Corporate Dollar Debt and Depreciations: Much Ado About Nothing?*

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December 20, 2002

Abstract

Much has been written recently about the problems for emerging markets that might result from a mismatch between foreign-currency denominated liabilities and assets (or income flows) denominated in local currency. In particular, several models, developed in the aftermath of financial crises of the late 1990s, suggest that the expansion in the "peso" value of "dollar" liabilities resulting from a devaluation could, via a net-worth effect, offset the expansionary competitiveness effect. Assessing which effect dominates, however, is ultimately an empirical matter. In this vein, we construct a new database with accounting information (including the currency composition of liabilities) for over 450 non-financial firms in five Latin American countries. We estimate, at the firm level, the reduced-form effect on investment of holding foreign-currency-denominated debt during an exchange-rate realignment. We consistently find that this effect is positive, contrary to the predicted sign of the net-worth effect. Additionally, we show that the estimated coefficient can be decomposed into competitiveness and net-worth effects, and we provide direct evidence that the competitiveness effect dominates the net-worth effect. We discuss some out-of-sample implications of these results.

Key Words: investment, financial crises, net worth, currency mismatch, Latin America
JEL Classification: E22, F41, G31

*Bleakley acknowledges the support of a NSF graduate research fellowship. We are extremely grateful to the Federal Reserve Bank of Boston for providing access to Bloomberg and to Adriana Merz of Bloomberg for her valuable help with the database. We thank Rashmi Melgeri and Cesar Serra for able research assistance. We also thank Daron Acemoglu, Adam Ashcraft, Olivier Blanchard, Ricardo Caballero, Kristin Forbes, Richard Frankel, Simon Gilchrist, Olivier Jeanne, Simon Johnson, Jonathan Kearns, Mark Lewis, Ugo Panizza, Bob Triest, Jaume Ventura and seminar participants at MIT, the Boston Fed, Darden (Virginia), the IMF, the IADB, and the 2002 Summer Meetings of the Econometric Society for useful comments. The authors alone are responsible for any remaining errors. The views expressed in this paper do not necessarily reflect those of the Federal Reserve Bank of Boston, the Federal Reserve System, or the Inter-American Development Bank.

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1 Introduction

The emerging-market financial crises of the late 1990s have challenged the old view of financial crises as having purely macroeconomic causes. None of the governments in these countries was turning to the printing press to cover budget deficits, the mechanism behind "first generation" models of crises. Moreover, there were no large output gaps that might have signaled a future need to devalue, as in "second generation" models. As a result, a new view has emerged in which the emphasis has shifted away from government-level and macro variables to firm-level micro variables and to the interaction of these variables with aggregate capital flows or with the exchange rate. Proponents of this view include Radelet and Sachs (1998) who argue that excessive reliance on short-term debt left emerging-market corporations vulnerable to "financial panic" *a la* Diamond and Dybvig (1983). For McKinnon and Pill (1998), on the other hand, it was excessive foreign borrowing by domestic banks that led to the crisis after the government withdrew its implicit guarantees.

A third group of studies identifies debt denominated in foreign currency as the key protagonist behind these crises.[1] At center stage in these studies is the drop in "net worth" that results from the interaction of a depreciation and a currency mismatch between liabilities and income at the firm level. This deterioration in balance sheets, holding all else fixed, makes firms appear to be riskier investments. Accordingly, creditors require higher rates of return and/or limit the amount of new debt issued to these firms. This, in turn, causes a contraction of investment by dollar-indebted firms following a exchange rate depreciation.[2]

The key mechanism, therefore, is that a depreciation inflates the peso value of dollar debt and the resulting weakening of balance sheet positions prevents firms from investing and expanding. Consequently, the expansionary effect, which a depreciation is typically assumed to have, may be attenuated or even reversed because of the behavior of firms that are highly leveraged in dollars. Indeed, many of the results derived in this literature rely not only on the existence of this particular

[1]These include Krugman (1999a and 1999b) and Aghion, Bacchetta, and Banerjee (2001).

[2]As it is common usage in the literature on foreign-currency assets and liabilities, we use the term "dollar debt" to refer to any liability denominated in a foreign currency. With similar aplomb, we refer to debt denominated in the domestic currency as "peso debt."

net-worth effect, but also require it to be large enough for depreciations to be contractionary. For example, in the work of both Krugman (1999a, 1999b) and Aghion, Bacchetta, and Banerjee (2001), it is the strongly *negative* relationship between investment and depreciation that generates multiple equilibria, and hence the potential for an expectations-driven crisis. Not surprisingly, the policy implications of this literature also depend crucially on the net effect of depreciations on firm investment. A tight monetary policy and dogged defense of the currency, for example, is the recommended response to a negative external shock only if a depreciation will further reduce output.

Whether the "net-worth effects" induced by changes in the domestic value of debt are large enough to overwhelm the "competitiveness effects" conventionally believed to be at play during a depreciation is ultimately an empirical issue, one that requires evidence at the microeconomic level. Several empirical treatments of the choice of currency composition of debt by firms exist; Conesa-Labastida (1997) examines Mexican corporations, and Dwor-Frecaut, Colaco, and Hallward-Driemeier (2000) summarize various World Bank studies that investigate East Asian firms. However, little evidence addresses the effect of foreign-currency debt on investment.

The present study is an attempt to fill this gap. We construct a new database with accounting information (including currency composition of liabilities) for approximately 500 publicly traded non-financial firms in five Latin American countries: Argentina, Brazil, Chile, Colombia, and Mexico. These data cover most of the large economies of Latin America for the period 1990 to 1999, a period of substantial exchange rate volatility for many of these countries. In addition, there are firms in our sample that hold substantial amounts of foreign-currency debt. These elements constitute the two ingredients necessary for testing the proposed mechanism. Our choice of publicly listed firms is determined exclusively by the availability of data on the currency composition of debt. We concentrate on the non-financial sector of the economy, as it is here that investment decisions are ultimately carried out.[3]

[3]While currency mismatch in the banking sector may play a role in emerging-market crises, banks differ so much from non-financial corporations in terms of (i) behavior and (ii) data availability as to be beyond the scope of this study. However, we do allow aggregate capital-market outcomes (such as bank credit) to enter exogenously into the analysis of firm-level investment.

Using this data set, we examine the behavior of corporate investment (both fixed capital and inventories). We investigate the response of fixed-capital investment to better understand how the proposed mechanisms might affect the productive capacity of the firm in the medium term. On the other hand, it has also been argued that falling net worth not only affects the supply of long-term credit for investment, but it also affects the availability of short-term working capital. A shortage of working capital reduces the firm's capacity to purchase intermediate goods and pay for variable factors of production, leading to a reduction in output. To explore this channel, we also examine the behavior of inventory investment.

Our specific empirical strategy is to assess whether firms with more dollar debt invest less in the aftermath of a depreciation. We do so by estimating reduced-form equations for inventory and fixed-capital investment. The proposed mechanism centers on the interaction of dollar indebtedness with shifts in the exchange rate, and so the key variable in our analysis is

$$(\text{Dollar Debt})_{i,t-1} \times (\Delta \ln \text{Exchange Rate})_t.$$

Using a simple model of firm investment, we show that this interaction effect can be decomposed into two components: the net-worth channel and the competitiveness channel. The manner in which these effects combine depends on the manner in which dollar debt is distributed across firms. More specifically, the key determinant of the sign of the overall effect is how strongly related the currency-composition of debt is with the exchange rate sensitivity of profits at the firm level. If, on average, this relation is strongly positive, then we say that firms are "currency matching" their balance sheet with their income stream, and, furthermore, the net result is a positive response of investment to depreciation among firms holding relatively dollarized debt. If not, a depreciation leads to a (relative) reduction in investment by dollar-indebted firms.

Our main empirical result is that we estimate this interaction to be positive: Firms holding dollar debt invest more than firms holding peso debt in the period following a depreciation. This finding is exactly the opposite of what one would expect from a net-worth model that only considers the deleterious effect of the exchange rate on the balance sheet. Furthermore, our results are robust to the inclusion of controls for both pre-existing firm differences and the interaction of these controls with aggregate macroeconomic variables.

We argue that this result is due to the degree to which firms match the currency composition of their debt with the elasticity of their income to the exchange rate. In the wake of a depreciation, the reduction of investment and output induced by the increase in indebtedness is more than offset by higher current and future earnings. Accordingly, we find that, after a depreciation, earnings are higher in those firms holding more dollar debt. Lending additional support to this hypothesis, we find that, in our sample, dollarization of liabilities is higher in firms whose income we expect *ex ante* to be more positively correlated with the real exchange rate (firms with tradable products, for example). Therefore, the finding essentially results from omitted variables. The interaction coefficient is positively correlated with investment opportunities that arise from changing relative prices.

To verify the robustness of our main competitiveness result, we explore a leading alternative explanation: that only "high quality" firms are able to issue debt in dollars, and that this subset of firms is more able to persevere and adapt when the exchange rate shifts. We argue that it is improbable that this would generate our results. First, we show that dollar-indebted firms do not respond differentially to aggregate changes in credit markets (e.g., capital outflows or a collapse of the banking sector). Second, we control directly for lagged performance and fail to find differences in the average investment response to a depreciation across firms with very different earnings and investment histories. In neither case does the inclusion of these controls affect materially our main result: Dollar-indebted firms invest relatively more following a depreciation. If dollar debt were basically an indicator of strong performance or good governance we would instead expect to have observed large drops in this estimate upon the inclusion of these controls. Instead, our estimates hardly change, and we, therefore, conclude that this alternative hypothesis cannot account for our results.

Note that we do not argue that the net-worth effect is not present. On the contrary, we show that firms holding dollar debt do see their net worth decline during depreciations, and, moreover, that net worth does appear to influence investment decisions. What we do argue is that this negative net-worth effect is more than compensated for by the positive effects of a depreciation on the earnings (and marginal product of capital) of those firms that choose to issue debt in dollars rather than pesos.

The rest of the study is organized as follows. Section 2 contains a description of our sample and variables. In Section 3, we present a model of firm-level investment upon which we base our empirical strategy. In Section 4, we present the main results of the study: Relative to corporations indebted in pesos, firms holding dollar debt invested more following depreciations of the domestic currency. In the two sections that follow, we examine each of the two channels affecting firm level investment: competitiveness (Section 5) and net worth (Section 6). Section 7 reviews the aggregate correlations in our sample and Section 8 contains a discussion of out-of-sample implications of our results. Section 9 concludes.

2 Description of Data

This section describes our sample and variables. Our data consist of firm-level accounting information for non-financial corporations in Argentina, Brazil, Colombia, Chile, and Mexico for the period 1990 to 1999. In addition, we have data describing the firms' main products, sectors in which they operate, ownership, and a history of the main corporate events. Our main source of information is the Bloomberg database on publicly traded firms. Additionally, some data for Brazilian firms and all data for Argentine firms come from a second dataset: Economática. Our choice of sources hinges on the availability of balance-sheet data that include a decomposition of liabilities by currency of denomination.

For our estimates, we use a sample restricted to the non-financial firms for which foreign-currency data are available. Table (1) shows the number of observations in the final sample per country and year as well as descriptive statistics for the main variables we use. The size of the sample changes as new firms are listed and incorporated into the Bloomberg database. Bankrupt or de-listed firms are not removed from Bloomberg unless their ticker is adopted by another firm. To our knowledge, there are no firms that are censored from our dataset for this reason. The decline in the number of observations towards the end of the sample is due to changes in the reporting requirements for foreign-currency debt, and not a result of bankruptcies.

Our main dependent variables are two measures of investment. The first is *investment in fixed capital*, measured as net purchases of fixed assets. We opt not to use the change in net fixed assets as a measure of investment because accounting standards in most of the countries in our sample allow for revaluations of assets, making it impossible to separate investment from changes in the accounting valuation of capital goods. The second is *investment in inventories* defined as the change in inventories in a given period. Inventories include raw materials, works in progress, and finished goods. In addition to investment, we also look at the effects of dollar debt on two income variables: *net sales* from operating activities and *earnings*.

The central explanatory variable is *foreign currency debt* (D^*), the book value of foreign currency liabilities converted into the respective local currency. In all of the countries in our sample, accounting standards dictate that conversion of debt from foreign to local currency values be carried out using the exchange rate for the period in which the balance sheet is reported.[4]

To explore the relationship between investment and dollar debt we control for additional determinants of investment. Our main group of controls includes direct and indirect measures of income and sales. The first of these is *earnings*, defined as earnings before accrued interest, taxes, depreciation, and amortization (EBITDA). Cash flow measures used in the investment literature are usually net of interest expenses and taxes. However interest and tax payments are both dependent on the firm's capital structure. Since we wish to identify the effects of leverage (and, in particular, leverage in dollars) on investment, we follow Lang, Ofek and Stulz (1996) and use a measure of cash flow that does not depend on the firm's debt choice. The second income control is the relevant *sectorial value added* (which we code according to the two digit ISIC2 classification).

[4]Accounting practices for Argentina, Brazil, and Mexico are described in Coopers and Lybrand (1993). Bavishi (1995) contains descriptions of accounting practices in the remaining countries.

Our final income-related control is a dummy variable that indicates whether the firm has *international operations*. Inclusion of this variable will allow us to explore the extent to which holding foreign assets affects the currency composition of debt and the subsequent response in the event of a depreciation.

Finally, we control for differences in firm ownership. *Parent* is a dummy variable that indicates whether the firm's controlling interest is another firm. This variable is motivated by studies of internal capital markets, in which ownership by a conglomerate affects the availability of internal funds for investment.[5]

We modify the original accounting data in four ways:

1. We inflate all data to 1999 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 1999.[6]

2. In the event of a merger, spin-off, or split, we construct an artificial firm that contains all of the component firms for the entire sample period. When information on a component firm is not available, we drop the firm from the sample. Ownership changes are reported under corporate news.

3. We drop all firm/year observations if the accounting data are not self-consistent. In particular, we drop observations if dollar liabilities exceed total liabilities or if accounting variables do not accord with sign conventions. This results in the deletion of 10 observations.

4. 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 $|z| > 5$. Twelve observations are dropped because of this rule. Our results are not sensitive to this particular choice of the threshold.

[5] We discuss coding of this variable in Section 4.2.3.

[6] We use consumer-price and exchange-rate data from the *International Financial Statistics* of the International Monetary Fund.

Because we are interested in the effects of a devaluation on firms holding dollar debt, in the analysis below, we interact D^* with changes in real exchange rate, Δe. Our definition of e (nominal exchange rate against the U.S. dollar scaled by the local CPI) is consistent with the inflation adjustments described above.[7] It is straightforward to show that using e on inflation-adjusted values of debt is equivalent to using the nominal exchange rate on current values. Note that according to this definition, a devaluation leads to a higher value of e. Also note, that because we do not have information on the exact currency composition of foreign debt, our assumption throughout is that all foreign currency debt is denominated in U.S. dollars. We believe this to be a reasonable approximation, as the volatility of the currencies in our sample usually dominates any exchange-rate movements among creditor currencies.[8]

3 Framework

In this section, we present a model of investment that incorporates the effect of changes in the exchange rate on both the balance sheet and profits of firms holding dollar debt. Our purpose in doing so is to determine the response of investment to changes in the exchange rate and to establish how this response varies across firms with different levels of debt dollarization. The model also serves to illustrate how the response of investment to a depreciation is the combination of potentially offsetting effects: net worth and competitiveness. Using the framework provided by the model, we then describe an empirical strategy for measuring the sample average of this composite effect.

[7] In all the specifications we report, we measure Δe as the log change in the real exchange rate between Decembers of successive years. Although we do not report them, we obtain similar results if Δe is measured as the log difference between the exchange rate in December of the previous year and the average exchange rate in the current year, or as the average-average change. We also obtain very similar results if we use J. P. Morgan's trade-weighted real exhange rate instead of our CPI-deflated measure.

[8] In addition, Hawkins and Turner (2000) report that, at the end of 1999, 87% of long term debt in Latin American countries was denominated in U.S. dollars.

3.1 Motivation

At about the same time as Robert Mundell was receiving the Nobel prize for economics, a series of studies—inspired by the emerging-market crises of the late 1990s—seemed to be undercutting the central assumption of the Mundell-Fleming model: that a depreciation of the exchange rate has an expansionary effect for the macro-economy. This "new" view of depreciations is centered on the micro level and pays particular attention to the (changing) credit constraints facing firms during financial crises. The key assumption of this literature is that the cost of external funds is decreasing in firm net worth. The second ingredient in these models is that some fraction of debt be denominated in foreign currency. A depreciation, therefore, not only has the usual effects on aggregate demand but also deteriorates net worth by inflating the domestic-currency value of debt. Holding all else fixed, we expect that the higher indebtedness leads to an increase in the cost of external finance and to a reduction in investment. Krugman (1999a) presents a stylized version of this effect, while Aghion, Bacchetta, and Banerjee (2001) and Céspedes, Chang, and Velasco (2000) incorporate this mechanism into more fully articulated models.

The link described above between investment and net worth has been widely treated in a variety of venues, including macroeconomics and corporate finance. On the macro side of things, Bernanke and Gertler (1989) and later Bernanke, Gertler and Gilchrist (1998) develop closed economy "financial accelerator" models in which the premium on external credit is decreasing in net worth. In their models, shocks to firm productivity affect both marginal conditions (i.e., the first order conditions for investment) and firm net worth, and, therefore, bring about changes in output that are larger than those implied by the neoclassical benchmark. Additionally, an extensive empirical literature documents the effect on investment of net worth, be it cash flows or leverage. Fazzari, Hubbard, and Petersen (1988), Hoshi, Kashyap, and Scharfstein (1991), and many others provide evidence that investment is related to the availability of internal funds.[9] Lang, Ofek, and Stulz (1996) show that there is a negative relation between investment and firm leverage.[10]

[9] Hubbard (1997) carries out an exhaustive survey of the literature on capital market imperfections and investment.

[10] There is also substantial evidence for the role of net worth on firm-level investment in developing countries. Individual country studies include Gelos and Werner (1998) who look at the effect of cash flow and collateral (proxied

The additional component of the "contractionary depreciation" models is indebtedness in foreign currency. Models explaining why firms choose to hold dollar debt in the first place typically include at least one of the following ingredients: (i) a failure of uncovered interest rate parity and (ii) risk-averse behavior by firms.

A series of explanations has been put forward for a failure of uncovered interest rate parity that results in a lower *ex ante* dollar rate. One set of models argues that dollarized debt entitles the creditor to larger payments in periods of default, lowering the required interest rate on dollar loans.[11] In another set of models (Jeanne 1999a, 1999b), foreign currency debt lowers interest rates by reducing moral hazard and signaling problems. Finally, in Calvo (1999, 2001), the failure of uncovered interest parity can be attributed to the interaction of information asymmetries and regulatory restrictions on the banking sector and to the costs of forming devaluation expectations, which are then included in the price of peso debt.[12]

The extent to which firms will take advantage of "cheaper" foreign–currency credit will in turn be determined by the effect of a currency mismatch on firm income variance and the costs to firms of this increased volatility. That risk-averse firms choose debt composition to hedge exchange rate shocks (i.e., to "match") is discussed for the banking sector by Ize and Levy-Yeyati (1998) and Arteta (2001), and for firms by Conesa-Labastida (1997), Calvo (2001), Martinez and Werner (2001), and Cowan (2002). The incentive for matching might also be external, with creditors charging higher rates to firms exposed to larger exchange rate risks. An additional reason often cited for holding dollarized debt is the lack of an adequate long-term domestic-currency debt market. According to this view, firms are willing to take on exchange-rate risk to avoid the interest-rate

by land values) on investment in Mexican manufacturing firms; Gallego and Loayza (2000) who look at the role of cash flows and debt overhang on publicly traded Chilean firms; and Harris, Schiantarelli, and Siregar (1994) who look at a sample of Indonesian firms. Laeven (2000) and Love (2001) carry out similar exercises on a panel of data from emerging economies.

[11] For Schneider and Tornell (2000), this takes place within the banking sector, where bailouts to dollar-indebted banks accompany devaluations. Chamon (2001), on the other hand, argues that when defaults are correlated with depreciations, holders of dollar debt benefit from the fact that they are entitled to a larger share of the liquidated assets.

[12] Regulatory constraints on currency mismatch encourage foreign banks to lend in their own currency, and, as a result, they charge a premium on peso rates. Similar regulatory constraints force domestic banks to match dollar deposits with dollar loans. Because of information advantages, these banks have incentives to place this debt domestically, leading to a lower equilibrium rate on dollar loans.

risk inherent in short-term peso liabilities (see Eichengreen and Haussman 1999).

3.2 Model

We consider in this section the theoretical impact on contemporaneous investment behavior of lagged decisions about the currency composition of debt. Following a movement in the exchange rate, four mechanisms will affect a firm's choice of capital:

1. The peso value of dollar debt will change, altering the value of total debt;
2. Internal funds available for investment will be affected because of changes in current profits;
3. Changes in expected future profits will alter the firm's current collateral; and
4. Shifts in relative prices will change the marginal product of capital.

The first two mechanisms will immediately affect the firm's balance sheet, and, if the firm is credit constrained, will affect investment because of higher costs of external capital. The third mechanism changes what a firm can credibly pledge to creditors, and thus may change the cost of capital as well. The fourth mechanism will affect demand for capital by altering current and future marginal products of capital.

The net result of these four effects is ambiguous. Specifically, we demonstrate below that it is not always the case that firms holding higher levels of dollar debt will experience larger reductions in investment during a depreciation. This result depends crucially on how dollar debt is distributed among firms. If firms match income streams with currency composition of liabilities, then those firms with higher levels of dollarization will also be those firms whose profits respond most favorably to a depreciation. Using the typology introduced later in this section, we observe that if firms match, the higher "competitiveness effect" of a change in the real exchange rate may well offset the larger "net-worth effect" brought about by dollar debt. Below we justify this typology and propose an empirical framework for assessing which effect dominates in our sample.

3.2.1 Setup

The model has two periods: t, and $t+1$. There is a continuum of firms indexed by $\beta \in [0,1]$, which corresponds to the fraction of firm debt dominated in dollars inherited from previous financing decisions. To abstract from the effect of leverage for the moment, we work with a neutral exchange rate ($\tilde{e}$) at which the peso value of total debt is identical for all firms. To simplify things further we normalize liabilities to one, so that β is both the ratio of dollar debt to liabilities and the total amount of dollar debt held by each firm.

Profits (in domestic currency) for each firm in period $t+1$ are given by

$$\pi_{t+1}(e_{t+1}, K_{t+1}) = g(e_{t+1})F(K_{t+1}) - r(W_t)K_{t+1}, \tag{1}$$

in which K_{t+1} is the amount of capital and $g(e_{t+1})F(K_{t+1})$ are earnings before interest payments. Firms inherit a predetermined capital stock, K_t, in period t, and receive $g(e_t)F(K_t)$ of profit. The function F has the usual properties: $F' > 0$ and $F'' < 0$.

The function $g(e)$ captures the response of profits to the exchange rate e. The simplest way to interpret g is that it is a relative price that depends on the exchange rate. This interpretation justifies the multiplicative separability of e_{t+1} and K_{t+1} in the profit function. We allow for possible variations across firms in $g(e)$. In particular, we postulate that the optimal composition of debt is likely to be a function of the response of profits to the exchange rate so that $\partial\beta/\partial g'(e) \neq 0$.

Firms cannot borrow at the risk-free rate but must pay a firm-specific risk premium that is decreasing and convex in period t net worth, W_t. Capital fully depreciates after one period of use, so that it has zero collateral value. This being the case, net worth is defined as

$$W_t \equiv \pi_t - (\beta e_t + (1-\beta)). \tag{2}$$

As mentioned above, firms inherit β units of debt denominated in foreign currency. If $\beta > 0$, then a depreciation (higher e_t) will lead to a reduction in the firm's net worth owing to the inflated domestic-currency value of its foreign liabilities.[13]

The firm's only choice variable is $t+1$ capital. Firms face a time-to-build constraint, so that in period t they determine K_{t+1} so as to maximize π_{t+1}, as described in equation (1), subject to equation (2). Allowing for persistence in the exchange rate, such that $e_{t+1} = \mu(e_t)$, the optimal level of capital can then be expressed as a function of the current exchange rate and the firm's net worth, itself a function of the exchange rate,

$$K^*_{t+1} = \check{K}^*(e_t, r(W_t(e_t))), \tag{3}$$

or simply as a function of the exchange rate:

$$K^*_{t+1} = \tilde{K}^*(e_t). \tag{4}$$

3.2.2 The competitiveness and net-worth channels

In this framework, what are the effects of a change in the current exchange rate on investment? Taking the derivative of $\tilde{K}^*$ and $\check{K}^*$ with respect to the exchange rate, we obtain

$$\frac{\partial \widetilde{K}_{t+1}}{\partial e_t} = \frac{\partial \check{K}_{t+1}}{\partial e_t} + \frac{\partial \check{K}_{t+1}}{\partial r} r'(W_t) \frac{\partial W_t}{\partial e_t}, \tag{5}$$

which allows us to decompose the response of investment to changes in e into two channels: (i) a *competitiveness channel*, in which an exchange-rate shock affects the optimal capital stock while holding constant net worth, and (ii) a *net-worth channel*, in which changes in the peso value of debt and changes in current earnings affect K_{t+1} by changing the cost of external funds.

[13]We have two additional simplifying assumptions behind this definition of net worth: (i) we assume (for now) that future profits are not pledgeable, and (ii) we ignore the effect of current-period investment on the interest rate. We obtain similar results to those presented in this subsection with a more general specification.

From the first-order condition, we can express the *competitiveness channel* as

$$\frac{\partial \check{K}_{t+1}}{\partial e_t} = g'(e_{t+1})\mu'(e_t)\left[-\frac{F'(K_{t+1})}{g(e_{t+1})F''(K_{t+1})}\right], \tag{6}$$

$$= g'(e_{t+1})\mu'(e_t)\theta_t \tag{7}$$

where $\theta_t > 0$. If we make the reasonable assumption that exchange-rate movements are persistent (*i.e.*, $\mu'(e_t) \geq 0$), then it is clear from equation (6) that earnings must be increasing in e for a depreciation to lead to higher investment. In turn, we can rewrite the *net worth channel* as

$$\frac{\partial \check{K}_{t+1}}{\partial r} r'(W_t)\frac{\partial W_t}{\partial e_t} = \sigma_t\left[g'(e_t)F(K_t) - \beta\right], \tag{8}$$

where $\sigma_t \equiv \frac{\partial \check{K}_{t+1}}{\partial C_t} = \frac{\partial \check{K}_{t+1}}{\partial r_t} r'$, the response of investment to net worth. By assumption, $\sigma_t \geq 0$.

This leads us to our first result: An increase in the exchange rate will have an ambiguous effect on investment in firms holding dollar debt. At one extreme, if $g' < 0$, a depreciation will reduce investment because falling current profits and a larger peso debt will increase the cost of external funds. At the same time, falling marginal product of capital reduces demand for capital. At the opposite extreme, $g' \gg 0$, it may well be the case that a higher neoclassical demand for capital is boosted by an improved balance-sheet position.

3.2.3 Variation across debt composition

Having characterized the response of K_{t+1} to e_t, we now address the key question of this section. We are interested in the differential effects of a depreciation on investment across firms with different β:

$$\frac{\partial}{\partial \beta}\left[\frac{\partial \widetilde{K}_{t+1}}{\partial e_t}\right] = \frac{\partial}{\partial \beta}\left[g'(e_{t+1})\mu'\theta_t\right] + \frac{\partial}{\partial \beta}\left[\frac{\partial \check{K}_{t+1}}{\partial C_t}\frac{\partial W_t}{\partial e_t}\right]. \tag{9}$$

Starting with the competitiveness effect, and evaluating the derivative at a neutral exchange rate (such that $g(\tilde{e}) = \tilde{g}$ in all periods and for all β, and, therefore, $\frac{\partial \theta_t}{\partial \beta} = 0$) we find that

$$\frac{\partial}{\partial \beta}\left[g'(e_{t+1})\mu'\theta_t\right] = \frac{\partial g'(e_{t+1})}{\partial \beta}\theta_t \mu'. \tag{10}$$

Similarly, as long as credit constraints do not vary across firms with different β, it is straight forward to show that at the neutral exchange rate the effect of β on the net-worth effect reduces to

$$\frac{\partial}{\partial \beta}\left[\frac{\partial \check{K}_{t+1}}{\partial C_t}\frac{\partial W_t}{\partial e_t}\right] = \left[\frac{\partial g'(e_t)}{\partial \beta}F(K_t) - 1\right]\sigma_t. \tag{11}$$

Combining equations (10) and (11) we obtain an expression for the variation across β of the response of investment to the exchange rate:

$$\begin{aligned}
\frac{\partial}{\partial \beta}\left[\frac{\partial \widetilde{K}_{t+1}}{\partial e_t}\right] &= \frac{\partial g'(e_{t+1})}{\partial \beta}\theta_t \mu' + \frac{\partial}{\partial \beta}\left[\frac{\partial W_t}{\partial e_t}\right]\sigma_t && (12)\\
&= \underbrace{\frac{\partial g'(e_{t+1})}{\partial \beta}\theta_t \mu'}_{\frac{\partial}{\partial \beta}[competitiveness]} + \underbrace{\left[\frac{\partial g'(e_t)}{\partial \beta}F(K_t) - 1\right]\sigma_t}_{\frac{\partial}{\partial \beta}[networth]} && (13)
\end{aligned}$$

This is the second main result of this section: The response of investment to the exchange rate can be either increasing or decreasing in β depending on the sign and magnitude of the key parameter $\frac{\partial g'(e)}{\partial \beta}$.

We highlight belo several special cases that result from equation (13).

1. **No matching:** $\frac{\partial g'(e)}{\partial \beta} = 0$. In this case, the right-hand side of equation (13) reduces to $-\sigma_t$. The result is unambiguous: Firms with higher β will reduce investment as a response to the higher cost of external financing.

2. **No capital-market friction**: $r'(W) = 0$. The net-worth effect disappears ($\sigma_t = 0$) and none of the level variables (debt, profits) enter. Since the competitiveness effect is (weakly) positive, firms holding more dollar debt invest (weakly) more. In this case, the response of

investment varies across β because of differences in the effect of e on the marginal product of capital.

3. **No persistence in the real exchange rate:** $\mu'(e) = 0$. There are no persistent differences in the marginal product of capital, so there is no competitiveness effect. The sign of $\frac{\partial}{\partial \beta}\left[\frac{\partial \widetilde{K}_{t+1}}{\partial e_t}\right]$ depends exclusively on the net-worth effect. Firms holding higher values of dollar debt will see greater increases in both debt and earnings. On balance, the net-worth effect is ambiguous.

Finally, consider the general case: The combined effects of persistence in the exchange rate, credit-market frictions and (weak) matching of the currency sensitivities of debt and income, $\frac{\partial g'(e)}{\partial \beta} \geq 0$. Matching is likely to take place if firms are concerned about the variance of their income or balance sheet—a result that arises from risk averse behavior of managers, bankruptcy costs, or capital-market frictions.[14] This being the case, firms with higher levels of dollar debt will also be those firms whose earnings are most responsive to the changes in the real exchange rate. In the event of a depreciation, increased current earnings may offset the inflated peso value of dollar debt so that the balance-sheet channel may turn out positive or negative. As for competitiveness factors, higher future marginal products of capital will increase the demand for capital. The combined effect of changes in current earnings, changes in liabilities and higher demand for capital is uncertain and, therefore, an empirical question. With this case in mind, we turn our attention to measuring these effects.

3.3 Empirical Methodology

The central empirical question of the present study is how the changing exchange rate interacts with dollar-denominated liabilities on the firm's balance sheet to alter the firm's investment behavior. Therefore, the key explanatory variable in our analysis is the interaction of lagged dollar debt, $D^*_{i,t-1}$, with the change in the exchange rate, Δe_t. To see this, consider firm i's optimal choice of period-$t+1$ capital, $K^*_{i,t+1}$, as implicitly defined above. Since the firm's predetermined net

[14] For a discussion and evidence on the relationship between capital-market frictions and optimal debt composition, see Cowan (2002).

worth, $W_{i,t}$, can be expressed as $W(e_t, D^*_{i,t-1})$, we can rewrite $K^*_{i,t+1}$ as $K^*(e_t, D^*_{i,t-1})$. Taking a second-order Taylor approximation around the lagged exchange rate, e_{t-1}, and some level of dollar leverage, X, we see that deviations from $K^*(e_{t-1}, X)$ can be expressed as

$$\Delta K = \frac{\partial K}{\partial e}\Delta e + \frac{\partial K}{\partial D^*}\Delta D^* + \frac{1}{2}\left(\frac{\partial^2 K}{\partial e^2}(\Delta e)^2 + \frac{\partial^2 K}{\partial D^{*2}}(\Delta D^*)^2 + \frac{\partial^2 K}{\partial e \partial D^*}(\Delta e \times \Delta D^*)\right), \qquad (14)$$

where $\Delta K = K^*(e_t, D^*_{i,t-1}) - K^*(e_{t-1}, X)$, $\Delta e = e_t - e_{t-1}$ and $\Delta D^* = D^*_{i,t-1} - X$.

The term of interest in equation (14) is the right-most one: the differential response in investment associated with holding dollar debt during a depreciation. This expression is equivalent to $\frac{\partial}{\partial \beta}\left[\frac{\partial K_{t+1}}{\partial e_t}\right]$ in the model above. Recall that the prediction for the sign of this derivative is ambiguous and results from the combination of variations across β of two distinct channels: a competitiveness effect, related to capital demand; and a net-worth effect, related to capital supply. By including this interaction of lagged dollar debt and the change in the exchange rate, we are trying to recover the sample average of this effect. The estimated sign of this coefficient should indicate which effect dominates: increasing competitiveness or decreasing net worth. We omit the other second-order terms in the regressions presented below for ease in interpreting the main effects. Estimation results for the interaction term are not sensitive to their exclusion as is discussed in more detail in Section 4.2.4.[15]

In addition to interaction effects, we also include both main effects: lagged foreign-currency-denominated debt and the change in the real exchange rate. These correspond to the first-derivative terms in the Taylor expansion. Including the main effect of dollar debt absorbs any pre-existing differences among firms with different levels of dollar indebtedness. Such differences might have prevailed in the absence of movements in the real exchange rate, e.g., if expanding firms were more likely to issue dollar debt than stagnant ones. The main effect for the change in the exchange rate captures the variation in relative prices that may affect all firms in the economy regardless of the currency composition of their debt. To control for differences in leverage, we also include lagged

[15] An alternative way to derive this same specification is to write down the law of motion for total debt, expressed in terms of inflation-adjusted pesos. The interaction effect is the only second-order term that enters this specification. See Appendix B for the derivation.

total debt, $D^T_{i,t-1}$ in all specifications.

The basic specification (for firm i in country j at year t) that results is

$$Y_{ijt} = \gamma(D^*_{i,j,t-1} \times \Delta e_{jt}) + \delta D^*_{i,j,t-1} + \alpha \Delta e_{jt} + \varphi D^T_{i,j,t-1} + \delta_j + \varepsilon_{ijt} \tag{15}$$

where Y_{ijt} is the firm-level outcome, typically investment, and δ_j are country dummies. This empirical framework allows us to estimate the result of holding dollar debt during an exchange rate realignment: $\hat{\gamma} = \widehat{\frac{\partial^2 Y}{\partial e \partial D^*}}$. It bears mentioning that this is not measuring a *causal* effect, but instead the result of a combination of one causal factor—the effect from increases in the peso value of debt—and other changes in financial and capital-demand factors that happen to be correlated with the currency composition of the firm's debt. To equation (15), we also add additional firm and macroeconomic control variables. These are detailed below.

Using the empirical specification presented in this section, we investigate how the response of investment to e varies across firms holding different fractions of dollar debt, $\frac{\partial}{\partial \beta}\left[\frac{\partial K_{t+1}}{\partial e_t}\right]$. Subsequent sections examine the differential effects of changing exchange rates on earnings ($\frac{\partial g'(e_t)}{\partial \beta}$ and $\frac{\partial g'(e_{t+1})}{\partial \beta}$). We then seek to quantify the relative importance of the net worth and competitiveness channels.

4 Investment

4.1 Main Results

Firms in our sample that hold dollar debt actually invest more than peso-indebted firms in the period following a depreciation. To show this, we employ the empirical methodology detailed above, and pay particular attention to the estimated coefficient on the interaction of lagged dollar debt and the change in the exchange rate, $(D^* \times \Delta e)$. We consistently find this coefficient to be positive: Dollar-indebted firms invest relatively *more* following a depreciation. Including contemporaneous measures of competitiveness in the regression reduces this estimate substantially, although it does not fully account for this finding. This leads us to believe that this differential increase in investment is a response in part to current and future profitability.

We focus on two types of investment: investment in fixed capital and investment in inventories. These are both important components of business-cycle fluctuations, but reflect very different types of investment activity and are likely to respond differently to crisis-induced shifts in credit and demand conditions. Investment in inventories is a relatively short-term affair. The ratio of inventory to sales in our sample is such that a product in the pipeline will typically be gone in under two months. Investing in the accumulation of inventories is likely to be sensitive to the availability of working capital, short-term financing that is often secured internally or through trade credit offered by input suppliers. On the other hand, investment in fixed capital plays out over a much longer horizon, and has to do with the long-term expansion of the productive capacity of the firm.

Tables (2) and (3) present estimates of the reduced-form effect on investment of holding dollar debt during a depreciation. Table (2) contains the results for fixed-capital investment, whereas in Table (3) we present estimates for inventory investment. The regression summarized in column A includes only the principal first-order effects and, of course, the interaction term: dollar debt times the change in the exchange rate. The effect of $(D^* \times \Delta e)$ on fixed-capital investment is estimated to be 0.407. The same effect on inventory investment is estimated to be 0.260. Both are significantly different from zero at conventional confidence intervals. In the case of fixed capital, this coefficient implies that, for example, a firm with a one-standard-deviation higher dollar indebtedness will, after a depreciation of fifty (log) percent, invest an additional amount equivalent to approximately seven percent of its prior year's assets. This increment in the ratio of investment to lagged assets compares with a sample mean of 7.1% and a sample standard deviation of 9.9%.

The sign and significance of this result is robust to the inclusion of a variety of additional controls. First, in column B, we control for possible indexation of peso debt.[16] Next, we add the

[16]To equation (15) above, we add $\sum_j \alpha_{jt} D_{i,t-1} \Delta \log CPI_{j,t}$, in which $D_{i,t-1}$is lagged peso debt (as before) and $CPI_{j,t}$ is the local price level. The first term indicates that domestic-currency debt can be "inflated away" in real terms by a change in the price level. Using country-specific α's allows the specification to accommodate different countries' accounting standards with respect to indexation of debt. See Appendix B for a formal derivation of this equation.

interaction of total debt with the change in the exchange rate in column C. In both cases, the inclusion of these controls hardly changes the estimated coefficient on $(D^* \times \Delta e)$.

Adding contemporaneous measures of the demand conditions facing firms, as displayed in columns D, E, and F, does not substantially alter this result. Exchange rate movements change relative prices, often rather markedly. If firms are matching the currency composition of their debt and income, the surge in their liabilities may be accompanied by an increase in their profit opportunities and current earnings. These effects could be responsible for the observed rise in investment by the firms that hold dollar debt. When contemporaneous profits and detailed sectorial conditions are taken into account, we find that the estimated coefficient on $(D^* \times \Delta e)$ is smaller that estimated earlier. However, the effect is still positive and significantly different from zero. Note, however, that in columns E and F both the sectorial-output and earnings variables enter the specification positively and significantly.

The findings reported in Tables (2) and (3) are exactly the opposite of what one would expect from the *naive* model of the balance-sheet effect (i.e., the "no matching" case presented above). In such a model, dollar-indebted firms should, as a result of increased debt and tightened financial constraints, invest less (relative to peso-indebted firms) after a depreciation. Instead, in our sample of firms we find that $\frac{\partial}{\partial \beta}\left[\frac{\partial K_{t+1}}{\partial e_t}\right] > 0$. Firms with higher levels of dollar debt invest more following a depreciation.

4.2 Robustness Checks

In this subsection we consider (and discard) several alternative hypotheses for why we might estimate a positive coefficient of $(D^* \times \Delta e)$ on investment. The concern is that dollar-indebted firms might differ from their peso-indebted counterparts along other dimensions than simply β and $\frac{\partial g'(e)}{\partial \beta}$. For example, the firms that are able to issue debt in dollars may have better access to international or domestic capital markets or have a different maturity structure of debt, and as such can better cope with the credit crunches that tend to figure in the emerging-market crises. We also concern ourselves with the possibility that firms holding dollar debt have operations in other countries. For those firms it is possible that we are either omitting some of the effects of a depreciation on earnings, or capturing a "mechanical" revaluation of investment absent any actual change in firm behavior.[17] Each of these possibilities suggest possible omitted-variables biases. To address this, we start with the investment regressions presented in the previous section and add plausible proxies for the supposed omitted variables. In each case, the inclusion of these proxies results in negligible changes in our estimates of the relationship between investment and $(D^* \times \Delta e)$.

4.2.1 Credit-Market Conditions

If firms holding dollar debt have differential access to international capital, and changes in the relative supply of domestic and foreign credit occur simultaneously with changes in the exchange rate, then our results may come from having omitted credit-market conditions in our estimates of investment. For example, in 1995, during the *tequila* crisis, Mexico suffered more-or-less simultaneous depreciation, capital flight, and collapse of the domestic banking system. In such an episode, the coefficient on $(D^* \times \Delta e)$ could well be capturing the asymmetric effects of contractions in domestic credit and international capital inflows.

To control for changing credit conditions, we estimate the investment regressions including an indicator of domestic credit (the change in the stock of private credit issued by domestic banks), and a measure of foreign credit inflows. In each case, we interact the macroeconomic variable with total leverage and the fraction of debt in foreign currency to allow for the differential effects of local and international credit supply on firms.

Table (4) shows the investment results obtained after including aggregate credit variables. Columns A and E report our basic specification, B and F allow for variation across firm size and indebtedness. In columns C and G, we introduce a measure of capital inflows, and, in columns

[17] In addition to these checks, we also run (but do not report) regressions in which we control for real *ex post* interest rates (with their respective interactions), firm fixed effects, other measures of aggregate capital flows (plus interactions), and a cubic in lagged assets (again, plus interactions). In all of these regressions, the coefficient on $(D^* \times \Delta e)$ is positive and significant.

D and H, a measure of domestic credit. We find that firm-level investment in fixed capital responds positively to domestic and international credit conditions so that a higher volume of domestic loans and credit inflows leads to higher investment.[18] We also find that the coefficients on the interaction of currency composition of debt and total leverage with the aggregate credit variables are not significant. This result suggests that the effects of aggregate credit-market conditions on firms do not depend either on the currency composition of debt or on the total level of leverage in the firm. For inventory investment, the results are similar, although the effects of credit inflows and domestic credit are not always significant at conventional confidence levels. As was the case of fixed-capital investment, the $(D^* \times \Delta e)$ interaction is significant and positive after including this additional set of controls.

4.2.2 Currency Mismatch versus Maturity Mismatch

Another credit-related hypothesis is that our results might be due to having omitted the maturity structure of debt. The impact of changing credit conditions will likely depend on the maturity structure of firm debt. For example, if firms are frequently rolling their debt over, they will suffer more from a negative shock to the supply of credit. To control for possible differences in the maturity structure of debt between dollar and peso-indebted firms, we directly include measures of short-term debt in our investment regressions. Furthermore, paralleling the treatment of dollar debt, we interact short-term debt with macroeconomic variables.

The results of including interactions of short-term debt with macroeconomic variables are displayed in Table (5). These additional interactions are either insignificant or, in one case, marginally significant. On the other hand, for both types of investment, we obtain significant and positive estimates of the coefficient on the interaction of dollar debt and the change in the exchange rate. Moreover, the point estimates on $(D^* \times \Delta e)$ hardly change. Overall, the evidence of an omitted-variable bias stemming from the maturity structure of debt is not compelling.

[18] We obtain similar results when using the capital account as our measure of foreign capital.

4.2.3 Cross-Border Ownership

In this subsection, we examine the confounding effect that may arise from firms that hold dollar debt and either own or are owned by corporations in a foreign country.

We start by looking at ownership of a foreign subsidiary. For those firms in which financial statements are consolidated, our estimates may be capturing the "mechanical" effect of the exchange rate on the domestic currency value of off-shore investment. For firms with non-consolidated balance sheets, our existing set of controls will not be fully measuring the effect of the exchange rate on net worth. On the other hand, firms with international operations may be in a poorer position to further expand abroad when the domestic currency is weak, and, therefore, may invest less as a result of a depreciation. Whether the final effect is positive or negative on net is not critical to our conclusion; what matters is the possible omitted-variable bias on the $(D^* \times \Delta e)$ interaction coefficient.

To address this possible omitted-variable bias, we construct a set of proxies for ownership of foreign assets. We do not have data on the fraction of the firm's operations located abroad, nor do we have reliable information on whether or not the accounting data we employed represents a "consolidated" view of both the firm's activities and those of its subsidiaries. The proxy variables we construct are instead simple dummy variables that indicate whether the firm has international operations or not. We created these variables by searching the Bloomberg database for either a reference to the ticker of a foreign subsidiary or for explicit mention of international operations in the company description.

As shown in Table (6), inclusion of these indicator variables for ownership relationships does not affect the main conclusion: Following a depreciation, investment continues to be significantly higher among firms with more dollar debt relative to firms with lower levels of dollar indebtedness. The changes in the estimated $(D^* \times \Delta e)$ coefficient are quite small. We conclude that the omitted-variable bias attributable to international operations is likely minimal.

Alternatively, it may be the case that the differences in the ownership of the firm itself bias our estimate of the $(D^* \times \Delta e)$ coefficient. To address this issue we construct two variables that proxy for foreign ownership. The first of these variables indicates whether the firm has a parent company. In all cases, we review the online archives of company news to verify that these ownership relationships predate the firm's first appearance in our sample. This ensures that these indicators are predetermined variables rather than endogenous outcomes. The second measure of foreign ownership is a dummy variable that indicates whether, in the previous period, the firm's shares were listed in a foreign stock exchange in the form of American Depositary Receipts (ADRs). In addition to being a proxy for foreign ownership, a foreign listing may also have effects on information disclosure and liquidity of firm equity that may bias our results. This variable is constructed matching the firms in the Bank of New York database on ADRs with those in our sample.

The results of estimating our baseline equation with the ownership controls are reported in Table (6). Once again, the effect of the additional control variables on our estimated coefficient on the $(D^* \times \Delta e)$ interaction is minimal (i.e., the coefficient moves by less than a standard error across specifications).

4.2.4 Relaxing the Assumption of Linearity

A plausible hypothesis is that the response of investment to leverage is nonlinear, so that a given change in debt causes a larger change in investment in highly leveraged firms.[19] To evaluate the effect of nonlinearity on our results, we estimate our basic investment specification allowing the response of investment to total debt and allowing the $(D^* \times \Delta e)$ interaction term to vary across indebtedness. The results of this exercise are reported in Table (7). As can be seen in columns A through C for fixed capital investment and E through G for inventory accumulation, the changes in the estimated $(D^* \times \Delta e)$ coefficient are quite small, and our main result remains unaffected by the additional terms.

[19] The most extreme case of this nonlinearity would be bankruptcy.

Throughout our analysis, we assume that the effects of depreciations and appreciations are symmetrical, and that, furthermore, these effects are linear. To evaluate the validity of the symmetry assumption, we generate a dummy variable that takes on the value of one if the currency has appreciated, and interact it with the exchange rate and with our $(D^* \times \Delta e)$ interaction coefficient. We are thus allowing both for the main effect and the interaction to be different in depreciations and appreciations. We report the results of this specification in Table (7) columns D and H. Allowing for a depreciation to impact firm level investment differently from an appreciation does not affect our main conclusion; the coefficient on $(D^* \times \Delta e)$ is still positive and significant for both fixed capital and inventory investment. Furthermore, (although not significant) the negative coefficient on $I(\Delta e < 0) \times (D^* \times \Delta e)$ suggests that the differential response of investment in firms holding dollar debt is larger in depreciations. We offer one possible interpretation of this differential response: If depreciations generate more persistent changes in relative prices, then the investment response will be larger following a depreciation.

Could our results be driven by the fact that many of the devaluation episodes in our sample were anticipated by firms? If depreciations are expected, then firms holding dollar debt are likely to alter their currency positions—reducing the effects of a devaluation on net worth. At the same time, a rise in the expected depreciation rate is likely to push domestic interest rates up, deteriorating the net worth of firms holding peso debt.

To address this concern, we repeat our exercise for a specific devaluation that we believe had a large unexpected component: the *tequila* crisis in Mexico during 1994 and 1995. The estimation results are reported in Table (8). Column A of Table (8) includes Mexican firms for all years in our sample (1990 to 1999); column B is restricted to 1994 and 1995. In line with our full sample results, the estimated coefficient on the $(D^* \times \Delta e)$ interaction term is positive and significant in both sub-samples. Columns C and D report an alternative exercise for 1994 and 1995, respectively. Controlling for current earnings and lagged dollar debt, we find that investment is higher in firms holding dollar debt in 1994 and 1995 and that this difference was significantly different during 1994. Overall, the results presented in Table (8) suggest that our results are not driven by a series of expected depreciation episodes.

4.2.5 Lagged Performance

In this subsection, we argue that the observed investment response to $(D^* \times \Delta e)$ is not due to dollar-indebted firms being "high performing" and, therefore, being able to better adapt to the changing exchange rate. Specifically, we condition on lagged firm performance, as proxied by lags of earnings and investment, and interact these proxies with aggregate capital flows and the change in the exchange rate. These results are displayed in Table (9). As above, the average effect of aggregate inflows of capital is strongly positive for investment in both fixed capital and inventories. Furthermore, the coefficients on lagged performance come out positive and significant in statistical and economic terms. However, we cannot reject the hypothesis that the interactions of these performance proxies with Δe have coefficients of zero. Not surprisingly, their inclusion in the specifications results in negligible changes in our estimate of the effect of $(D^* \times \Delta e)$. There is some evidence that firms that were investing more before a depreciation invest relatively more afterward as well (in Table (9), column C, the interaction of lagged investment and Δe is almost significant at the 10% level). However, the estimated effect of $(D^* \times \Delta e)$ remains within half a standard error of the earlier estimate. Therefore, we find it unlikely that pre-existing differences in firm "quality" are responsible for the differential investment behavior we observe post-depreciation among firms with varying degrees of lagged dollar indebtedness.

5 The Competitiveness Effect

In this section, we argue that the differential investment behavior of dollar-indebted firms following a depreciation that we find in the preceding section is largely attributable to the differences across firms in the competitiveness effect described in the model. We document two facts that provide evidence for this claim:

1. Firms that could be expected to benefit from a depreciation—firms that have tradable products, for example—are more likely to hold debt that is denominated in foreign currency.

2. Dollar-indebted firms experience a relative surge in profits following a depreciation.

Both indicate positive currency matching of debt and income flows—or, in terms of the model, that $\frac{\partial g'(e)}{\partial \beta} > 0$.

We then compare the (relative) increases in profits and investment associated with increased dollar debt and ask whether the increase in profitability is large enough to justify the surge in investment. To answer this question, we combine the estimated profit and investment responses with our model and find that, for plausible interest rates, the observed investment response is consistent with a model in which only the competitiveness effect is present.

5.1 Determinants of the Currency Composition of Debt

In this subsection we examine the determinants of liability dollarization. To do so, we estimate the following equation on the full sample

$$\beta_{ijt} = v_j + \delta\alpha_{ijt} + X_{ijt}\Gamma + u_{ijt} : \qquad (16)$$

in which β_{ijt} is the ratio of dollar debt to total liabilities; v_j are country-specific intercepts; $X_{ijt}\Gamma$ are controls, including the natural logarithm of firm assets and a dummy variable indicating whether the firm is a subsidiary of a larger company; and α_{ijt} corresponds to one of several proxies for the sensitivity of profits to the real exchange rate, $g'(e;\beta)$:

1. a dummy variable that takes on a value of one if the firm is in a tradable sector (agriculture, mining, or manufacturing);

2. the average elasticity of each sector's output to the real exchange rate;[20]

[20]To construct this measure, we estimate $\Delta(\ln y_{jkt}) = \delta_0 + \delta_1\Delta\ln(e_{jt}) + \delta_3 x_{jt} + \varepsilon_{jkt}$ for the period for each sector

3. a dummy variable if the firm has foreign subsidiaries.

In each specification, proxies of $g'(e;\beta)$ show a positive correlation with the fraction of debt issued in foreign currency. Columns A through C of Table (10) show the main results for the full sample estimation. In all specifications, the estimates of δ are positive and significant: Firms whose income we expect to be positively correlated with the exchange rate have a higher fraction of foreign-currency-denominated liabilities. The fraction of dollar-denominated liabilities is 5% higher in firms that belong to the tradable sectors; the average value of β_{ijt} is 24%. Firm size is also positive and significant in all specifications; larger firms hold a higher fraction of dollar debt. Although we do not report them individually, country dummies are also highly significant (at the 99% level of confidence) with firms in Argentina and Mexico holding the highest fractions of dollar debt. All in all, size and tradability (or sectorial elasticity of output to the real exchange rate) explain close to 45% of variance in β_{ijt}.[21]

Firms with international operations were also much more likely to issue their debt in dollars. The last column of Table (10) shows the results of estimating equation (16) for the remaining proxy of $g'(e;\beta)$ on a sub-sample of firms.[22] As in the previous specifications, both the size variable and the tradable dummy are always positive and significant at the 99% confidence level. Column E includes the dummy variable for firms that have a parent company and the dummy variable for firms that own subsidiaries in foreign countries. Both of these variables are significant. The positive coefficient on the subsidiary variable is in line with the results discussed above. Income from the foreign subsidiary, in terms of domestic currency, is positively correlated with movements in the real exchange rate.

Our results in this section 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

k in each country j. $\Delta(\ln y_{jkt})$ is the first difference of the log of sector k value added, $\Delta \ln(e_{jt})$ the first difference of the log of the real exchange rate and x_{jt} a vector of country-level controls that includes capital inflows and growth in private-sector bank credit.

[21] We obtain identical results when we estimate β using a tobit regression.

[22] Because of data availability, the sample used in specification E is smaller and excludes firms from Argentina and some of the firms from Brazil. Because of this, column D presents the results of our baseline estimation using an identical sample to E.

event of a depreciation.

5.2 Relative Change in Profitability

In this subsection, we show that, after a depreciation, dollar-indebted firms see their sales and earnings rise substantially relative to their peso-indebted counterparts. These findings provide additional support for our proposition that firms holding more dollar debt are better poised to take profitable advantage of the depreciation and that this factor explains their increased investment.

To analyze sales and earnings, we employ the same empirical framework used above for investment. Table (11) presents estimates of the differential effect of exchange rate movements across firms with varying degrees of dollar indebtedness. The specification of these regressions parallels those of Tables (2) and (3), columns D. We include our principal interaction effect ($D^* \times \Delta e$), all main effects, and dummies for each country/year cell. Columns A and B of Table (11) show that in periods in which the local currency depreciated, sales were higher in firms holding dollar than they were in firms holding peso debt. As in the investment estimates, the coefficient on ($D^* \times \Delta e$) corresponds to $\frac{\partial^2 Y}{\partial \beta \partial e}$, so that a positive coefficient estimate here implies that $\frac{dg'(e)}{d\beta} > 0$.

Dollar-indebted firms also saw significantly higher earnings in the year *following* a depreciation. These results are displayed in Table (11), columns C through F. For example, column C indicates that a firm holding one additional dollar of foreign-currency debt received 36 cents in extra earnings in a year following a one-unit logarithmic change in the real exchange rate. Of course, as we document above, such a firm was likely to be investing more as well. Therefore, we see in columns D and E that a fraction of these higher profits is due to the differential investment behavior of the firms. Nevertheless, even after controlling for investment behavior, the rise in earnings in the subsequent year is still positive and significant.

Finally, as further support of the varying competitiveness hypothesis, we demonstrate that this relative increase in future profitability occurs even after controlling for contemporaneous earnings. The positive *investment* responses observed above were also robust to the inclusion of contemporaneous profitability. Therefore, some aspect of the change in competitiveness must have been uncorrelated with period-t earnings. In column F of Table (11), we add contemporaneous earnings to the regression. The predictive power of our interaction term remains positive and statistically significant.

These results serve as further evidence that firms with higher β experience relative increases in the marginal product of capital (MPK). This can be seen by considering the differential shift in MPK_{t+1} following a change in e_t. Holding β constant, we can write this as

$$\begin{aligned} \frac{\partial MPK_{t+1}}{\partial e_t} &= g'(e_{t+1})\mu'(e_t)F'(K_{t+1}) \\ &= \frac{[g'(e_{t+1})F(K_{t+1})\mu'(e_t)]\,[F'(K_{t+1})g(e_{t+1})]}{F(K_{t+1})g(e_{t+1})} \\ &= \frac{r(w_t)}{\pi_{t+1}}\frac{\partial \pi_{t+1}(e_t, K_{t+1})}{\partial e_t}, \end{aligned}$$

so the differential shift across β can be shown to be

$$\frac{\partial^2 MPK_{t+1}}{\partial \beta \partial e_t} = \frac{r(w_t)}{\pi_{t+1}}\frac{\partial^2 \pi_{t+1}(e_t, K_{t+1})}{\partial \beta \partial e_t}, \tag{17}$$

when evaluated at the neutral exchange rate $\tilde{e}$. This equation indicates that we can interpret the differential increase in earnings as a differential rise in the marginal product of capital and, consequently, as a differential shift in demand for capital for firms that hold more dollar debt. This bolsters our hypothesis that the positive coefficient on $(D^* \times \Delta e)$ contains a large, differential competitiveness component.[23]

To quantify precisely how much of the differential investment behavior can be attributed to changes in the marginal product of capital would require specific knowledge about the marginal conditions affecting the firm's decisions. In particular, we would need to know $F''(K)$. Given the inherent difficulties in calculating this number we opt to address a distinct question in the subsection that follows: Are the added profits from fixed-capital investment consistent with a model of capital

[23] The differential increase in earnings also affects firm net worth. We discuss the implications of this in the next section.

choice absent credit constraints?

5.3 Consistency Check

The previous subsections provide direct and indirect evidence of matching. Firms with higher dollar debt are those firms whose profits increase most during a depreciation. We further argued in the last section that through changes in the demand for capital, these higher profits might explain the coefficient on the $(D^* \times \Delta e)$ interaction. To evaluate this hypothesis, we assume that only the competitiveness effect is present and evaluate the consistency of the estimated increases in investment and future profits associated with holding dollar debt during a depreciation.

In particular, we measure the marginal profit associated with the relative increase in investment and then compute the implied rate of return on that investment. The conclusion hinges on the plausibility of the implied interest rate that this calculation generates. If the implied rate is very high, we might suspect that firms were unable to exploit potential profit opportunities because of difficulties in obtaining financing, which contradicts our initial assumption about the dominance of the competitiveness channel. If, instead, the implicit interest rate is near the market rate, it casts doubts on the view that those firms were constrained to invest less than they would have otherwise in a frictionless world, and as such it provides evidence in favor of the competitiveness hypothesis.

Consider writing the firm's profit (before interest) as $\pi_{t+1}(e_t, \tilde{K}_{t+1}(e_t); \beta)$, and furthermore define the profit function (implicitly defined by the maximization program) to be $\tilde{\pi}_{t+1}(e_t; \beta)$. Now, consider only the competitiveness channel, so that financial variables do not enter into the function. Taking full derivatives w.r.t. e_t, and rearranging slightly, we see that

$$\frac{\partial \tilde{\pi}_{t+1}}{\partial e_t} - \frac{\partial \pi_{t+1}}{\partial e_t} = \frac{\partial \pi_{t+1}}{\partial K_{t+1}} \frac{d\tilde{K}_{t+1}}{de_t}, \tag{18}$$

in which β appears as a parameter in each term. By the assumption of profit maximization, we can replace $\frac{\partial \pi_{t+1}}{\partial K_{t+1}}$ with the interest rate, r_t.

Finally, to make the expression comparable with our empirical analysis, take derivatives of both sides w.r.t. β:

$$\frac{\partial^2 \tilde{\pi}_{t+1}}{\partial e_t \partial \beta} - \frac{\partial^2 \pi_{t+1}}{\partial e_t \partial \beta} = r_t \frac{\partial^2 \tilde{K}_{t+1}}{\partial e_t \partial \beta}. \tag{19}$$

Since all the effects of net worth are assumed away for the moment, β has an effect through $\frac{dg'(e)}{d\beta}$ only. The first term, $\frac{\partial^2 \tilde{\pi}_{t+1}}{\partial e_t \partial \beta}$ (the differential change in profits across dollar indebtedness caused by exchange-rate movements) is estimated above by the coefficient on $(D^* \times \Delta e)$ in column C of Table (11). The second term, $\frac{\partial^2 \pi_{t+1}}{\partial e_t \partial \beta}$, is the same differential response of profits, but, in this case, we are holding capital fixed. This estimate is displayed in column E, in which we control for investment in period t. Finally the right-hand side of the equation represents the interest rate times the differential investment response. An estimate of the latter term is displayed in Table (2), column F.

Our consistency check hinges on the plausibility of the rate of return on investment implied in equation (19). Plugging the numbers from above into equation (19), we obtain

$$(0.355) - (0.331) = r \cdot (0.293), \tag{20}$$

and, therefore, an implied interest rate of approximately seven percent. Hence, the calculation suggests that variation in the response of investment to the exchange rate associated with higher dollar debt are consistent with the variations in the response of earnings in a model in which only the demand for capital affects investment.

6 The Net-Worth Effect

In this section, we evaluate the key ingredients required for a depreciation to be contractionary in the models discussed above: namely, the negative effect of a depreciation on the net worth of firms holding dollar debt and the reduction of investment that this causes. In particular, we address the following questions:

1. Did overall debt actually increase as a result of holding dollar debt during a depreciation? (Yes.)

2. Did this rise in debt lead to a decline in firm net worth? (Most likely.)

3. What is a plausible magnitude for this net worth component of the effect on investment? (At least an order of magnitude smaller than the estimated overall effect.)

6.1 Change in Net Worth

Holding dollar debt during a depreciation leads to an increased indebtedness of the firm (in domestic currency) that was not entirely offset by higher current earnings.[24] This discards one possible explanation for the apparent absence of a net-worth effect on investment: that there was a limited effect on the balance sheet itself. In particular, firms may have recomposed their debt portfolio or purchased currency forwards in anticipation of a change in the exchange rate.

We estimate an equation for the predicted total debt and debt service of firm i in country j in year t. The interaction of $(D^* \times \Delta e)$ continues to be the term of interest. The theoretical prediction is that the real value of the firm's debt rises if it holds foreign-currency debt and the exchange rate goes up faster than the domestic-price level. To equation (15) above, we add $DN^T_{i,t}$, firm i's net issuance of new debt in period t. This simple framework provides a basis for predicting autonomous changes—i.e., those caused by the mechanical increase of dollar debt in local currency—in the financial obligations of a firm. We present estimates of this augmented specification in Table (12).

Firms holding foreign-currency denominated debt saw the value of their debt rise in the aftermath of a depreciation. As before, we focus on the estimated effect of the interaction of lagged dollar debt and the change in the real exchange rate. Columns A and B contain results for the

[24] As seen above, the dollar-indebted firms tended to be larger and produce relatively tradable output. 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. Nevertheless, we show that exchange rate realignments did indeed have the supposed effect on firms' balance sheets: Firms holding dollar debt saw the real (peso) value of their debt rise substantially. If firms do in fact buy derivatives or substitute debt to offset the mechanical revaluation of their debt, they appear to do so to a limited degree.

regressions of total t-period debt on $(D^* \times \Delta e)$. In column C and D, we present results for the effect on the change in debt. In all cases, holding dollar debt during a depreciation causes a near one-for-one rise in the real peso value of debt.

Comparing the first four columns of Table (12) suggests that excluding new debt from the analysis has no appreciable change on our estimates of the effect of the dollar debt/exchange rate interaction term. This is fortunate because data on issues of new debt are not available for many firms, especially for those from countries already poorly represented in the sample. To take maximal advantage of the cross-country nature of our data set, we exclude new-debt issues from the remainder of the analysis.

Holding foreign-currency debt during an exchange rate depreciation also increases the interest charges incurred by the firm. This result is displayed in column E of Table (12), in which the dependent variable is accrued interest charges. The $(D^* \times \Delta e)$ term is associated with a increase in interest charges, although this effect is not precisely determined. Reassuringly, the three debt variables displayed all have coefficients that are of the order of interest rates, and debt in local currency is associated with substantially higher interest payments on average.

Finally, in column F, we sum the values for the change in debt and the accrued interest charges to produce a single statistic that describes how the firm's overall financial obligations have changed because of the interaction of dollar debt and the change in the exchange rate. Not surprisingly, the coefficient on the interaction is approximately equal to the sum on the individually estimated effects. Thus, for every extra dollar of debt held during a depreciation, firms experience a proportional increase in their financial obligations of about $1.28 per unit of log change in the real exchange rate.

The next stage, which incorporates the effect of a change in the exchange rate on current earnings, is relatively uncomplicated. Using the estimated coefficients from previous sections, we sum up the effects of a depreciation on debt and on earnings to find the impact of a depreciation on the firm's balance sheet. The components of this sum are displayed in Panel A of Table (13). Departing from our model, we also allow for collateralizability of future profits. To do this, we calculate the present discounted value of the rise in future earnings caused by a depreciation under different assumptions about the persistence of the exchange rate shock. Column 1 of Panel B combines the balance-sheet effects and future-earnings effects under various assumptions of collateralizability of future earnings. We find that holding dollar debt during a depreciation causes a decline in firm net worth, but that this decline is partly offset by higher current and future profits.

6.2 Effects of Net Worth on Investment

Finally, we combine the estimates of the decline in net worth with our model to calculate the approximate magnitude of the net-worth effect on fixed-capital investment. The principal ingredient in this calculation is an assumption about the depressing effect of financial net worth on investment. In the present study, our regressions of fixed-capital investment on financial factors typically indicate that one additional dollar of lagged *leverage* was associated with three cents less investment.[25]

Under this assumption, the net-worth component of the change in investment is estimated to be very small relative to the overall effect of holding dollar debt during an exchange rate realignment. These estimates are displayed in Panel B, column 2 of Table (13), and the net-worth component expressed as a fraction of the overall effect is presented in column 3 of the same panel. Focusing on column 3, we see that the net-worth component is smaller than the overall effect of $(D^* \times \Delta e)$ by between one and two orders of magnitude. Overall, this suggests that the net-worth effect was a relatively unimportant channel.

To corroborate our conclusion on the relative importance of the net-worth channel, we compare our estimate of the effect of leverage with those from other studies that have estimated firm level investment in developing countries. Harris, Schiantarelli, and Siregar (1994) look at a sample of 520 listed and non-listed manufacturing firms in Indonesia for the period 1981 to 1988. For 1985

[25] Of course, such an estimate does not imply a causal effect. However, the typically proposed biases on the coefficient result in a more negative estimate. For example, a firm with relatively strong growth prospects will invest more and pay down its debt faster, generating a negative correlation between leverage and investment in the data. Therefore, our use of this parameter estimate likely gives an *overestimate* of the effect of net worth on investment.

to 1988, the period in which the authors argue administrative control of credit was replaced by market assignment, they find that the coefficient on debt is between -0.025 and -0.018 for small firms (depending on the estimation technique) and actually positive for large firms. Gallego and Loayza (2000) carry out a similar exercise using 79 listed firms in Chile over the period 1985 to 1995. For the full sample, they find a coefficient on leverage of -0.038. Finally, Laeven (2000) using a panel of (mostly) listed firms in 13 developing countries for 1988 to 1998 finds a coefficient for debt that ranges between -0.014 and -0.057 for the full sample and between -0.03 and -0.13 for firms in countries in which financial liberalization has not take place. Hence, in most cases, existing studies have found coefficients similar in magnitude to our estimates. Larger coefficients have been found only in cases of severely regulated financial markets or administrative control of credit.

In conclusion, we verify that, under plausible assumptions, dollar-indebted firms do, on average, experience a decline in their net worth after a depreciation, even after considering the effects of both current and future earnings. However, we find that this reduction probably translates into a very small effect on fixed-capital investment. The first result is a question of accounting. The second result depends on our assumption about how much net worth affects investment. Although we have no satisfactory estimate of this causal effect, most of the typically proposed biased would lead us to overestimate the effect of net worth.[26]

Combining this evidence with the results in the previous section, we argue that positive investment responses associated with holding dollar debt during a depreciation reflect a competitiveness effect that arises from firms' matching the currency composition of the balance sheet to that of their income flows. In contrast, nowhere in our evidence is the large, negative net-worth effect on investment that has been presumed to be present during emerging-market depreciations. We do observe a decline in net worth but calculate that its impact on investment is comparatively small.

[26]Some have argued that the biases operate in the opposite direction. If this is the case, however, we believe that the sheer magnitude of the differences between the size of the net-worth effect and the total effect of dollar debt is informative. Even in the most conservative scenario discussed in Table (13) (zero collaterizability of future earnings), the coefficient on lagged leverage would have to be approximately seven times our estimated value, for the net-worth effect to have dominated the competitiveness effect.

7 Aggregate Results

Many of the predictions of the open-economy balance-sheet models depend on the economy-wide effects of a depreciation on investment. With this in mind, we now show that, in our sample, depreciations were on average associated with higher levels of investment.[27] We modify our basic specification, and estimate the investment equation using de-meaned values of dollar debt. In columns A through D of Table (14) we present the results of estimating investment using de-meaned values of dollar debt. For this specification, the average response of investment to the exchange rate is estimated by the main effect of Δe. We first examine fixed-capital investment in Panel A. The baseline result (Column A) is that investment and the real exchange rate do not co-move. However, after including measures of foreign credit inflow, bank credit and/or year effects, we estimate the main effect of the exchange rate to be significantly positive at conventional confidence intervals. For inventory investment, the main effect of the exchange rate is also positive, although not significantly different from zero (Table 14, Panel B). Unlike the case of fixed-capital investment, the coefficient on domestic credit in the inventory equation is significantly different from zero. The coefficient on the inflow of foreign credit, on the other hand, is not significant.

The implication of these results is immediate. On average, firms in our sample increased fixed-capital investment during depreciations. Thus, not only do dollar-indebted firms invest relatively more following a depreciation (the micro result discussed in previous sections) but on average the traditional Mundell-Fleming effect appears to have dominated the net-worth effect proposed in the third-generation currency-crisis models. For inventory investment, changes in the exchange rate have, on average, had a negligible effect.[28]

[27]Unlike the results presented above, the analysis in this section links the macro variables to *sample-average* investment. We present these results not as causal effects of the exchange rate, but rather as reduced-form correlations.

[28]Note that we are evaluating the direct effects of the exchange rate on firm-level decisions. Our results do not measure the effects of the exchange rate elsewhere in the economy that may in turn affecy firm investment. For example, if a devaluation leads to contraction in bank credit, then the aggregate effect of Δe on investment could well be negative.

8 Extrapolation

In this section we discuss some out-of-sample implications of our results. We find that holding the degree of matching constant, $\frac{\partial}{\partial\beta}\left[\frac{\partial I_t}{\partial e_t}\right]$ is positive for a wide range of values of leverage and financial constraints. To do so, recall that the differential effect of the exchange rate on investment across β could be decomposed into

$$\frac{\partial}{\partial\beta}\left[\frac{\partial I_t}{\partial e_t}\right] = \frac{\partial g'(e_{t+1})}{\partial\beta}\theta_t\mu' + \frac{\partial}{\partial\beta}\left(\frac{\partial\ net\ worth}{\partial e_t}\right)\sigma_t,$$

where the first term represents the differential competitiveness effect. If we assume that differences across β in $\frac{\partial\ net\ worth}{\partial e_t}$ are due only to the mechanical effect of e on the value of debt, then our estimated parameters from Table (13) imply that $\frac{\partial}{\partial\beta}(\frac{\partial\ net\ worth}{\partial e_t}) \approx -1.1$. In turn, parameters from Table (2) show that this reduction in net worth is associated with four cents less investment, so that $\sigma_t = -0.04$ and $\sigma_t\frac{\partial}{\partial\beta}(\frac{\partial\ net\ worth}{\partial e_t}) \cong -0.05$. Combining this result with the lower bound of our estimates for $\frac{\partial}{\partial\beta}\left[\frac{\partial I_t}{\partial e_t}\right]$ from Table (4), we find that $\frac{\partial g'(e_{t+1})}{\partial\beta}\theta_t\mu' \cong 0.33$. In the following subsection, we use this result to discuss some out-of-sample implications of our findings.

We begin with changes in average firm leverage. In our framework, an increase in leverage by a factor of λ is equivalent to multiplying $\frac{\partial}{\partial\beta}(competitiveness)$ by $1/\lambda$. If leverage is doubled, for example, then our estimated coefficient on $\frac{\partial}{\partial\beta}\left[\frac{\partial I}{\partial e}\right]$ is reduced to $(0.33/2) - 0.05 = 0.11$. To get a feeling of plausible variation in average leverage, we turn to data from Claessens and Djankov (2000), who report measures of leverage for firms in East Asia. Within their sample, the highest leverage ratios (those of Korea) exceeded those in our sample by a factor of two, considerably less that the factor of six required for negative net-worth effects to offset our estimated changes in competitiveness across β.

Our sample contains large, publicly listed firms. For firms that are not listed, the effects of net worth on investment (as measured by σ_t) are likely to be more severe. If, however, the only difference between the firms in our sample and non-listed firms is the severity of financial constraints, then these differences would have to be substantial—again by a factor of six—to generate a negative effect. Furthermore, as we discussed in the section on debt composition, smaller firms hold smaller fractions of dollar debt. The net effect is unclear: Among non-listed firms, the larger effect of net worth on investment may be offset by a smaller currency mismatch. In any case, σ_t would have to be an order of magnitude larger than that estimated for our sample for the relationship to be negative.

9 Conclusions

The present study provides evidence on the effect of foreign-currency liabilities on firm-level investment in periods of exchange rate volatility. Our starting point is a concern—advanced recently by several authors—about problems stemming from the currency mismatch of debt among emerging-market corporations. A consequence of this mismatch is that a depreciation may lead to a deterioration of firm net worth (as a result of inflated domestic-currency values of debt) that could attenuate or even reverse the usual expansionary effects of the depreciation.

Assessing which effect dominates, however, is ultimately an empirical question, and one for which little evidence has been presented so far. To attempt to fill this gap, we construct a new database of firm-level accounting information (including the currency composition of liabilities) for over 500 firms in five Latin American countries, and use it to estimate the reduced-form effect on investment of holding foreign-currency-denominated debt during an exchange rate realignment. In doing so, we believe that this study addresses a specific channel through which dollarized liabilities interact with exchange rate movements to affect investment by publicly traded firms. We do not, however, argue that other channels are not present (and potentially important).[29]

We consistently find that firms holding dollar debt invest more than firms holding peso debt in the period following a depreciation. This finding is exactly the opposite of what one would expect from a naive net-worth model that only considers the detrimental effect of the exchange rate on the

[29] One such channel, and one that definitely merits further careful research, is the effect of currency mismatch in the banking sector.

balance sheet. This result is robust to the inclusion of controls for both pre-existing firm differences and the interaction of these controls with aggregate macroeconomic variables.

We argue that this result is due to the degree to which firms match the currency composition of their debt with the elasticity of their income to the exchange rate. In the wake of a depreciation, the inflated peso value of dollar debt causes a deterioration in net worth that in turns induces a reduction in output and investment. However, in our sample, this negative net-worth effect is more than offset by higher current and future earnings caused by the competitiveness effect of the depreciation.

Providing support for this hypothesis we find that, after a depreciation, earnings are higher in those firms holding more dollar debt. In addition, in our sample, dollarization of liabilities is higher in firms whose income we expect *ex ante* to be more positively correlated with the real exchange rate (firms with tradable products, for example). Moreover, the competitiveness effect we measure would have likely outweighed the net-worth effect even if there had been substantial changes in average pre-depreciation financial factors, as we demonstrate using a simple, theoretically informed extrapolation.

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Appendix A. Variables

Microeconomic Variables

The following is a description of the main firm-level variables used in the paper.

1. **D*, Foreign debt:** debt denominated in a foreign currency converted into local currency. In all countries, accounting standards dictate that conversion of debt from foreign to local currency values be carried out using the exchange rate for the period in which the balance sheet is reported—in this case December. (Balance Sheet)
2. **Investment in fixed capital:** We combine purchases of fixed assets with disposal of fixed assets to construct our measure of fixed capital investment. Both of these variables are detailed in the cash flow statement. We opt not to use the change in net fixed assets as a measure of investment because accounting norms in most of the countries in our sample allow for revaluations of assets (Cash Statement)
3. We define **Investment in inventories** as the change in inventories in a given period. Inventories include raw materials, work in progress, and finished goods. (Balance Sheet)
4. **Net sales:** revenues from main operating activities. (Income Statement)
5. **Interest expense**: accrued interest on liabilities. (Income Statement)
6. **Earnings:** earnings before accrued interest, taxes, depreciation, and amortization (EBITDA). EBITDA = Operating Income + Depreciation and Amortization. (Cash Flow Statement)
7. **DN, New debt:** measure of new debt issued, net of repayments on outstanding principal. This variable does not include changes in debt coming from accrued interest payments. (Cash Flow Statement)
8. **Sector** is the industry in which the firm has its main operations. We code firms according to the two-digit ISIC 2 classification. (Company Notes)
9. **Parent** is a dummy variable that indicates whether the firm's controlling interest is another firm. See text for coding. (Company Notes and Historical News)
10. **International Operations** is a dummy variable that indicates whether the firm has subsidiaries or direct operations in other countries. See text for coding. (Company Notes)
11. **ADR** is a dummy variable that takes on a value of one if the firm's shares were listed in a foreign stock exchange in the form of American Depositary Reciepts (ADRs) in the previous period. (Bank of New York (2002))

Macroeconomic Variables

This subsection contains a description of the macroeconomic variables used throughout the paper. The source of most data is the IMF International Financial Statistics. IFS codes are in **(bold)**, series names are in *italics*. The rest of the data are from the IADB's web site, www.iadb.org.

IFS Data

1. **Bank Credit** (as a percentage of nominal GDP). A measure of financial sector credit to the private sector, specifically *claims on the private sector held by deposit banks*, end of period. While a more comprehensive measure of private credit that includes other financial institutions exists in the IFS, fewer observations are available. In any case correlation between both series over the 1980-99 period is extremely high (>.99). Dollar values were converted to domestic currency using period average exchange rates as described below.
2. **Inflow of Credit** (as a percentage of nominal GDP). A measure of inflows of credit to private companies. It is the sum of two components of the capital account: *debt securities liabilities* **(78bnd)** and *other investment liabilities to other sectors* **(78bvd).** Dollar values were converted to domestic currency using period average exchange rates as described below.
3. **Capital Inflows** (as a percentage of nominal GDP). An aggregate measure of total net capital inflows, *Financial Account* **(78bjd).**
4. **Nomint** (annual percentage). nominal interest rates on loans issued by the financial sector. In many cases, these data were not available for the entire sample period (if at all) so an alternative series was used:
   (a) Argentina - *lending rate* **(60p)**: 30-day loans by banks to prime clients.
   (b) Brazil - *savings rate* **(60k)**: rate paid by Brazilian savings and loan system on 30-day savings deposits.
   (c) Chile - *lending rate* **(60p)**: 30-89-day loans by banks, weighted average during the month (*tasa promedio sistema bancario*)
   (d) Colombia - *deposit rate* **(60l)**: weighted average rate paid on 90 day certificates of deposit.
5. **Realint**. The *ex post* real interest rate, calculated using **Nomint** and monthly variation in CPI over the same period as the debt maturity.
6. **Exchange rate**. Nominal exchange rate / CPI, end of period and period average.

Other sources

Aggregate Output. Real value added by sector and total nominal and real GDP. Sectors are defined according to the ISIC Revision 2. For Brazil, data for 1997 to 1998 are from the Brazilian Central Bank. Source: IADB and Brazilian Central Bank.

Appendix B. Derivation of the Law of Motion for Debt

Consider the movement of nominal balance-sheet variables over time. Dollar debt, D_t^*, follows a simple law of motion:

$$D_t^* = D_{t-1}^*(1 + r_{t-1}^*) - DS_t^* + DN_t^* \tag{21}$$

where DS_t^* is the period-t debt service paid on dollar debt and DN_t^* is the net issuance of new debt in period t. We multiply by $e_t \frac{CPI_T}{CPI_t}$ to obtain an equation in period-T dollars, and we define $\tilde{X}_t$ to be period-t X when expressed in period-T pesos. We also assume that debt service exactly covers interest charges each period, i.e., $DS_t^* = D_{t-1}^* r_{t-1}^*$. This yields

$$\tilde{D}_t^* = \tilde{D}_{t-1}^* \left(\frac{e_t}{e_{t-1}}\right)\left(\frac{CPI_{t-1}}{CPI_t}\right) + \tilde{DN}_t^*. \tag{22}$$

Similarly, for peso-denominated debt we have

$$D_t = D_{t-1}\theta_t(1 + r_{t-1}) - DS_t + DN_t, \tag{23}$$

where θ_t is a factor that allows for the indexation of domestic-currency debt. As before, we transform the equation into period-T units, and maintain the assumption that interest is paid completely each period:

$$\tilde{D}_t = \tilde{D}_{t-1}\theta_t \left(\frac{CPI_{t-1}}{CPI_t}\right) + \tilde{DN}_t. \tag{24}$$

We parameterize the indexation of debt as follows: $\theta_t = \left(\frac{CPI_t}{CPI_{t-1}}\right)^{\alpha}$, $\alpha\epsilon[0, 1]$. This allows for the special cases of full indexation ($\alpha = 1$), and no indexation ($\alpha = 0$), as well as for intermediate values.

Defining total debt $\tilde{P}_t$ as $\tilde{P}_t = \tilde{D}_t + \tilde{D}_t^*$, we find that

$$\Delta\tilde{P}_t \approx \tilde{D}_{t-1}^* \Delta \log\left(\frac{e_t}{CPI_t}\right) + (\alpha - 1)\tilde{D}_{t-1}\Delta \log CPI_t + \left(\tilde{DN}_t + \tilde{DN}_t^*\right). \tag{25}$$

The first term on the right-hand side is the one of interest. The real value of the firm's debt rises if it holds foreign-currency debt and the exchange rate goes up faster than the domestic-price level. This is, of course, a purely mechanical effect. The second term indicates that domestic-currency debt can be "inflated away," albeit at a slower pace if the debt is indexed to the local-price level. Moreover, by interacting $(\alpha-1)\tilde{D}_{t-1}\Delta \log CPI_t$ with country dummies, we allow the average degree of debt indexation to vary across countries. Finally, it is clear that net issues of new debt will also change the firm's level of debt holdings.

Holding foreign-currency debt during an exchange rate realignment similarly affects the interest charges incurred by the firm. The firm's debt service in constant pesos is as follows:

$$\left(\tilde{DS}_t + \tilde{DS}_t^*\right) \approx r_t\tilde{D}_{t-1} + r_t(\alpha - 1)\Delta \log CPI_t\tilde{D}_{t-1} + r_t^*\tilde{D}_{t-1}^* + r_t^*\Delta \log\left(\frac{e_t}{CPI_t}\right)\tilde{D}_{t-1}^*. \tag{26}$$

The rD terms reflect the usual charges for interest. The remaining terms represent the "revaluation" effects that come from changing relative prices over time, as seen in equation 25 as well.

Table 1. Sample Statistics

Panel A: Number of Firms in Sample Per Country and Year

Country	Year 1991	1992	1993	1994	1995	1996	1997	1998	1999	Total
Argentina		3	12	21	25	27	29	51	47	215
Brazil	54	87	101	116	153	237	243	242	256	1,489
Chile		11	18	56	73	86	95	69	2	410
Colombia				1	6	11	17	19	19	73
Mexico	26	35	43	66	73	85	96	105	108	637
Total	80	136	174	260	330	446	480	486	432	2,824

Panel B: Descriptive Statisitics

	Mean	Std. Dev.	N
Firm-Level Variables			
Lagged Dollar Debt	.104	(.152)	2824
Lagged Total Debt	.440	(.274)	2824
Lagged Short-Term Debt	.264	(.217)	2812
Fixed-Capital Investment	.071	(.099)	2824
Inventory Investment	.009	(.051)	2810
Earnings (EBITDA)	.106	(.101)	2802
Change in Total Debt	.065	(.197)	2824
Interest Accrued	.057	(.079)	2789
Macro Variables			
Δ Log Real Exchange Rate	.000	(.155)	2824
Inflow of Credit (% nominal GDP)	.024	(.026)	2749
Δ Log Bank Credit	.054	(.172)	2824
Δ Log Sectoral Value Added	.031	(.049)	2808
Micro/Macro Interactions			
Dollar Debt x (Δ Log Real Exchange Rate)	-.001	(.022)	2824
Total Debt x (Δ Log Real Exchange Rate)	.005	(.059)	2824
Dollar Debt x (Inflow of Credit)	.000	(.004)	2749
Total Debt x (Inflow of Credit)	-.001	(.007)	2749
Dollar Debt x (Δ Log Bank Credit)	-.005	(.034)	2824
Total Debt x (Δ Log Bank Credit)	-.004	(.041)	2824

Panel C: Comparisons

Lagged Dollar Indebtedness:	**Below Median**		**Above Median**	
Exchange-Rate Movement:	**Appr.**	**Depr.**	**Appr.**	**Depr.**
Variables:				
Change in Total Debt	.082	.064	.048	.068
	(.171)	(.215)	(.186)	(.218)
	[778]	[634]	[807]	[605]
Interest Accrued	.047	.075	.044	.067
	(.071)	(.116)	(.045)	(.071)
	[766]	[627]	[794]	[602]
Earnings (EBITDA)	.118	.083	.114	.102
	(.112)	(.103)	(.096)	(.085)
	[774]	[624]	[807]	[597]
Fixed-Capital Investment	.075	.058	.072	.078
	(.092)	(.082)	(.084)	(.135)
	[778]	[634]	[807]	[605]
Inventory Investment	.016	.005	.006	.007
	(.067)	(.043)	(.041)	(.046)
	[770]	[630]	[805]	[605]

Note:
Panel A displays, per country and year, the number of firms in the sample that have nonmissing data on lagged foreign-currency debt. In Panel B, "Firm-level" variables are contemporaneous unless otherwise indicated. All accounting variables are converted to real (constant-peso) values and scaled by the lagged real value of total firm assets. Macroeconomic variables are from the current period (i.e., concurrent with the investment variables). The real exchange rate is defined as the nominal exchange rate divided by the domestic CPI. Panel C displays the mean, the standard deviation (in parentheses), and number of observations (in brackets). The accounting data are the pooled Bloomberg / Economatica sample, as described in the text. Macro data are drawn from various sources, principally International Financial Statistics. For detailed sources and descriptions, see Section 2 and Appendix A.

Table 2. Effect of Dollar Debt And Exchange-Rate Movements On Investment in Fixed Capital

	Dependent Variable: Investment in Fixed Capital					
	Baseline Results			Results with Competitiveness Controls		
Independent Variables	(A)	(B)	(C)	(D)	(E)	(F)
Interaction Effect						
Dollar Debt x (Δ Log Real Exchange Rate)	0.407 ***	0.422 ***	0.415 ***	0.326 *	0.356 ***	0.293 *
	(0.123)	(0.136)	(0.111)	(0.180)	(0.103)	(0.161)
Main Effects						
Total Debt	-0.030 ***	-0.022 ***	-0.024 **	-0.038 ***	-0.014	-0.028 ***
	(0.011)	(0.008)	(0.010)	(0.009)	(0.011)	(0.009)
Dollar Debt	0.019	0.000	0.002	0.023	0.003	0.025
	(0.017)	(0.020)	(0.026)	(0.024)	(0.023)	(0.022)
Δ Log Real Exchange Rate	0.018	0.016	0.017		0.030	
	(0.032)	(0.030)	(0.028)		(0.023)	
Controls						
Country Dummies x Peso Debt x (Δ Log CPI)		Yes	Yes	Yes	Yes	Yes
Total Debt x (Δ Log Real Exchange Rate)			0.014	0.071	-0.003	0.046
			(0.071)	(0.049)	(0.069)	(0.054)
Country x 1 Digit ISIC Dummies x (Δ Log Real Exchange Rate)				Yes		
Δ Log Sectorial Value Added					0.123 ***	
					(0.037)	
Contemporaneous Earnings					0.246 ***	0.212 ***
					(0.028)	(0.029)
Fixed Effects						
Fixed Effects	Country	Country	Country	Country x 1 Digit ISIC	Country	Country x Year x 1 Digit ISIC
Regression Statistics						
N	2824	2824	2824	2824	2786	2802
R^2	0.029	0.035	0.036	0.113	0.099	0.187

Note:
This table reports the OLS estimates of equation (14) in the text. Standard errors adjusted for clustering by (country x year) are reported in parentheses. A single asterisk denotes statistical significance at the 90% level of confidence; double, 95%; triple, 99%. The number of observations varies because of data availability. The dependent variable is investment in fixed capital. Firm-level independent variables are once-lagged values, except for contemporaneous earnings. All accounting variables are scaled by the lag of total firm assets. Macroeconomic variables (real exchange rate, sectorial value added, and CPI) are from the current period (i.e., concurrent with the LHS investment variable). The real exchange rate is defined as the nominal exchange rate divided by the domestic CPI. The accounting data are the pooled Bloomberg / Economatica sample, as described in the text. Macro data are drawn from various sources. For detailed sources and descriptions, see Section 2.

Table 3. Effect of Dollar Debt and Exchange-Rate Movements on Investment in Inventory

	Dependent Variable: Investment in Inventories					
	Baseline Results			Results with Competitiveness Controls		
Independent Variables	(A)	(B)	(C)	(D)	(E)	(F)
Interaction Effect						
Dollar Debt x	0.260 ***	0.249 ***	0.229 ***	0.163 ***	0.208 ***	0.129 **
(Δ Log Real Exchange Rate)	(0.058)	(0.055)	(0.055)	(0.058)	(0.049)	(0.054)
Main Effects						
Total Debt	-0.006	-0.009 ***	-0.015 ***	-0.019 ***	-0.010 **	-0.011 **
	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)
Dollar Debt	-0.028 **	-0.018 *	-0.013	-0.003	-0.013	0.002
	(0.014)	(0.010)	(0.011)	(0.012)	(0.009)	(0.010)
Δ Log Real Exchange Rate	0.001	0.005	0.006		0.011	
	(0.018)	(0.016)	(0.017)		(0.012)	
Controls						
Country Dummies x Peso Debt x (Δ Log CPI)		Yes	Yes	Yes	Yes	Yes
Total Debt x			0.038 **	0.067 ***	0.026	0.034
(Δ Log Real Exchange Rate)			(0.016)	(0.022)	(0.016)	(0.024)
Country x 1 Digit ISIC Dummies x (Δ Log Real Exchange Rate)				Yes		
Δ Log Sectorial Value Added					0.073 **	
					(0.032)	
Contemporaneous Earnings					0.130 ***	0.147 ***
					(0.024)	(0.033)
Fixed Effects	Country	Country	Country	Country x 1 Digit ISIC	Country	Country x Year x 1 Digit ISIC
Regression Statistics						
N	2988	2988	2988	2988	2902	2918
R^2	0.023	0.028	0.029	0.064	0.097	0.216

Note:
This table reports the OLS estimates of equation (14) in the text. Standard errors adjusted for clustering by (country x year) are reported in parentheses. A single asterisk denotes statistical significance at the 90% level of confidence; double, 95%; triple, 99%. The number of observations varies because of data availability. The dependent variable is investment in fixed capital. Firm-level independent variables are once-lagged values, except for contemporaneous earnings. All accounting variables are scaled by the lag of total firm assets. Macroeconomic variables (real exchange rate, sectorial value added, and CPI) are from the current period (i.e., concurrent with the LHS investment variable). The real exchange rate is defined as the nominal exchange rate divided by the domestic CPI. The accounting data are the pooled Bloomberg / Economatica sample, as described in the text. Macro data are drawn from various sources. For detailed sources and descriptions, see Section 2.

Table 4. Importance of Changes in Aggregate Credit Conditions

	Dependent Variables: Investment in…							
	Fixed Capital				Inventories			
Independent Variables	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
Interaction Effect								
Dollar Debt x	0.422 ***	0.413 ***	0.382 **	0.403 ***	0.249 ***	0.217 ***	0.248 ***	0.228 ***
(Δ Log Real Exchange Rate)	(0.136)	(0.130)	(0.153)	(0.126)	(0.055)	(0.055)	(0.057)	(0.047)
Main Effects								
Total Debt	-0.022 ***	-0.023 **	-0.030 ***	-0.026 ***	-0.009 ***	-0.017 ***	-0.016 ***	-0.007
	(0.008)	(0.010)	(0.007)	(0.008)	(0.003)	(0.004)	(0.004)	(0.005)
Dollar Debt	0.000	-0.002	0.015	0.000	-0.018	-0.005	-0.009	-0.020
	(0.020)	(0.026)	(0.021)	(0.019)	(0.010)	(0.009)	(0.010)	(0.010)
Δ Log Real Exchange Rate	0.016	0.017	0.058 **	0.013	0.005	0.007	0.020	0.005
	(0.030)	(0.028)	(0.027)	(0.024)	(0.016)	(0.017)	(0.016)	(0.014)
Controls								
Total Debt x		0.012				0.044 ***		
(Δ Log Real Exchange Rate)		(0.072)				(0.017)		
Log (Lagged Total Assets)		0.001				-0.002 **		
		(0.001)				(0.001)		
Log (Lagged Total Assets) x		0.000				0.004		
(Δ Log Real Exchange Rate)		(0.010)				(0.005)		
Inflow of Credit to Country			0.489 ***				0.187	
			(0.146)				(0.120)	
Total Debt x			-0.371				-0.334	
Inflow of Credit			(0.344)				(0.183)	
Dollar Debt x			0.415				0.428	
Inflow of Credit			(0.508)				(0.406)	
Δ Log Bank Credit (of Country)				0.037 ***				0.040 **
				(0.011)				(0.016)
Total Debt x				-0.074				0.058
Δ Log Bank Credit				(0.054)				(0.053)
Dollar Debt x				-0.043				-0.095
Δ Log Bank Credit				(0.072)				(0.073)
Regression Statistics								
N	2824	2824	2749	2824	2988	2988	2909	2988
R^2	0.035	0.036	0.04	0.039	0.028	0.033	0.035	0.038

Note:
This table reports the OLS estimates of equation (14) in the text, plus the indicated main effects and interactions of firm-level and macro variables in Columns B through D and F through H. Specification includes country fixed effects, Δ Log CPI, and the interaction of the two with peso debt, as in Table 2, Column B. Standard errors adjusted for clustering by (country x year) are reported in parentheses. A single asterisk denotes statistical significance at the 90% level of confidence; double, 95%; triple, 99%. The number of observations varies because of data availability. The dependent variables are as indicated above. Firm-level independent variables are once-lagged values. All accounting variables are scaled by the lag of total firm assets. Macroeconomic variables (real exchange rate, sectorial value added, and CPI) are from the current period (i.e., concurrent with the LHS investment variable). The real exchange rate is defined as the nominal exchange rate divided by the domestic CPI. "Inflow of Credit to Country" is a measure of aggregate credit inflows to the private sector. "Bank Credit" is the measure of aggregate claims on the private sector by deposit banks. Both credit-market macro variables are scaled by GDP. The accounting data are the pooled Bloomberg / Economatica sample, as described in the text. Macro data are drawn from various sources. For detailed sources and descriptions, see Section 2.

Table 5. Composition of Debt: Maturity versus Currency

	Dependent Variables: Investment in…									
	Fixed Capital					Inventories				
Independent Variables	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
Dollar Debt x (Δ Log Real Exchange Rate)	0.406 ***	0.415 ***	0.422 ***	0.392 ***	0.427 ***	0.204 ***	0.195 ***	0.186 ***	0.189 ***	0.209 ***
	(0.094)	(0.100)	(0.099)	(0.093)	(0.097)	(0.058)	(0.055)	(0.053)	(0.048)	(0.050)
Dollar Debt x Inflow of Credit			0.532		0.608			-0.018		0.244
			(0.389)		(0.469)			(0.481)		(0.492)
Dollar Debt x Δ Log Bank Credit				-0.067	-0.093				-0.106	-0.122 **
				(0.082)	(0.067)				(0.063)	(0.059)
Short-Term Debt x (Δ Log Real Exchange Rate)		0.087	0.172 *	0.072	0.182 **		-0.064	-0.010	-0.055	-0.032
		(0.097)	(0.091)	(0.090)	(0.083)		(0.056)	(0.086)	(0.047)	(0.084)
Short-Term Debt x Inflow of Credit			0.788		1.031			0.671		0.308
			(0.735)		(0.746)			(0.514)		(0.634)
Short-Term Debt x Δ Log Bank Credit				-0.115	-0.149				0.129	0.130
				(0.099)	(0.088)				(0.077)	(0.093)
Regression Statistics										
N	2703	2691	2617	2691	2617	2869	2869	2790	2869	2790
R^2	0.035	0.036	0.042	0.042	0.045	0.033	0.035	0.04	0.045	0.049

Note:
This table reports the OLS estimates of equation (14) in the text, plus the indicated interactions of firm-level and macro variables in Columns B through E and G through J. Specification includes country fixed effects, Δ Log CPI, and the interaction of the two with peso debt, as in Table 2, Column B. Also includes the interactions of total debt with the real exchange rate, Δ Log Bank Credit, and Inflow of Credit; and all relevent main effects. Standard errors adjusted for clustering by (country x year) are reported in parentheses. A single asterisk denotes statistical significance at the 90% level of confidence; double, 95%; triple, 99%. The number of observations varies because of data availability. The dependent variables are as indicated above. Firm-level independent variables are once-lagged values. All accounting variables are scaled by the lag of total firm assets. Short-term debt is all firm debt coming due within one year (i.e., in the previous year since this variable is lagged). Macroeconomic variables (real exchange rate, sectorial value added, and CPI) are from the current period (i.e., concurrent with the LHS investment variable). The real exchange rate is defined as the nominal exchange rate divided by the domestic CPI. "Inflow of Credit to Country" is a measure of aggregate credit inflows to the private sector. "Bank Credit" is the measure of aggregate claims on the private sector by deposit banks. Both credit-market macro variables are scaled by GDP. The accounting data are the pooled Bloomberg / Economatica sample, as described in the text. Macro data are drawn from various sources. For detailed sources and descriptions, see Section 2.

Table 6. Cross-Border Ownership

Independent Variables	Dependent Variables: Investment in… Fixed Capital (A)	(B)	(C)	(D)	(E)	(F)	Inventories (G)	(H)	(I)	(J)	(K)	(L)
Interaction Effect												
Dollar Debt x	0.427 ***	0.428 ***	0.455 ***	0.373 ***	0.453 ***	0.405 ***	0.230 ***	0.231 ***	0.224 ***	0.220 ***	0.225 ***	0.216 ***
(Δ Log Real Exchange Rate)	(0.113)	(0.126)	(0.125)	(0.104)	(0.133)	(0.114)	(0.057)	(0.056)	(0.059)	(0.058)	(0.058)	(0.060)
Controls												
Dummy if Has Parent Company		0.021 ***			0.022 ***			0.001			0.001	
		(0.006)			(0.006)			(0.002)			(0.002)	
I(Has Parent) x		0.012			0.007			0.003			0.005	
(Δ Log Real Exchange Rate)		(0.053)			(0.051)			(0.026)			(0.026)	
Dummy if Has International Operations			0.013 ***		0.015 ***	0.010 **			0.000		0.001	0.000
			(0.004)		(0.004)	(0.004)			(0.002)		(0.002)	(0.002)
I (International Operations) x			-0.045		-0.041	-0.059			0.011		0.012	0.009
(Δ Log Real Exchange Rate)			(0.030)		(0.021)	(0.032)			(0.006)		(0.008)	(0.007)
Dummy if Has ADR				0.019 ***		0.018 ***				0.005		0.005
				(0.005)		(0.005)				(0.003)		(0.003)
I(Has ADR) x				0.084 **		0.091 **				0.013		0.012
(Δ Log Real Exchange Rate)				(0.042)		(0.043)				(0.011)		(0.011)
Regression Statistics												
N	2602	2602	2602	2602	2602	2602	2693	2693	2693	2693	2693	2693
R^2	0.036	0.041	0.038	0.045	0.044	0.047	0.03	0.03	0.03	0.031	0.03	0.031

Note:

This table reports the OLS estimates of equation (14) in the text, plus the indicated interactions of firm-level and macro variables in Columns B through F. Specification includes country fixed effects, Δ log CPI, and the interaction of the two with peso debt, and all relevant main effects. Standard errors adjusted for clustering by (country x year) are reported in parentheses. A single asterisk denotes statistical significance at the 90% level of confidence; double, 95%; triple, 99%. The dependent variables are as indicated above. Firm-level independent variables are once-lagged values. All accounting variables are scaled by the lag of total firm assets. Macroeconomic variables are from the current period (i.e. concurrent with the LHS investment variable). The real exchange rate is defined as the nominal exchange rate divided by the domestic CPI. The accounting data are a Bloomberg subsample with nonmissing ownership data. The variable on international operations is an indicator constructed by searching in the Bloomberg company profile for references to foreign subsidiaries or other activities abroad. The indicator variable for whether the firm has a parent company was constructed by examining current ownership and the history of large share transactions. This variables is coded as one if firms had a parent company prior to their first appearance in the sample. The indicator variable for whether the firm has American Depositary Receipts (ADRs) is constructed from the Bank of New York ADR database. This variable is coded as one if the firm's shares where listed as ADRs in a foreign stock exchange in the previous period. For detailed sources and descriptions, see Section 2.

Table 7. Relaxing the Assumption of Linearity

	Dependent Variables: Investment in…							
	Fixed Capital				Inventories			
Independent Variables	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
Interaction Effect								
Dollar Debt x	0.407 ***	0.406 ***	0.429 ***	0.497 **	0.260 ***	0.260 ***	0.259 ***	0.242 ***
(Δ Log Real Exchange Rate)	(0.123)	(0.121)	(0.065)	(0.223)	(0.058)	(0.058)	(0.071)	(0.031)
Controls								
Total Debt	-0.030 ***	-0.046 ***	-0.026 ***	-0.030 ***	-0.006	-0.005	-0.009	-0.006
	(0.011)	(0.011)	(0.007)	(0.010)	(0.004)	(0.007)	(0.006)	(0.004)
$(\text{Total Debt})^2$		0.006 ***				0.000		
		(0.002)				(0.001)		
Total Debt x (Dollar Debt x			-0.158				-0.021	
(Δ Log Real Exchange Rate)			(0.365)				(0.130)	
Appreciation Dummy x Dollar Debt				-0.283				-0.002
x (Δ Log Real Exchange Rate)				(0.296)				(0.103)
Regression Statistics								
N	2824	2824	2824	2824	2988	2988	2988	2988
R^2	0.029	0.031	0.032	0.034	0.023	0.023	0.024	0.03

Note:
This table reports the OLS estimates of equation (14) in the text, plus the indicated interactions and all relevant main and second-order effects. Specification includes country fixed effects, Δ log CPI, and the interaction of the two with peso debt, as in Table 2, Column B. Standard errors adjusted for clustering by (country x year) are reported in parentheses. A single asterisk denotes statistical significance at the 90% level of confidence; double, 95%; triple, 99%. The dependent variables are as indicated above. Firm-level independent variables are once-lagged values. All accounting variables are scaled by the lag of total firm assets. Macroeconomic variables are from the current period (i.e., concurrent with the LHS investment variable). The real exchange rate is defined as the nominal exchange rate divided by the domestic CPI. The accounting data are the pooled Bloomberg / Economatica sample, as described in the text. Macro data are drawn from various sources. For detailed sources and descriptions, see Section 2.

Table 8. Mexico

Independent Variables	Dependent Variable: Investment in Fixed Capital			
	(A) **1990-99**	(B) **1994-95**	(C) **1994**	(D) **1995**
Interactions				
Dollar Debt x	0.337 **	0.546 **		
(Δ Log Real Exchange Rate)	(0.166)	(0.243)		
Total Debt x	-0.546 **	-0.615		
(Δ Log Real Exchange Rate)	(0.271)	(0.394)		
Main Effects and Controls				
Δ Log Real Exchange Rate	0.109 ***	0.151 ***		
	(0.032)	(0.041)		
Dollar Debt	0.074 ***	0.029	0.324 **	0.026
	(0.022)	(0.033)	(0.126)	(0.034)
Total Debt	-0.108 ***	-0.113 **	-0.439 **	-0.104 **
	(0.026)	(0.046)	(0.204)	(0.049)
Contemporaneous Earnings	0.290 *	0.162 *	0.302	0.017
	(0.039)	(0.104)	(0.187)	(0.071)
Regresion Statisitics				
N	635	139	66	73
R^2	0.161	0.169	0.096	0.088

Note:
This table reports the OLS estimates of equation (14) in the text for a sub-sample of Mexican firms. Robust standard errors are reported in parentheses. A single asterisk denotes statistical significance at the 90% level of confidence; double, 95%; triple, 99%. The dependent variable is investment in fixed capital. Firm-level independent variables are once-lagged values, except for contemporaneous earnings. All accounting variables are scaled by the lag of total firm assets. The real exchange rate is from the current period (i.e., concurrent with the LHS investment variable) and is defined as the nominal exchange rate divided by the domestic CPI. The accounting data are from the Bloomberg sample, as described in the text. Macro data are drawn from various sources, principally International Financial Statistics. For detailed sources and descriptions, see Section 2.

Table 9. Conditioning on Lagged Performance

Independent Variables	(A)	(B)	(C)	(D)	(E)	(F)
	Dependent Variables: Investment in…					
	Fixed Capital			Inventories		
Interaction Effect						
Dollar Debt x (Δ Log Real Exchange Rate)	0.405 ***	0.414 ***	0.353 ***	0.197 ***	0.190 ***	0.192 ***
	(0.122)	(0.107)	(0.109)	(0.049)	(0.049)	(0.048)
Controls						
Inflow of Credit to Country	0.484 ***	0.426 ***	0.449 ***	0.341 ***	0.370 ***	0.365 ***
	(0.115)	(0.117)	(0.128)	(0.115)	(0.106)	(0.106)
Total Debt x Inflow of Credit	-0.403	-0.522	-0.866	0.163	0.067	0.117
	(0.582)	(0.687)	(0.655)	(0.281)	(0.292)	(0.289)
Dollar Debt x Inflow of Credit	0.552	0.614	1.051 **	-0.116	-0.185	-0.267
	(0.403)	(0.442)	(0.478)	(0.397)	(0.401)	(0.387)
Earnings		0.227 ***	0.186 ***		0.080 ***	0.085 ***
		(0.024)	(0.026)		(0.018)	(0.019)
Earnings x (Δ Log Real Exchange Rate)		0.438	0.296		-0.225	-0.222
		(0.240)	(0.304)		(0.144)	(0.158)
Earnings x Inflow of Credit		3.185 ***	3.443 ***		-2.713 ***	-2.798 **
		(0.947)	(1.201)		(1.006)	(1.097)
(Lagged) LHS Variable			0.292 ***			-0.034 **
			(0.069)			(0.014)
(Lagged) LHS Variable x (Δ Log Real Exchange Rate)			0.752			-0.005
			(0.457)			(0.133)
(Lagged) LHS Variable x Inflow of Credit			-2.242			0.533
			(2.590)			(0.773)
Regression Statistics						
N	2647	2647	2647	2658	2658	2658
R^2	0.039	0.082	0.151	0.039	0.067	0.071

Note:
This table reports the OLS estimates of equation (14) in the text, plus the indicated interactions of firm-level and macro variables. Specification also includes country fixed effects, Δ Log CPI, and the interaction of the two with peso debt, and all relevent main effects. Standard errors adjusted for clustering by (country x year) are reported in parentheses. A single asterisk denotes statistical significance at the 90% level of confidence; double, 95%; triple, 99%. The dependent variables are as indicated above. Firm-level independent variables are once-lagged values. All accounting variables are scaled by the lag of total firm assets. "Earnings" are the firm's earnings before interest, depreciation, and taxes (EBITDA). The lagged LHS variable is one lag of the dependent variable. Macroeconomic variables are from the current period (i.e., concurrent with the LHS investment variable). The real exchange rate is defined as the nominal exchange rate divided by the domestic CPI. "Inflow of Credit to Country" is a measure of aggregate credit inflows to the private sector. "Bank Credit" is the measure of aggregate claims on the private sector by deposit banks. Both credit-market macro variables are scaled by GDP. The accounting data are the pooled Bloomberg/Economatica sample described in the text. Macro data are drawn from various sources, principally International Financial Statistics. For detailed sources and descriptions, see Section 2.

Table 10. Determinants of Currency Composition of Debt

Independent Variables	Full Sample (A)		Full Sample (B)		Full Sample (C)		Sample with Ownership Data (D)		Sample with Ownership Data (E)	
Indicators of g′(e;β)										
Dummy for Tradeable Sector	0.054	***			0.045	***	0.065	***	0.059	***
	(0.008)				(0.008)		(0.008)		(0.008)	
Elasticity of Own-Sector Value Added to Real Exchange Rate			0.448	***	0.299	***				
			(0.076)		(0.047)					
Dummy for International Operations									0.098	***
									(0.016)	
Controls										
Log Assets	0.047	***	0.042	***	0.044	***	0.046	***	0.043	***
	(0.002)		(0.002)		(0.002)		(0.002)		(0.002)	
Dummy if Has Parent Company									-0.021	**
									(0.009)	
Regression Statistics										
N	3419		3419		3421		3242		3242	
R^2	0.428		0.425		0.43		0.398		0.409	

Note:
This table reports the OLS estimates of equation (16) in the text. Specification also includes (country x year) fixed effects. Standard errors adjusted for clustering by firm are reported in parentheses. A single asterisk denotes statistical significance at the 90% level of confidence; double, 95%; triple, 99%. The dependent variable is the fraction of debt denominated in foreign currency. "Full sample" is pooled Bloomberg/Economatica data described in the text. "Sample with ownership data" consists of the Bloomberg sample with nonmissing ownership data. The elasticity of sectorial value added to the real exchange rate was computed using data from 1980 through 1999. The variable on international operations is an indicator constructed by searching in the Bloomberg company profile for references to foreign subsidiaries or other activities abroad. The indicator variable for whether the firm has a parent company was constructed by examining current ownership and the history of large share transactions. This variable is coded as one if firms had a parent company prior to their first appearance in the sample. For detailed sources and descriptions, see Section 2.

Table 11. Effect of Dollar Debt and Exchange-Rate Movements on Firm Income

	Dependent Variables					
	Sales	Earnings	Earnings (t+1)			
Independent Variables	(A)	(B)	(C)	(D)	(E)	(F)
Interaction Effect						
Dollar Debt x	2.616 ***	0.219 **	0.355 ***	0.350 ***	0.331 ***	0.248 ***
(Δ Log Real Exchange Rate)	(0.528)	(0.100)	(0.099)	(0.098)	(0.096)	(0.078)
Main Effects						
Total Debt	0.574 ***	-0.036 ***	-0.045 ***	-0.040 ***	-0.040 ***	-0.021 **
	(0.080)	(0.012)	(0.012)	(0.012)	(0.012)	(0.009)
Dollar Debt	-1.079 ***	-0.004	0.007	0.003	0.006	0.011
	(0.099)	(0.015)	(0.016)	(0.016)	(0.016)	(0.012)
Controls						
Total Debt x	-1.774 ***	-0.045	-0.100	-0.134	-0.141	0.017
(Δ Log Real Exchange Rate)	(0.301)	(0.082)	(0.109)	(0.112)	(0.112)	(0.061)
Fixed-Capital Investment				0.185 ***	0.173 ***	
(period t)				(0.025)	(0.025)	
Inventory Investment					0.126 ***	
(period t)					(0.041)	
Earnings (period t)						0.637 ***
						(0.022)
Regression Statistics						
N	2883	2807	2514	2368	2359	2359
R^2	0.093	0.107	0.096	0.116	0.121	0.121

Note:
This table contains OLS estimates of equation (14) in the text. The dependent variables are as indicated above. Standard errors adjusted for clustering by (country x year) are reported in parentheses. A single asterisk denotes statistical significance at the 90% level of confidence; double, 95%; triple, 99%. The dependent variables are as indicated above. Firm-level independent variables are once-lagged values. All accounting variables are scaled by the lag of total firm assets. "Sales" are the firm's sales revenue for the current year. "Earnings" are the firm's current-year earnings before interest, depreciation, and taxes (EBITDA). "Earnings (t+1)" are the firm's EBITDA for the succeeding year. Macroeconomic variables are from the current period. The real exchange rate is defined as the nominal exchange rate divided by the domestic CPI. The accounting data are the pooled Bloomberg/Economatica sample described in the text. Macro data are drawn from various sources, principally International Financial Statistics. For detailed sources and descriptions, see Section 2.

Table 12. Effect of Dollar Debt and Exchange-Rate Movements on Firm Liabilities

Independent Variables	Debt Level (A)		Debt Level (B)		Change in Debt (C)		Change in Debt less New Issues (D)		Accrued Interest Charges (E)		Change in Debt plus Interest (F)	
	Dependent Variables											
Interaction Effect												
Dollar Debt x	1.118	***	1.442	***	1.118	***	1.514	***	0.159		1.280	***
(Δ Log Real Exchange Rate)	(0.151)		(0.205)		(0.151)		(0.219)		(0.162)		(0.181)	
Main Effects												
Peso Debt	1.055	***	0.972	***	0.055		-0.042		0.198	***	0.252	***
	(0.036)		(0.040)		(0.036)		(0.054)		(0.018)		(0.053)	
Dollar Debt	0.870	***	0.855	***	-0.130	***	-0.151	***	0.111	***	-0.019	
	(0.033)		(0.028)		(0.033)		(0.032)		(0.016)		(0.040)	
Δ Log Real Exchange Rate	0.038		0.013		0.038		0.005		0.042		0.082	
	(0.088)		(0.090)		(0.088)		(0.089)		(0.027)		(0.088)	
Controls												
Total Debt x	-0.440	***	-1.039	***	-0.440	***	-1.217	***	0.111	**	-0.332	**
(Δ Log Real Exchange Rate)	(0.118)		(0.136)		(0.118)		(0.203)		(0.052)		(0.166)	
New Issues of Debt			0.684	***								
			(0.144)									
Regression Statistics												
N	3003		2815		3003		2815		2918		2918	
R^2	0.675		0.693		0.041		0.193		0.528		0.098	

Note:
This table contains OLS estimates of equation (14) in the text. The dependent variables, various firm liabilities, are as indicated above. Specification also includes country fixed effects, Δ Log CPI, the interaction of the two with peso debt, and all relevent main effects. Standard errors adjusted for clustering by (country x year) are reported in parentheses. A single asterisk denotes statistical significance at the 90% level of confidence; double, 95%; triple, 99%. The dependent variables are as indicated above. Firm-level independent variables are once-lagged values, except for new issues of debt. All accounting variables are scaled by the lag of total firm assets. Macroeconomic variables are from the current period. The real exchange rate is defined as the nominal exchange rate divided by the domestic CPI. The accounting data are the pooled Bloomberg/Economatica sample described in the text. Macro data are drawn from various sources, principally International Financial Statistics. For detailed sources and descriptions, see Section 2.

Table 13. Did Firm Net Worth Actually Decline?

Panel A: Estimated Changes in Selected Dependent Variables

	Sign of Effect on Net Worth	Estimated Effect of (Dollar Debt times RER)	Source for Estimate
Current Period			
Debt	(-)	1.118	Table 11, Col. C
Debt Service	(-)	0.159	Table 11, Col. E
Earnings	(+)	0.219	Table 10, Col. B
Subtotal		-1.058	
Future Periods			
Earnings (period t+1)	(+)	0.331	Table 10, Col. E

Panel B: Overall Change in Net Worth

	PDV of Above Effects	Calcluated Impact on Capital Inv.	Expressed as Fraction of Actual Effect
Full collateralizability of future earnings			
Deval. has one year half life	-0.506	-0.015	-0.067
Deval has eighteen month half life	-0.354	-0.011	-0.047
50% collateralizability of future earnings			
Deval. has one year half life	-0.782	-0.023	-0.104
Deval has eighteen month half life	-0.706	-0.021	-0.094
Zero collateralizability of future earnings	-1.058	-0.032	-0.140
Debt and debt service only	-1.277	-0.038	-0.170

Source: Authors' calculations. Assumes a 10% annual discount rate and coefficient of investment to wealth of -3%. See text.

Table 14. Effects of Macroeconomic Variables

Panel A: Investment in Fixed Capital

	Exchange-Rate Effect Evaluated at Sample Mean of Dollar Indebtedness				Exchange-Rate Effect Evaluated at Zero Dollar Indebtedness	
Independent Variables	(A)	(B)	(C)	(D)	(E)	(F)
Δ Log Real Exchange Rate	0.019	0.043 ***	0.071 ***	0.078 ***	0.017	0.052 ***
	(0.031)	(0.009)	(0.021)	(0.012)	(0.018)	(0.015)
Inflow of Credit to Country			0.590 ***	0.429 ***		0.429 ***
			(0.107)	(0.116)		(0.116)
Δ Log Bank Credit (of Country)				0.020		0.020
				(0.015)		(0.015)
Year Effects		Yes		Yes	Yes	Yes
Regression Statistics						
N	2824	2824	2749	2749	2824	2749
R^2	0.029	0.04	0.035	0.042	0.04	0.042
Number of clusters	40	40	38	38	40	38

Panel B: Investment in Inventories

	Exchange-Rate Effect Evaluated at Sample Mean of Dollar Indebtedness				Exchange-Rate Effect Evaluated at Zero Dollar Indebtedness	
Independent Variables	(A)	(B)	(C)	(D)	(E)	(F)
Δ Log Real Exchange Rate	0.001	0.006	0.019	0.017	-0.016	-0.007
	(0.018)	(0.010)	(0.018)	(0.013)	(0.015)	(0.020)
Inflow of Credit to Country			0.215	0.104		0.104
			(0.121)	(0.100)		(0.100)
Δ Log Bank Credit (of Country)				0.044 **		0.044 **
				(0.018)		(0.018)
Year Effects		Yes		Yes	Yes	Yes
Regression Statistics						
N	2988	2988	2909	2909	2988	2909
R^2	0.023	0.035	0.028	0.048	0.035	0.048
Number of clusters	40	40	38	38	40	38

Note:
This table displays OLS estimates of the main effects of macroeconomic variables. The dependent variable is fixed-capital investment in Panel A and inventory investment in Panel B. The regression specification also allows for interaction effects and the first-order effects of accounting variables, as in equation (14) in the text. Robust standard errors adjusted for clustering by (country x year) are reported in parentheses. A single asterisk denotes statistical significance at the 90% level of confidence; double, 95%; triple, 99%. Firm-level independent variables are once-lagged values. All accounting variables are scaled by the lag of total firm assets. Macroeconomic variables are from the current period. The real exchange rate is defined as the nominal exchange rate divided by the domestic CPI. The accounting data are the pooled Bloomberg/Economatica sample described in the text. Macro data are drawn from various sources, principally International Financial Statistics. For detailed sources and descriptions, see Section 2.