
Brazil		208	239	299	314	317	337	393	367	339	293	269	254	224	224	224	4301
Chile			232	246	253	253	257	256	251	245	238	228	217	211	211	211	3309
Colombia			141	167	174	169	129	133	105	122	123	118	115	88	88	88	1760
Mexico	169	183	189	172	163	149	134	123	106	116	110	101	94	82	82	82	2055
Peru			122	125	151	150	141	123	126	123	106	100	94	89	89	89	1628
Total	169	528	1081	1188	1242	1238	1212	1243	1168	1144	962	896	856	776	772	772	15247
Panel B: Number of Firms by Economic Sector																	
Agriculture		137	158	179	187	200	214	215	213	199	92	80	82	82	78	78	2194
Mining		208	239	299	314	317	337	393	367	339	293	269	254	224	224	224	4301
Manufacturing			232	246	253	253	257	256	251	245	238	228	217	211	211	211	3309
Construction			141	167	174	169	129	133	105	122	123	118	115	88	88	88	1760
Utilities	169	183	189	172	163	149	134	123	106	116	110	101	94	82	82	82	2055
Commerce			122	125	151	150	141	123	126	123	106	100	94	89	89	89	1628
Transport			122	125	151	150	141	123	126	123	106	100	94	89	89	89	1628
Services			122	125	151	150	141	123	126	123	106	100	94	89	89	89	1628
Miscellaneous			122	125	151	150	141	123	126	123	106	100	94	89	89	89	1628
Total	169	528	1081	1188	1242	1238	1212	1243	1168	1144	962	896	856	776	772	772	15247

Source: Author's own calculations based on the firm-level database described in the text.

TABLE 1: Descriptive Statistics by Country

Variables	Argentina	Brazil	Chile	Colombia	Mexico	Peru	All
Panel A: Descriptive Statistics of Firm-Level Variables							
Dollar debt/Total debt(%)	53.9	19.0	19.2	8.3	37.3	58.3	29.1
(std. dev.)	(30.9)	(20.6)	(28.5)	(16.1)	(30.6)	(28.2)	(31.0)
Net Dollar debt/Total debt	38.2	18.5	-15.0	4.4	21.1	13.2	10.3
(std. dev.)	(49.8)	(19.5)	(91.4)	(14.1)	(37.0)	(72.7)	(62.2)
(exports/sales)(%)	7.8	11.1	6.2	10.3	16.9	16.9	10.8
(std. dev.)	(17.7)	(20.5)	(18.1)	(20.9)	(23.3)	(27.8)	(21.4)
Total assets(billions USD)	0.5	1.9	0.3	0.2	1.4	0.2	0.93
(std. dev.)	(1.3)	(7.0)	(0.8)	(0.5)	(3.5)	(0.4)	(4.2)
Access to Foreign Stock Mkts (in %: Yes=1, No=0)	11.0	15.0	8.0	2.0	34.0	5.0	12.5
(std. dev.)	(31.0)	(35.0)	(27.0)	(14.0)	(47.0)	(21.0)	(33.0)
Foreign Ownership (in %: Yes=1, No=0)	42.0	30.0	19.0	22.0	37.0	33.0	29.5
(std. dev.)	(49.0)	(46.0)	(40.0)	(41.0)	(48.0)	(47.0)	(45.6)
Panel B: Descriptive Statistics of Country-Level Variables (%)							
$Reserves/GDP$	9.0	6.8	18.8	10.1	7.2	17.5	11.2
(std. dev.)	(3.1)	(1.8)	(3.4)	(1.0)	(1.0)	(2.2)	(5.5)
$r - r*$	12.5	59.2	5.9	21.5	17.1	23.1	26.5
(std. dev.)	(14.4)	(15.2)	(2.0)	(10.6)	(15.0)	(4.1)	(23.6)
$ExternalDebt/GDP$	11.3	4.1	7.3	4.6	4.9	8.2	6.4
(std. dev.)	(3.3)	(0.8)	(1.3)	(1.2)	(3.9)	(4.2)	(3.5)

Panel A columns report avg. values across all firms in each country.
Panel B columns report average values across all years in each country.
Last Column in both panels reports avg. values across all countries pooled.

Source: Author's own calculations based on the firm-level database described in the text. Columns in Panel A report average values across all firms in each country. Columns in Panel B report average values across all years in each country. The last column reports average values across all firms and years in the pooled sample of all six countries. *(in %; Yes =1, No=0)

TABLE 3: Firm Dollar-Debt and central bank Dollar-Reserves		
	Dep. Var: Dollar debt/Total debt	
Indep.Vars.	(1)	(2)
$reserves/GDP$	0.724***	1.116**
	(0.215)	(0.181)
$exports/sales$	0.248***	0.250***
	(0.016)	(0.016)
$firm\_size$	3.391***	3.418***
	(0.185)	(0.190)
adr_gdr	4.581***	4.663***
	(0.523)	(0.534)
$forown$	2.679***	2.585***
	(0.512)	(0.525)
$r - r*$		0.011
		(0.013)
$rervol * dep$		-3.177**
		(1.649)
$rervol * app$		16.834***
		(2.149)
finopen		0.246***
		(0.081)
crisis	8.029***	11.663***
	(1.100)	(0.596)
Country-Year Dummies	Y	Y
Observations	9852	9577
Uncensored Obs. (in percent)	77.1	77.0
McFadden's Adj. R^2	0.543	0.539

Note: Column (3) corresponds to equation (1) in the text. Table shows results of Tobit regressions over the sample period 1995-2007 for non-financial firms of all 6 LATAM economies. *reserves/GDP* is international reserves scaled by GDP of each country, *exports/sales* is the ratio of firm-level exports and sales, *firm_size* is variable firm size measures by log of total assets, *adr_gdr* is a dummy variable denoting whether the firm is listed in a foreign stock exchange, *rervol*dep* and *rervol*app* are volatility of exchange rate of each country interacted with a depreciation and an appreciation dummy respectively. *r-r** and *finopen* are the difference between domestic and external borrowing costs and financial openness of an economy, respectively. Coefficient estimates denote marginal effects on dependent variable, evaluated at mean values of independent variables. For dummies, it is the effect of discrete changes from 0 to 1. Robust Standard errors clustered at country-year level in parentheses. ***, **, and * denote signicance at the 1 percent, 5 percent, and 10 percent levels, respectively.

TABLE 4: Alternative Measures of Dollarization

Indep.Vars.	(Net Dollar debt/Total debt)	(Dollar Debt/Total Assets)
$reserves/GDP$	0.573***	0.591***
	(0.149)	(0.149)
$exports/sales$	0.076***	0.213***
	(0.009)	(0.009)
$firm\_size$	2.810***	4.205***
	(0.139)	(0.139)
adr_gdr	0.627	2.170**
	(0.751)	(0.751)
$forown$	1.486***	3.148***
	(0.628)	(0.628)
$r - r*$	0.002	0.001
	(0.007)	(0.007)
$revol\_dep$	-3.164***	0.183
	(0.797)	(0.797)
$revol\_app$	15.461***	7.994***
	(1.178)	(1.178)
finopen	0.113***	0.212**
	(0.043)	(0.043)
crisis	10.994***	4.384***
	(0.420)	(0.420)
Country-Year Dummies	Y	Y
Observations	8530	9577
Uncensored Obs. (in percent)	61.4	77.0
McFadden's Adj. R^2	0.359	0.022

Note: Table shows results of Tobit regressions over the sample period 1995-2007 for non-financial firms of all 6 LATAM economies. All explanatory variables are as in Table 3. Coefficient estimates denote marginal effects on dependent variable, evaluated at mean values of independent variables. For dummies, it is the effect of discrete changes from 0 to 1. Robust Standard errors clustered at country-year level in parentheses. ***, **, and * denote signicance at the 1 percent, 5 percent, and 10 percent levels, respectively.

TABLE 5a: Alternative Measure of Reserves

Indep.Vars.	(Dollar debt/Total debt)	(Net Dollar debt/Total debt)	(Dollar Debt/Total Assets)
$reserves/M2$	0.429***	0.181***	0.189**
	(0.111)	(0.048)	(0.087)
$exports/sales$	0.249***	0.072***	0.221***
	(0.016)	(0.010)	(0.053)
$firm\_size$	3.377***	2.815***	4.343***
	(0.201)	(0.143)	(0.919)
adr_gdr	4.706***	0.708	2.341**
	(0.538)	(0.764)	(1.059)
forown	2.900***	1.810***	3.623***
	(0.535)	(0.629)	(1.046)
$r - r*$	0.042***	0.016***	0.015*
	(0.008)	(0.003)	(0.009)
$rervol\_dep$	4.390**	-0.026	3.258*
	(2.233)	(0.945)	(1.754)
$rervol\_app$	17.231***	15.614***	8.283***
	(2.583)	(1.098)	(2.219)
finopen	-0.025	-0.015	0.089
	(0.113)	(0.046)	(0.099)
crisis	11.870***	10.870***	4.293***
	(1.192)	(0.510)	(1.345)
Country-Year Dummies	Y	Y	Y
Observations	8801	7890	8801
Uncensored Obs. (in percent)	77.0	61.29	77.0
McFadden's Adj. R^2	0.541	0.362	0.022

Note: Columns (1) and (2) correspond to equation (1) in the text. All explanatory variables are as in Table 3. Coefficient estimates denote marginal effects on dependent variable, evaluated at mean values of independent variables. For dummies, it is the effect of discrete changes from 0 to 1. Robust Standard errors clustered at country-year level in parentheses. ***, **, and * denote signicance at the 1 percent, 5 percent, and 10 percent levels, respectively.

TABLE 5b: Alternative Measure of Reserves

Indep.Vars.	(Dollar debt/Total debt)	(Net Dollar debt/Total debt)	(Dollar Debt/Total Assets)
reserves/debt	0.429***	0.181***	0.189**
	(0.111)	(0.048)	(0.087)
exports/sales	0.249***	0.072***	0.221***
	(0.016)	(0.010)	(0.053)
firm_size	3.377***	2.815***	4.343***
	(0.201)	(0.143)	(0.919)
adr_gdr	4.706***	0.708	2.341**
	(0.538)	(0.764)	(1.059)
forown	2.900***	1.810***	3.623***
	(0.535)	(0.629)	(1.046)
$r - r*$	0.042***	0.016***	0.015*
	(0.008)	(0.003)	(0.009)
rervol_dep	4.390**	-0.026	3.258*
	(2.233)	(0.945)	(1.754)
rervol_app	17.231***	15.614***	8.283***
	(2.583)	(1.098)	(2.219)
finopen	-0.025	-0.015	0.089
	(0.113)	(0.046)	(0.099)
crisis	11.870***	10.870***	4.293***
	(1.192)	(0.510)	(1.345)
Country-Year Dummies	Y	Y	Y
Observations	8801	7890	8801
Uncensored Obs. (in percent)	77.0	61.29	77.0
McFadden's Adj. R^2	0.541	0.362	0.022

Note: Columns (1) and (2) correspond to equation (1) in the text. All explanatory variables are as in Table 3. Coefficient estimates denote marginal effects on dependent variable, evaluated at mean values of independent variables. For dummies, it is the effect of discrete changes from 0 to 1. Robust Standard errors clustered at country-year level in parentheses. ***, **, and * denote signicance at the 1 percent, 5 percent, and 10 percent levels, respectively.

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6 Appendix

Table A1 shows results of fixed effects panel estimations based on equation (1) in the text. This estimation incorporates firm-specific effects and hence controls for unobserved heterogeneity factors at the firm level that may affect firm dollar debt but that cannot be explicitly controlled for owing to lack of data, such as risk appetite of firms, stock market value of firms, share of imported inputs etc. However, such fixed effects linear estimation model does not take into account the censored nature of the dependent variable and hence may produced biased coefficient estimates. Results show that the reserves to GDP ratio is consistently negative and significant implying that a lower level of reserves (and hence higher probability of crisis) may increase firms' dollar borrowing.

TABLE A1: Firm Dollar Debt & central bank Dollar Reserves

VARIABLES	(1)	(2)	(3)
reserves/GDP	-0.392***	-0.488***	-0.455***
	(0.089)	(0.105)	(0.107)
exports_sales		0.119***	0.121***
		(0.025)	(0.025)
firm_size		0.029***	0.027***
		(0.006)	(0.006)
adr_gdr		-0.001	0.004
		(0.019)	(0.019)
exvol_dep			-0.000
			(0.000)
exvol_app			0.000
			(0.000)
domcredit/GDP			0.070**
			(0.031)
finopen			-0.012
			(0.047)
Constant	0.274***	-0.236**	-0.238**
	(0.021)	(0.120)	(0.119)
Year Dummies	Y	Y	Y
Observations	13932	12202	12202
R^2	0.065	0.079	0.081

Note: Columns (1) to (3) correspond to equation (1) in the text. Table reports results of fixed effects estimations on a panel dataset of all firms of all 6 LATAM countries in the sample. Robust Standard errors are in parentheses. ***, **, and * denote signicance at the 1 percent, 5 percent, and 10 percent levels, respectively.

6.1 Technical Appendix: Tobit Model

Our baseline regressions which are Tobit model estimations quantify the overall impact of reserves on firms' liability dollarization with non-linear maximization of the following log-likelihood function:

$$\begin{aligned}\Lambda = \quad & \textstyle\sum_{D_{ijct}=0} log\left[\Phi(-\beta_1 R_{ct} + X'_{ijct}\beta_2 + Z'_{ct}\beta_3 + \alpha_j + \gamma_c + \delta_t)\right] + \\ & \textstyle\sum_{D_{ijct}>0} log\left[\phi(-\beta_1 R_{ct} + X'_{ijct}\beta_2 + Z'_{ct}\beta_3 + \alpha_j + \gamma_c + \delta_t)\right] \end{aligned} \tag{7}$$

where Φ and ϕ represent the CDF and the PDF respectively of a standard normal distribution. The Tobit model weighs censored and uncensored observations differently from the standard normal. The net result is a combination of a Probit likelihood function for censored values and the likelihood of a normal distribution. Maximizing it over unknown parameters $(\beta_1, \beta_2, \beta_3, \alpha_j, \gamma_c, \delta_t)$ we obtain the marginal effect on the latent variable (D^*_{ijct}).

However we are interested in the effect of the explanatory variables on the observed D_{ict} (i.e. dollar debt ratio of firms). In this model, the marginal effect of each variable on the expected value of the dependent variable is given by the marginal effect on the latent variable times the probability that the latent variable is above the censoring limit (in case of left censoring as is our case wherein dollar-debt is left censored at 0). For instance the marginal effect of reserve to GDP ratio will be given by:

$$\frac{\delta E\left[D_{ijct}(R_{ct}, X'_{ijct}, Z'_{ct}, \alpha_j, \gamma_c, \delta_t)\right]}{\delta R_{ct}} = \beta_1 * P(D^*_{ijct} > 0) \tag{8}$$

It is this overall marginal effect, indicated in equation (8) above that we report and discuss in section (3). It can be referred to as the overall effect as it sums both the effect on positive and censored values of dollar-debt.