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Foreign Currency Borrowing, Balance Sheet Shocks, and Real Outcomes*

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Abstract

Emerging market firms frequently borrow in foreign currency (FX), but their assets are often denominated in domestic currency. This behavior leads to an FX mismatch on firms balance sheets, which can harm their net worth in the event of a depreciation. I use a large, unanticipated, and exogenous depreciation episode and a unique dataset to identify the real and financial effects of firm balance sheet shocks. I construct a new dataset of all listed non-financial firms, matched to their banks, in Mexico over 2008q1-2015q2. This dataset combines firm-level balance sheets and real outcomes, currency composition of both assets and liabilities, and firms' loan-level borrowing from banks in peso and FX. This data allows me to control for shocks to firms' credit supply to identify the balance sheet shock and examine its real consequences. I find that non-exporting firms that have a larger FX mismatch experience greater negative balance sheet effects following the depreciation. Among these, smaller firms see a decrease in loan growth, resulting in stagnant employment growth and decreased growth in physical capital relative to firms with smaller FX mismatch. Larger firms with a large FX mismatch also have lower growth in FX loans following the shock, but are able to increase borrowing in peso loans, resulting in relatively higher growth in employment and physical capital. My results imply that firms are subject to net worth based borrowing constraints, and that these constraints are more binding on smaller firms and for loans in FX.

JEL-Codes: E44, F31, F41, F44, G31, G32
Keywords: Balance Sheet Shocks, Credit Rationing, Currency Risk, Foreign Currency, Corporate Finance, Bank Lending, Investment

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1 Introduction

Much of the credit extended to emerging market firms is denominated in foreign currencies.[1] In this paper, I study the impact that foreign currency (FX) borrowing has on firms following a large depreciation. More generally, I address how negative shocks to firm net worth (balance sheet shocks) affect firm activity. I construct a novel dataset of currency exposures and loan-level borrowing and examine both the financial and real consequences of negative balance sheet shocks due to foreign currency mismatch.

Standard theory predicts that balance sheet shocks, with no offsetting changes to firm revenue, will lead to tighter borrowing constraints and a consequent decline in real activity. I find that firm size and the currency denomination of debt are two important characteristics that determine the impact of these constraints. Borrowing constraints are more binding following adverse balance sheet shocks for smaller firms, indicating a net worth or size-based borrowing constraint, and for foreign currency loans, suggesting an additional tighter constraint on a firm's foreign currency debt. The interaction of these two constraints leads large firms with a negative shock to decrease their foreign currency borrowing, but allows them to increase their local currency borrowing and thus remain unconstrained in their real activity. Small firms who are constrained in their total borrowing contract their real activity following a negative balance sheet shock.

Balance sheet effects are difficult to identify empirically because it is hard to separate changes in outcomes due to firm balance sheet shocks from other channels. For example, shocks to the supply of bank credit (the bank lending channel) have been shown to be quantitatively large and important for real outcomes (Chodorow-Reich, 2014). Firm specific demand shocks are also hard to separate from the effects of firm-specific balance sheet shocks. Existing empirical work in both macro and finance cannot cleanly identify balance sheet shocks.

I address these challenges in this paper. I construct a dataset that consists of firm bal-

[1] See Caballero, Panizza, and Powell (2014); Chui, Kuruc, and Turner (2016); Du and Schreger (2015); Maggiori, Neiman, and Schreger (2017); McCauley, McGuire, and Sushko (2015); Shin (2013).

ance sheets and loan level outcomes for all listed non-financial firms in Mexico, matched to their banks. This dataset allows me to capture developments on both the financial and real sides of firm activity, connecting balance sheet effects to real outcomes. The dataset has two unique features that are crucial to the identification of a balance sheet shock. First, it includes data on both firms' FX assets and FX liabilities. This allows me to construct a measure of true balance sheet FX exposure (currency mismatch) for each firm and to compare firms with differing levels of exposure, as larger exposure should result in larger shocks to a firm's balance sheet for a given sized depreciation.[2] Second, the data includes loan-level information for each of the banks that the firm borrows from, in both foreign and domestic currency. To my knowledge, this paper is the first to employ such matched firm-bank data to identify the impacts on the firm of balance sheet shocks, controlling for credit supply shocks.[3]

The matched nature of the data makes it possible to compare firms who borrow from the same bank in the same currency at the same time and are thus exposed to the same bank-level shocks to credit supply in each currency. This comparison isolates differences in credit outcomes due to idiosyncratic shocks to firms. Controlling for shocks to credit supply is crucial because such shocks directly affect the channel by which the balance sheet effect operates, through the credit available to the firm. Failure to control for bank credit supply shocks can bias estimates of balance sheet effects if, for instance, firms who borrow more in foreign currency also borrow more from stronger banks. I show that, for regressions estimating the impact of the balance sheet shock on FX loan borrowing, failure to control for credit supply shocks can bias the estimated coefficient downward (toward zero) by 40%.

I analyze the effect of a shock to the exchange rate initiated by the collapse of Lehman

[2] Most datasets used in these studies only have data on debt dollarization, but not assets. Exceptions include Kalemli-Özcan, Kamil, and Villegas-Sanchez (2016), Cowan, Hansen, and Óscar Herrera (2005b), and Alvarez and Hansen (2017).

[3] Niepmann and Schmidt-Eisenlohr (2017a) use loan level data to show that firms with a higher share of foreign currency loans are more likely to default on their loans, though they do not examine changes in credit or real outcomes for these firms. Gan (2007) uses matched firm-bank data in Japan to study if banking relationships affect the impact of a real estate balance sheet shock, but does not fully control for shocks to credit supply on lending.

Brothers in 2008. This depreciation was large, unanticipated, and exogenous to Mexico's fundamentals. An endogenous exchange rate shock, such as currency crises used in previous literature, is problematic because the cause of the shock likely also caused changes in outcomes through other channels. If the shock is anticipated, firms may endogenously adjust their FX borrowing and behavior in advance of the shock, leading to mismeasurement of the balance sheet effect. Thus, an exogenous, unanticipated depreciation is ideal to identify the balance sheet effect.

My analysis focuses on the interaction of the firm's pre-shock balance sheet exposure (FX mismatch) with an indicator variable for the period following the depreciation shock: $Exposure_f \times Shock_t$. This serves as a difference-in-difference estimator, capturing the differences in outcomes post-depreciation for firms with different exposure (and thus different size of balance sheet shock). Importantly, I study both the financial and real outcomes of the firms, which has been seldom done in the literature. For financial outcomes, I focus on loan growth in foreign and domestic currency, and for real outcomes, I examine growth in employment and physical capital. Examining financial outcomes is important to identify the channel by which balance sheet shocks operate, via loss of credit, while examining real outcomes is important to understand the impacts on firm behavior and real economic activity.

In addition to controlling for correlated credit supply effects, I take several steps to control for changes in credit demand from the firm that are not driven by balance sheet shocks. First, I focus on non-exporting firms, which do not have significant foreign currency revenues that would increase with the favorable terms-of-trade change. Second, I control for shocks to broadly defined sectors (such as changes in demand or production costs) either by including sector interactions (with the shock) or sector*year fixed effects. Third, I control for time-varying characteristics of the firm that might affect loan demand, including firm size, leverage, sales, cash, derivatives, exports, and bond credit. Fourth, I compare the interaction of the shock with FX exposure with other interacted firm characteristics that may affect firm credit demand following the shock. Fifth, I compare the responses of large vs. small firms in my sample;[4] large and small firms should both respond to changes in demand, but smaller firms are more likely to be constrained following an adverse balance sheet shock.

Real outcomes vary at the firm level rather than the loan level. In order to control for shocks to bank credit supply in regressions on real outcomes, I construct a firm-level measure of bank credit shocks from the loan level data. I show that this measure can be used as a time varying control when time fixed effects are included in the regression, enabling me to dynamically control for shocks to credit supply at the firm level. I then proceed with the same difference-in-difference estimator as before, controlling for time varying firm characteristics and firm-specific credit supply shocks, comparing different interactions with the shock, and comparing outcomes of large and small firms.

For loan outcomes, I find the expected balance sheet effect on foreign currency loans: firms (non-exporters) with higher currency mismatch see lower loan growth than less exposed firms following the shock. Large firms with higher mismatch, however, compensate with an even larger increase in local currency borrowing. Smaller firms do not see this increase in their peso borrowing. Uncovered interest rate parity (UIP) fails such that foreign currency loans have lower interest rates and are more attractive to borrowers. However, the switch from foreign to domestic currency loans by large firms is not driven by changes in the interest rate differential following the shock. Foreign currency loans remain consistently cheaper than local currency loans, even comparing within-firm and within-bank variation in interest rates. This suggests that the switch to peso loans is driven by borrowing constraints, where firms are subject to a borrowing constraint on their total borrowing and an additional, tighter constraint on their FX borrowing.

At the firm level, the impact of the shock is largely insignificant when large and small firms are pooled together. Consistent with results found with loan outcomes, I find that

[4] Small is defined as being below the sample median in total assets. My sample consists of listed firms, which tend to be much larger than other firms in the economy, so "small" is a relative term. Nevertheless, both large and small firms in my sample will be subject to similar demand shocks, particularly those in the same sector in the same year, so the difference in size will be a salient characteristic in their response.

large, exposed non-exporters (who are able to increase their total borrowing by switching to peso) increase their employment and investment, while small, exposed non-exporters have no change in employment growth and decrease their physical capital growth relative to firms with lower mismatch. These results together suggest that balance sheet shocks can trigger financial constraints that affect a firm's ability to borrow, which can then have real effects. The curious finding of an increase for large firms, also found previously in the literature, could be due to a reallocation of capital towards safer borrowers (in this case domestic currency capital).

My results have two implications for policy. First, domestic currency liquidity and the health of the domestic banking system may be a relevant factor for risk assessment of firm balance sheet shocks, as domestic currency loans provide a substitute for credit lost by large firms who experience a negative balance sheet shock. This further implies that negative balance sheet effects will be stronger when a banking crisis accompanies a currency crisis, the so-called "twin crises" (Kaminsky & Reinhart, 1999). Second, negative real effects from balance sheet shocks are more likely to come from small firms, so the joint distribution of size and FX mismatch is important to understand the risk to the economy. Opposite the conventional wisdom that large firms are important for aggregate effects, small and medium firms may contribute significantly to the observed negative aggregate outcomes if their FX mismatch is sufficiently large.

My empirical results are relevant for the theoretical literature. First, I show how firms may face an additional borrowing constraint on their foreign currency borrowing in addition to the typically modelled borrowing constraint on total debt. Second, my results suggest that firm heterogeneity in size matters for the impact of the shock through these two constraints. Accounting for and explaining the different behavior of large and small firms, and the general equilibrium implications, will be important in order to understand the aggregate effects. Theoretical research on balance sheet effects should thus account for the joint distribution of firm size and balance sheet shock exposure.

The remainder of the paper proceeds as follows: Section 2 reviews the literature and further clarifies the contribution of this paper; Section 3 presents and describes the data and the context for Mexico; Section 4 describes the identification strategy and presents results for outcomes at the firm-bank level; Section 5 describes the identification strategy and presents results for outcomes at the firm level; Section 6 discusses implications for theory; and Section 7 concludes.

2 Literature

Much of the empirical work studying firm balance sheet shocks has been done in the context of exchange rate shocks. A couple of papers, notably Gan (2007) (for Japan) and Chaney, Sraer, and Thesmar (2012) (for the U.S.), find evidence of a balance sheet channel affecting firm investment in the context of a real estate price shock. The more expansive FX literature largely uses firm-level data and examines the effect on investment of an interaction of firm FX debt with exchange rate changes.[5] Most of these papers draw on periods involving a crisis, with some explicitly using a difference-in-difference approach around the crisis.

Evidence of negative effects from exchange rate related balance sheet shocks have been found in studies for Mexico (Aguiar, 2005; Pratap, Lobato, & Somuano, 2003), as well as other emerging markets (Carranza, Cayo, & Galdon-Sanchez, 2003; Cowan et al., 2005b; Echeverrya, Fergussona, Steinerb, & Aguilara, 2003; Gilchrist & Sim, 2007). Firms with more FX debt reduce investment following the depreciation, though exporters fare better.[6] However, several studies find either zero or positive balance sheet effects (Benavente, Johnson, & Morande, 2003; Bleakley & Cowan, 2008; Bonomo, Martins, & Pinto, 2003; Luengnaruemitchai, 2003). These positive effects are sometimes attributed to firms matching their FX debt with FX revenues, FX assets, or FX derivatives. Very few of these studies have

[5]See Table 1 of Cowan, Hansen, and Óscar Herrera (2005a) for a useful comparison of FX exposure measures, countries, samples, outcomes, and controls for FX assets and derivatives across papers in the literature.

[6]Cross country evidence is sparse, but includes Bleakley and Cowan (2008); Caballero (2018); Kalemli-Özcan et al. (2016); Serena Garralda and Sousa (2017). Serena Garralda and Sousa (2017) and Caballero (2018) use bond borrowing in FX by firms in many countries to show that FX borrowing is correlated with reduced investment following an exchange rate shock.

data on FX assets or derivatives. Exceptions include Kalemli-Özcan et al. (2016), which uses a dummy variable indicator for holdings of FX assets in a sample of Latin American firms, and Cowan et al. (2005b) and Alvarez and Hansen (2017), which find that Chilean firms with FX liabilities match with FX assets, FX revenues, and FX derivatives. Cowan et al. (2005a) shows that controlling for FX assets can cause the positive and insignificant coefficient on FX debt (interacted with depreciation) to become negative and insignificant. On the extensive margin, Kim, Tesar, and Zhang (2015) shows that negative balance sheet shocks due to FX debt can increase the probability of firm exit. Similar top this paper, they also highlight that large firms, who are often used in this literature due to data availability, actually increase their investment and survival probability following a negative balance sheet shock, while small firms decrease investment and increase their probability of exit.

The existing literature largely relies on variation due to crisis episodes without the ability to control for shocks to credit supply. Variation in the exchange rate during non-crisis periods is also problematic, as it is less sudden and likely driven by the economy's fundamentals. Estimates using this variation are thus more prone to bias from forward looking behavior regarding future exchange rate realizations and simultaneity of past borrowing and investment affecting future realizations of the exchange rate. Kalemli-Özcan et al. (2016) provides an identification strategy to separate the balance sheet shock from credit supply shocks. Using a cross-country dataset on listed firms, they compare outcomes of exporting firms during currency crises with those in countries experiencing simultaneous currency and banking crises (the "twin crises"). They find that during a depreciation, all exporting firms increase investment, but when the depreciation is accompanied by a banking crisis, only foreign-owned exporters (who have better access to capital) increase investment. Desai, Foley, and Forbes (2008) similarly conclude that affiliate firms of US multinationals in emerging markets are able to bypass credit constraints following sharp depreciations, whereas domestic firms cannot, further illustrating the importance of accounting for credit access and credit supply.

This paper contributes to and harmonizes the existing empirical literature in several ways. In addition to controlling for the value of FX assets, FX revenues, and net derivatives position, I directly control for credit supply shocks using matched firm-bank data. This allows me to use a sharp depreciation episode to measure a clear shock to the balance sheet while controlling for correlated changes in credit conditions. This identification of the balance sheet effect of depreciations is unique to the literature. My results confirm those in Kim et al. (2015), finding that the conflicting results in the literature can be driven by the behavior of large firms. By comparing domestic vs. foreign currency borrowing, I can further explain how large firms are able to increase their investment, which is precisely because they are able to access domestic currency debt, despite the negative balance sheet shock. This corroborates the evidence shown in Kalemli-Özcan et al. (2016), as a concurrent banking crisis, which reduces domestic currency liquidity, is more likely to generate negative effects even for large firms. Thus, crisis episodes in emerging markets are likely to generate negative balance sheet effects, but these effects measured on data from large firms could be zero or positive if there is sufficient liquidity in domestic currency loans.

Most of the existing literature does not directly examine how balance sheet shocks affect access to credit, focusing rather on firm level outcomes like profitability and investment. In addition to examining real outcomes, I test the mechanism of the balance sheet channel directly by examining borrowing outcomes for these firms, cleaned of credit supply shocks, and additionally differentiate the effects by currency of borrowing. Niepmann and Schmidt-Eisenlohr (2017a) examines the effects of balance sheet shocks on credit from the perspective of lending banks. They show indirect evidence of balance sheet effects on loan repayment using loan-level data from US banks to firms in many emerging markets, finding that a US dollar appreciation is associated with a higher likelihood of default (becoming past due on loan payments) for firms with a higher share of loans in FX. This provides direct evidence that firm risk due to FX mismatch can transfer to banks, even if the bank has no FX mismatch. My research complements theirs by matching the loan-level data to firm FX exposures, balance sheets, and studying the real outcomes of firms. Gan (2007) uses a real estate bubble in Japan as a shock to firm asset value, concurrently examining banking relationships. In addition to decreased investment, she finds that firms with larger shock exposure see a decrease in their long term bank loans. While the paper examines the propensity of banks to lend to more exposed firms, it does not fully control for shocks to credit supply. Chaney et al. (2012) uses variation in local real estate prices in the US as a shock to firm collateral value. They find that firms issue more debt when the value of local real estate where the firm is headquartered increases.

This paper is also related to the literature on the determinants of foreign currency borrowing.[7] I contribute to this literature by examining how exchange rate balance sheet shocks affect the currency composition of firm borrowing.[8] Methodologically, this paper is in line with much of the recent literature on the bank lending channel, which uses credit registry and other matched firm-bank data (Chodorow-Reich, 2014; Cingano, Manaresi, & Sette, 2016; Jiménez, Ongena, Peydró, & Saurina, 2014; Khwaja & Mian, 2008). These papers exploit the matched nature of their datasets for identification, often by including various sets of fixed effects to remove confounding variation, including firm-time, bank-time, or firm-bank fixed effects to control for possible time varying characteristics of firms and banks and time invariant characteristics of a particular firm-bank match. Several of these papers specifically analyze the international transmission of shocks via the banking system (Baskaya, di Giovanni, Kalemli-Özcan, Peydró, & Ulu, in press; Baskaya, di Giovanni, Kalemli-Özcan, & Ulu, 2017; Morais, Peydró, & Ruiz, 2015; Ongena, Peydró, & van Horen, 2015; Ongena, Schindele, & Vonnak, 2016; Schnabl, 2012). While my analysis relies on an international shock (namely, the dollar appreciation due to the 2008 financial crisis), I focus on the effect of firm exposure to the shock, controlling for changes in credit supply.

[7]See for example Barajas and Morales (2003); Basso, Calvo-Gonzalez, and Jurgilas (2011); Ize and Levy Yeyati (2003); Luca and Petrova (2008); Rosenberg and Tirpák (2008) for studies using macro data and Allayannis, Brown, and Klapper (2003); Brown and de Haas (2012); Brown, Kirschenmann, and Ongena (2014); Brown, Ongena, and Yeşin (2011); Martínez and Werner (2002); Salomao and Varela (2016) for studies using micro data.

[8]Bonomo et al. (2003) finds a similar result that large firms adjust the currency composition of their debt towards local currency when exchange rate risk increases.

Further, the construction of firm level bank shocks from loan level data is related to Alfaro, Garcia-Santana, and Moral-Benito (2016); Amiti and Weinstein (in press); Greenstone, Mas, and Nguyen (2014); Niepmann and Schmidt-Eisenlohr (2017b). My work makes an important contribution here by proving that these bank shock estimates can be included dynamically in panel regressions when properly demeaned. This result can be potentially useful in any application of using granular data (e.g. credit registries, student-teacher datasets, bilateral trade data, etc.) to compute aggregated regressors.

In the theoretical literature, balance sheet effects are central to many macroeconomic and international finance models (Bernanke, Gertler, & Gilchrist, 1999; Kiyotaki & Moore, 1997). These models rely on a borrowing constraint that depends on the firm's collateral or net worth. Krugman (1999) adapted this mechanism to study the impact of exchange rates and foreign currency debt. Recently the theoretical literature has incorporated currency mismatch and balance sheet shocks into general equilibrium environments (Bianchi, 2011; Céspedes, Chang, & Velasco, 2004; Korinek, 2011; Mendoza, 2010). These papers generally assume that firms only borrow in FX. This paper contributes to the theoretical literature by highlighting the difference in borrowing constraints by currency and the importance of firm heterogeneity in size and shock exposure. This necessitates considering balance sheet shocks in an environment where firms can choose the currency of their debt. Salomao and Varela (2016) constructs a two period model of firm investment dynamics in which firms can choose a mix of foreign and domestic currency debt. They find that more productive firms select into larger FX mismatches, but they do not explore the consequences of balance sheet shocks for these firms. In the appendix, I show that a simple model with borrowing in both local and foreign currency and separate constraints on total and FX borrowing can explain many of my empirical results.[9]

[9] Adrian, Colla, and Shin (2012) presents evidence and a model showing how shocks can induce credit to move from one instrument, bank lending, to another instrument, bond finance. Rather than switching between types of debt, my paper shows a shift between currencies of debt.

3 Data

3.1 Data Description

The source of my data is quarterly financial reports of firms listed on the Mexican stock exchange, the Bolsa Mexicana de Valores (BMV). Non-financial listed firms are required to submit quarterly financial reports to the BMV, which are published on the BMV website as well as distributed by the individual firms.[10] These reports come in pdf form and contain tables for balance sheet statements, income statements, and cash flow statements. In addition, several annex tables include more detailed information on sales, sources of credit, and currency composition of the balance sheet, among other things. These reports are consolidated, and so include the positions of any subsidiaries, whether foreign or domestic. The data from these reports are scraped from the pdf files, harmonized across different pdf formats and variable names, and assembled into a single dataset.

The reports include standard balance sheet variables, notably the value of property, plant, and equipment (physical capital) and the market value of on-balance sheet derivatives positions. In addition to standard balance sheet variables, a couple of pieces of information reported are worth noting. Firms report the volume of external sales, which is exports plus sales by foreign subsidiaries, which gives a more comprehensive measure of foreign currency revenue for the firm than exports alone.[11] Also, firms include a separate line item for total employment in each quarter. Thus, I can connect financial outcomes from the balance sheet with real outcomes like employment and investment.

The two most important and unique features of this dataset are the data on currency composition of the balance sheet and the data on sources of credit. The annex on currency

[10] The Mexican National Banking and Securities Commission (CNBV) requires reporting of relevant corporate information (i.e. may influence its stock price) to the regulators and public for all listed issuers on the BMV. Circular 11-28 establishes these reporting requirements, the dissemination of which is managed by the BMV (Ritch, 2001). Under the new Securities Market Law established in 2006, "listed companies are required to prepare consolidated financial statements following the standards of the CNBV...The CNBV has established procedures to review financial statements of the regulated entities in order to enforce compliance with accounting and auditing requirements...The CNBV is empowered to impose sanctions for the violation of the reporting requirements." (OECD, 2008)

[11] Sales by these firms' foreign subsidiaries to buyers in Mexico are assumed to be negligible.

composition lists the assets and liabilities on the balance sheet in foreign currency, split into US dollar and other currencies. On average, about 90% of all foreign currency liabilities for my sample are denominated in USD. As I cannot determine which foreign currency a given loan is in, I make the simplifying assumption that all FX balance sheet items are denominated in USD for the remainder of the paper. The currency composition of both sides of the balance sheet is used to give a more complete picture of a firm's on-balance sheet exposure to an exchange rate shock.[12]

The second unique feature of this data is the detail on credit to the firms. Firms list every loan product that they have outstanding, as well as bonds and trade credit extended by other firms. For each loan, the firm indicates the name of the bank extending the loan, the interest rate on the loan, the currency of the loan (either peso or FX), and the remaining maturity structure on the loan (how much of the loan is due within 1 year, within 2 years, etc.). Loans are listed both from banks resident in Mexico as well as cross-border banks. The combination of data on a firm's on-balance sheet foreign currency positions with loan level data, split by currency, is a unique data contribution that is crucial to identifying the impact of a balance sheet shock.

My identification strategy relies on using matched firm-bank data on credit relationships. However, the firms list only the name of the lending bank for each loan, with no common identifiers. I harmonize by hand all of the bank names reported in the data, taking account of nicknames, abbreviations, different spellings, different languages, and name changes for the bank.[13] 5% of loans by volume are identified only by generic names or grouped together as "Others" or "Various". These observations are dropped from the main estimation sample. Of the remaining loans, 30% (by volume) either list multiple banks as the lenders or indicate that the loan is a syndicated loan without identifying the bank. In these cases, I reference

[12] I consider also the on-balance sheet derivatives positions, though I cannot tell the notional amounts of the derivatives or the type (currency or foreign exchange derivatives, etc.).

[13] Information on each bank (location, ownership, mergers, names and nicknames, etc.) was obtained from banks' individual web pages, wikipedia, and Bloomberg pages. I further match these banks up to information in Bankscope, when possible, and use that information and notes in the Foreign Bank Ownership database, provided by Claessens and Van Horen (2014), to further identify the banks and match them up appropriately for each firm.

information on syndicated loans for these firms from the Thompson One database. Where it is obvious who the lead bank is, I match the loan to the lead bank. When I cannot tell who the lead bank is, I match the loan to the largest bank by assets that I can identify as part of the syndicate. For the few cases in which the participating banks are unclear, the loan is given its own unique bank identifier.[14] With the banks uniquely identified, loans are aggregated up to the firm-bank-currency-time level.[15]

All data is presented in thousands of pesos.[16] All FX loans are cleaned of valuation effects and all series are deflated to 2010 pesos using Mexico's CPI.[17] The resulting dataset covers 134 firms over 2008q1-2015q2.[18,19]

3.2 Representativeness

Listed firms in Mexico make up an important part of the economy. The market capitalization of these firms fluctuates around 30-40% of GDP (source World Bank, BMV). The vast majority of listed firms in Mexico are non-financial firms. Between 2008-2014, the total share of GDP from non-financial firms (both listed and unlisted) was around 62%.[20]

Listed non-financial firms represent about 7% of total employment in Mexico in 2008.[21] Table A7 plots the share of overall GDP, share of GDP in the non-financial sector, and share of total credit to the private non-financial sector made up by my full sample of firms. Listed firms make up around 10% of GDP, and up to a quarter of all non-financial output in 2009. These firms also absorb a large volume of formal credit (defined as loans + bonds) in the

[14] Results are robust to excluding sydicated loans.

[15] While care has been taken to accurately match firms to banks, note that any error in the matching process will add noise to the dependent variable, loans. This measurement error works against my results by attenuating the estimates.

[16] A few financial reports are presented in thousands of US dollars. These are converted into peso using end of period exchange rates.

[17] After the 1995 peso crisis, Mexico introduced inflation indexed lending (UDIS) that banks could use, funded by nominal bonds which shifted the inflation risk to the government. Such lending was primarily used for mortgages (Karaoglan & Lubrano, 1995).

[18] Balance sheet data for these firms is available from 2005q1, but I am unable to examine loan-level trends before 2008.

[19] For perspective, there are about 130 firms listed on the BMV at any given time.

[20] Source for Market capitalization of listed firms is from the World Bank and BMV. Source for GDP share of non-financial firms is INEGI.

[21] Source is the 2009 Economic Census in Mexico. For reference, the 1000 largest firms represent 17% of total employment.

economy, usually around 60% of all credit to the private non-financial sector.

The firms in my data account for a large portion of the foreign currency debt in Mexico. Non-banks in Mexico (which includes government, households, etc.) had US dollar debt outstanding of $117.7 Billion USD on average in 2008.[22] In that same period, the firms in my data accounted for $55.5 Billion USD in FX debt (mostly US dollar), which is about 47% of all FX debt for non-banks in Mexico.

Relative to the largest 1000 firms in Mexico, firms in my dataset are at the top end of the size distribution. Table A8 shows the average size, employment, sales, equipment, and operating margin of firms in Mexico in 2008, with data in the first two columns drawn from the 2009 Economic Census in Mexico.[23] While my sample is not necessarily representative of all firms in Mexico, it does represent an important segment of the overall economy, so their outcomes have ramifications for the aggregate, as well as potential spillover effects to smaller firms, such as through production network shocks or credit spillovers. These firms may also be similar to large firms in other emerging markets, so their behavior could be more widely informative.

3.3 Sample and Summary

For my regression analysis, I drop state owned/controlled firms, utilities, and non-financial firms that provide auxiliary financial services.[24] I also drop a few firms that are controlled by a parent company in the sample and all firms with either no loans or no loans from an identifiable bank.[25]

I split the sample into exporters and non-exporters, where exporters are defined as having their median share of external sales to total sales over the sample greater than 15%. I focus my analysis in this paper on the non-exporter sample, so as to isolate the balance

[22]Source: BIS global liquidity indicators.

[23]Note that I remove the financial firms from the "All Firms" and "1000 Largest Firms" samples. The 1000 largest firms are then the 921 largest non-financial firms.

[24]The only quasi public firm is PEMEX, while the only auxiliary financial firm is American Express Mexico.

[25]Some firms group smaller loans into "various" or "others" categories, and some loans are identified with too generic a name for the bank in order to identify which bank it is. This drops 5% of loan volume from the sample.

sheet shock from changes in export revenues, but results for exporters are in the appendix for comparison. I also split the sample by firm size, where "small' is defined as having average size (measured by log assets) below the sample median.[26] These splits break the firms roughly in half for each group in the regression sample, as shown in Table A1. While large firms are split evenly between the exporter and non-exporter samples, fewer small firms are exporters.

These firms are spread across a variety of (broadly defined) sectors,[27] shown in Table A2, though half of the firms and observations are in the manufacturing sector. These sectoral differences may be relevant for how firms are affected by and respond to the exchange rate shock and global recession. I address this in Section 4.

As my identification strategy relies on comparing different firms borrowing from the same bank, Table A3 summarizes the banking relationships in the regression sample. The vast majority of firms and loan volume in the sample are covered by firms that maintain multiple banking relationships, with firms averaging close to 7 simultaneous bank relationships. On the bank side, there are many more banks in this sample than there are firms. This is due to the sample being large listed firms that borrow both domestically and internationally. In addition to borrowing from banks resident in Mexico, each firm may borrow from any one of a wide variety of cross-border banks. This makes it more likely that these banks will lend to just one firm in the sample. Despite having a large number of banks with only one relationship with a firm in the sample, between 73-90% of total loan volume is covered by banks with multiple borrowers in sample. The average number of lending relationships in the sample for the full set of banks is around 3, but that number doubles when single relationship banks (which are dropped with the inclusion of bank-quarter fixed effects) are excluded.

Including the extensive set of fixed effects in separate samples reduces the firm sample size to 93 firms. Table A4 shows how the full sample, regression sample (after dropping

[26] Results are robust to adjusting the cutoffs for both exporter and small designations.

[27] Sectors are broad categories: Construction, Energy, Health, IT, Manufacturing, Real Estate, Restaurants and Hotels, Retail and Wholesale, Telecom, and Transportation.

firms with no bank debt, and fixed effects sample compare. There are a few mild differnces across samples, the most significant of which are that the fixed effect sample firms are slightly larger on average (assets, employees) than the main regression sample. Otherwise, the fixed effects do not change the composition of the sample of firms.

Table A5 summarizes the loan observations of the regression sample, aggregated to the firm-bank-currency level. Interest rates are loan weighted averages up to the firm-bank-currency level. Non-exporters tend to have slightly more and larger loan relationships in peso than they do in FX, whereas exporting firms have substantially more and larger loan relationships in FX. However, both exporter and non-exporter firms have lower interest rates on their FX borrowing than their peso borrowing, on average.[28] Across both groups and both currencies, firms tend to have about half of their outstanding loans due within 1 year. These firms thus may need to roll over both their peso and FX bank debt frequently.

A key variable in my analysis is the firm's foreign currency exposure (mismatch). I define this exposure as

$$Exposure_{f,t} = \frac{FXLiabilities_{f,t} - FXAssets_{f,t}}{Assets_{f,t}} \tag{1}$$

which captures the net share of assets that is exposed to foreign currency mismatch. As a firm increases its FX exposure, it makes itself more vulnerable to a depreciation that will have larger negative effects on the balance sheet. Table A6 explores the characteristics of firms that have more exposure prior to the shock. In the left panel, firms in the telecom sector have the largest mismatch, while the manufacturing sector, which accounts for the largest share of firms, has the second highest exposure. Since exposure is not even across sectors, it will be important to make sure that the effects are driven by exposure and not by sectoral differences. The right panel presents correlation coefficients for $Exposure_{f,t}$ with other firm characteristics. Exposure is higher for firms that are larger in terms of assets and physical capital, and that have higher leverage, less cash holdings, and a higher share of exports.[29] Leverage is the strongest correlate. I control for all of these variables in my regres-

[28] These are simple averages of the interest rates calculated at the firm-bank-currency level. I formally test the difference between FX and peso interest rates in loan weighted regressions in Table 6.

[29] Note that my non-exporter sample can still have non-zero FX revenues. While these revenues are still small

sion analysis, and allow for interactions of these attributes with the shock period dummy to ensure that I am not measuring a spurious relationship of exposure to outcomes.

The comparison between exporting and non-exporting firms highlights the degree of exposure in the non-exporting firms. Figure 1 plots the time series for the average share of foreign sales in total shares, with scale on the left axis, and the average on-balance sheet FX exposure, with scale on the right axis. Exporters on average receive 40-45% of their revenues from external buyers, whereas the non-export sample average is closer to 5% of their sales, as expected by definition. Despite the substantial difference in potential FX revenue, non-exporting firms still have a relatively high exposure to FX, between 5-10% as compared to the exporter average of 10-15%. Hence while exporters may have their balance sheet positions sufficiently hedged by their FX revenues, it is less likely that the balance sheet positions of non-exporting firms are adequately hedged. Despite having little revenue denominated in FX, non-exporters have half of their (aggregated) loans denominated in FX at the beginning of 2008.

To further illustrate the importance of my measure of mismatch, Figure 2 plots $Exposure_{f,t}$ for my firms against the share of their loans denominated in FX. As is evident in the figure, the amount of FX loan borrowing does not always give an accurate picture of the currency exposure of the firm. Some firms with 100% of their loans in FX have a negative exposure due to their holdings of FX assets, while some firms with 0% of their loans in FX have positive exposure, due to FX borrowing in other forms (bonds, etc.).

3.4 Context For Mexico

The source of the balance sheet shock comes from a sharp depreciation of the exchange rate in late 2008. The collapse of Lehman brothers in the US precipitated the global financial crisis. One important effect that accompanied this crisis was an appreciation of the US dollar vis-a-vis almost every other currency. The US Dollar Mexican peso exchange rate is plotted in Figure 3. The depreciation of the peso was both sudden and unexpected. This is

and infrequent, I control for them directly in the empirical analysis.

important for my identification because firms were not adjusting their currency positions in anticipation of a depreciation, and the exchange rate shock was not driven by Mexico's fundamentals. The currency movement was also large, as the dollar appreciated by 55% against the peso.[30]

The shaded area of the graph is the shock period, which captures the aftermath of the shock for 8 quarters.[31] There is also a large depreciation at the end of the sample, beginning with the Taper Tantrum in 2013.[32] However, this depreciation is a long and protracted event that was likely to be anticipated and possibly connected to Mexico's fundamentals, making it unsuitable as an experiment. I end my regression sample in 2013q1 to avoid this period.[33]

While the Lehman-induced exchange rate shock is plausibly exogenous, there are other consequences of the global financial crisis that could potentially also affect the firms in my sample, particularly because of Mexico's close proximity and ties to the United States. Figure 4 shows some of the macroeconomic trends in Mexico around this same period. Around the crisis, there was a clear slow down in growth in Mexico, as well as a mild decrease in exports relative to GDP. The drop in exports occurred despite the terms-of-trade improvement, which reflects decreased demand from its primary trading partner, the US.[34] This movement in exports directly affects the foreign currency revenues in the economy, so export status and revenue are important factors to account for in my analysis.

Panel (b) of Figure 4 examines trends in financial variables. Debt inflows to the banking and corporate sectors both dropped significantly in the aftermath of the crisis, followed by a strong recovery. Also plotted is the growth of total US dollar credit to non-banks throughout Latin America, which highlights the general trends of dollar liquidity over the period,

[30] See Sidaoui, Ramos-Francia, and Cuadra (2010) for a more detailed description of Mexico's experience with and response to the global financial crisis.

[31] Results are robust to adjusting this period to end earlier or start earlier.

[32] The Taper Tantrum was a panic in emerging markets that was initiated on May 22, 2013 when the Federal Reserve announced that it would begin tapering its bond purchases. This sparked the panic because an anticipated US dollar appreciation and tighter US monetary policy meant that the FX debt accumulated during quantitative easing would inflate and become difficult to service.

[33] Results are robust to extending the sample to 2015q2, the last period in my data.

[34] 80% of Mexico's exports are to the US, and 50% of its imports are from the US over the sample period (UN COMTRADE database). For the remaining trade, recent evidence from Gopinath (2015) shows that most trade is invoiced in USD, even if the US is not involved in the trade.

matching the capital inflows. Changes in these flows could affect the price and availability of foreign currency credit. Key to my identification is the ability to control for shocks to credit supply in each currency.

Despite the growth slowdown, drop in exports, and drying up of external and USD financing, Mexico was able to recover fairly quickly from the crisis. Mexico's banking system was well capitalized ahead of the shock (Sidaoui et al., 2010).[35] It is dominated by several large foreign banks, but the Credit Institutions Law restricts the amount of capital a subsidiary can transfer abroad to their parent bank to less than 50% of Tier 1 capital, which helped keep the domestic banking sector more stable during the crisis (Sidaoui et al., 2010). The strong position of domestic banks could potentially help to absorb the loss of external financing and smooth out the credit results for borrowing firms. Further, banks in Mexico are required to keep their open FX position below 15% of Tier 1 capital maintained on their balance sheet, to limit their on-balance sheet currency mismatch (IMF, 2016). This additionally may have helped prevent trouble arising in these banks. However, firms have no such regulation. My sample consists of large firms who borrow substantially in FX from banks both within and outside of Mexico, making them a pertinent sample to study the effects of exchange rate related balance sheet shocks.[36]

It is possible that firms in my sample have derivatives positions that hedge their exposure. Anecdotally the use of derivatives by emerging market firms to hedge FX exposure is quite limited, however, and the market value of their on-balance-sheet net derivatives positions appear to be small. Figure 5 plots the sample average net derivatives position relative to total assets. Derivatives positions that would hedge against exchange rate movements would be reflected after the exchange rate depreciates at the end of 2008, as the sudden depreciation would cause their value to change. For non-exporters, the average market value of their derivatives positions did jump to about half a percent of assets following the depre-

[35]The Basel III regulatory framework released in 2010 suggests a capital adequacy ratio (CAR) of about 8-10%, whereas Mexico's aggregate CAR has been around 16% over the whole sample period (Banco de Mexico).

[36]Of loans made by domestic banks, the share denominated in foreign currencies was historically just below 20% prior to 2003, but has since dropped to just under 10% since 2005 (Hardy, 2018).

ciation, indicating some potential hedging, but anecdotally firms did not use derivatives to hedge and the market value remained small compared to the nearly 10% of assets exposure (on average) that these firms had at the time. Exporters may have a natural hedge of FX revenues, but their derivatives positions turn negative on average following the shock. This is due to several listed firms engaging in risky derivatives contracts that essentially bet against a large depreciation of the peso (Chui, Fender, & Sushko, 2014; Sidaoui et al., 2010).

Why would non-exporting firms take the risk of unhedged FX exposure on their balance sheet? As is common in many emerging markets, deviations from uncovered interest rate parity (UIP) make FX loans relatively attractive despite the risk.[37] Figure 6 plots deviations from UIP, where $= 1$ means UIP holds, and > 1 indicates that FX loans are relatively cheaper than peso loans. There are consistent deviations from UIP that make FX loans attractive for even unhedged firms to borrow in. This incentivizes firms tol take unhedged FX positions, exposing themselves to potential future balance sheet shocks.

4 Firm-Bank Level Loan Outcomes

4.1 Identification Strategy

A key component to my identification strategy is an exogenous shock to firms' balance sheets. The sharp depreciation of the peso at the end of 2008 provides such a shock, as discussed earlier and shown in Figure 3. While this shock provides a movement in the exchange rate that is exogenous to Mexico's fundamentals, there could be other macroeconomic effects that occurred simultaneously with the global financial crisis. Of particular concern are changes in trade, which affect foreign currency revenues, and capital inflows, which affect the credit supply.[38] To address the first concern, I split the sample into exporting firms (defined as those whose median sales share of exports is above 15%) and non-

[37]See Salomao and Varela (2016) for evidence of UIP deviations in European countries and the correlation of FX loans with UIP.

[38]While a depreciation is usually associated with increased exports due to the terms-of-trade improvement, the recession in the US (Mexico's primary trading partner) led to a reduction in demand that overpowered the improved competitiveness.

exporting firms. Non-exporting firms are of particular interest because they do not have the same "natural hedge" of FX revenues as exporting firms.

Financial markets worldwide were shocked following the collapse of Lehman Brothers (concurrent with the depreciation). Credit supply shocks to a firm's bank could bias the estimated effect of the shock if banks that lend more in foreign currency or lend more to exposed firms are affected differently from the shock. My identification strategy addresses this by exploiting the matched nature of my dataset between firms and banks. Firms often maintain multiple bank relationships, and banks lend to many firms. By comparing multiple firms that borrow from the same bank in the same currency, I am able to control for credit supply shocks to a specific bank in that currency. In particular, I estimate separate regressions for FX and peso loans, and control for bank-time fixed effects, which accounts for all variation in outcomes from observed and unobserved time-varying bank factors. This leaves variation in loan outcomes coming from firm characteristics, with FX mismatch as the main characteristic of interest.

The shock period is from 2009q1-2010q4, capturing the 2 years following the large peso depreciation.[39,40] $Shock_t$ takes a value of 1 during this period and 0 otherwise. Defining the shock in this manner allows for flexibility in the timing of the impact for each firm, as firms may not need to roll over debt or adjust their investment in every quarter. I take the average of my FX exposure measure ((FX Liabilities - FX Assets)/Total Assets) over 2008 to get a time invariant measure of exposure just prior to the shock period. I winsorize this measure for two outlier firms, which have unusually large stocks of FX assets.[41] I interact this measure with the shock dummy to capture the balance sheet shock. Using a time-invariant pre-shock measure of FX exposure avoids possible endogenous adjustment of the firm's FX position

[39] Results are robust to adjusting the length of the shock period to end 2 or 3 quarters earlier, or start 1 quarter earlier. Given that the exchange rate is both at a higher level and more volatile following the Lehman collapse, I also check results using just a sample from 2009q1-2013q1 (comparing the immediate aftermath of the shock with normal times after the shock). Results are robust.

[40] The "Taper Tantrum" episode in 2013 also sparked a depreciation of the peso, but this depreciation was a steady, prolonged episode, and so it is less plausible as an unexpected shock unrelated to Mexico's fundamentals. Hence, my main sample of interest ends before that period, spanning 2008q1-2013q1.

[41] Results are stronger with the inclusion of non-winsorized outliers. I prefer a winsorized specification to ensure that results are not driven by these two firms.

in response to the shock.

My identification assumption is that, conditional on firm fixed effects and additional time-varying firm controls, firms with different FX exposure who borrow from the same bank in the same currency do not differ from each other in a way that is correlated with the difference in their loan growth outcomes following the shock. This improves on the existing literature, which assumes that firms are exposed to the same credit supply shocks. The primary threat to this identification will be latent firm characteristics that are correlated with exposure and that affect loan outcomes through some other channel during the shock period. I discuss and address these threats in Section 4.2.1.

I implement my empirical strategy using the following baseline regression for non-exporting firms, run separately by currency:

$$\Delta \log(Loan^{c}_{f,b,t}) = \alpha_f + \alpha_{b,t} + \beta_0 Exposure_f \times Shock_t + \Phi X_{f,t-1} + \epsilon^{c}_{f,b,t} \tag{2}$$

where $\log(Loan^{c}_{f,b,t})$ is the log value of the loans outstanding at firm f from bank b at time t (quarterly data) in currency c. The dependent variable is loan growth, measured by $\Delta \log(Loan^{c}_{f,b,t}) = \log(Loan^{c}_{f,b,t}) - \log(Loan^{c}_{f,b,t-1})$, which compares the loans outstanding between the same firm-bank pair in the same currency over time.[42] Bank-quarter $\alpha_{b,t}$ and firm α_f fixed effects control for time-varying credit supply factors and time-invariant firm heterogeneity.[43] In some specifications, I also include sector dummy interactions or sector-year fixed effects to account for trends in each sector that could be correlated with the exchange rate shock, such as changes in demand or input cost.

$X_{f,t-1}$ is a vector of time varying firm controls, lagged one period to avoid simultaneity, which captures any remaining determinants of loan outcomes not associated with the balance sheet shock. These include firm size measured by log assets, the ratios of cash to assets, bond debt to assets, total liabilities to assets, sales to assets, and net derivatives position

[42] This is winsorized at 1% to reduce the influence large outliers in terms of loan outcomes, but results are robust to not winsorizing.

[43] Any common effects from macroeconomic conditions varying at the quarterly level are subsumed in the bank-quarter fixed effects.

relative to liabilities, as well as the share of sales to foreigners (which includes both exports and sales by foreign subsidiaries).[44] Since my independent variable of interest varies only at the firm-time level, but my outcome variable varies at the firm-bank-time level, I cluster the standard errors at the firm level.[45] The regressions are weighted by the lagged value of log loans, $\log(Loan^c_{f,b,t-1})$.[46,47]

It is possible that we would not observe a significant effect because firms may receive a balance sheet shock but not hit their borrowing constraint. The effect of a given shock should be more relevant for firms that are more vulnerable or have less collateral, such as smaller firms. Thus, I add an interaction of the shock with a dummy for small firms, defined as having average size (measured by log assets) below the sample median.[48,49]

$$\Delta \log(Loan^c_{f,b,t}) = \alpha_f + \alpha_{b,t} + \beta_1 Exposure_f \times Shock_t + \beta_2 Small_f \times Shock_t + \beta_3 Exposure_f \times Small_f \times Shock_t + \Phi X_{f,t-1} + \epsilon^c_{f,b,t} \quad (3)$$

In this specification, β_1 represents the impact of the shock for large firms, while $\beta_1 + \beta_3$ is the impact of the shock for small firms. Note that the sample consists of some of the largest firms in the economy, so small is a relative term, but it is useful to separate out these firms from the ultra-large firms since extreme size may enable such firms to access capital readily

[44] These variables are winsorized as necessary to avoid the influence of outliers, but results are robust to either including non-winsorized controls and excluding controls.

[45] While clustering may be appropriate, some of the regressions have a lower number of clusters (e.g. 34) which casts doubt on the asymptotic properties of the estimator. However, results are robust to pooling the exporters and non-exporters together (for more clusters) and including an exporter dummy interaction with the main variables of interest. For presentational convenience, results are presented separately by export status. Results are robust to two way clustering on firm and time. Results are also robust to using Huber-White robust errors instead of clustered errors.

[46] This weighting allows larger loans to be given more weight in the results, so the movements of smaller, less meaningful loans do not drive the results, but with a decreasing returns to size, so idiosyncrasies in ultra large loans are not given undue influence on the estimates. Results are robust to not weighting.

[47] All regressions are produced in STATA using reghdfe (Correia, 2016).

[48] Results are robust to defining the small firm dummy as being in the bottom third instead of the bottom half.

[49] While leverage seems like a better candidate to classify more vulnerable firms, the capacity for leverage increases non-linearly with firm size (Gopinath, Kalemli-Özcan, Karabarbounis, & Villegas-Sanchez, 2017). Thus, some firms may have a large amount of leverage and not be near their borrowing constraint, while other will have less leverage and have their constraint be binding. Thus, when working with a sample of firms at the larger end of the firm-size distribution, size may be a better measure of nearness to a borrowing constraint than leverage. I consider leverage in conjunction with size and FX exposure in Table A11.

despite increased risk.

My identification strategy follows a difference-in-difference framework. I check the validity of this approach by examining pre-period placebos (to check the parallel trends assumption), and firm specific time trends (to control for any differential trends for each firm).

I next present results for loan outcomes at the firm-bank level. I focus on non-exporters in my analysis, but results for exporters can be found in the Appendix in Tables A15 and A24.

4.2 Results

Table 1 presents my main results at the firm-bank level. In columns (1)-(4), I find that firms with a higher level of FX mismatch have lower growth in FX loans following the depreciation. This result holds after including bank-quarter fixed effects in column (3). Of note is the difference between columns (2) and (3). Column (2) uses the same sample as column (3), but does not include the bank-quarter fixed effects.[50] Failing to control for changes in bank credit supply can bias the main coefficient of interest downward because firms that have a currency mismatch and borrow in FX are likely to be borrowing from larger, stronger banks. Omitting this control in column (2) results in an estimate that is nearly 40% smaller in absolute value, though still significant. The drop in FX loan growth appears to be general among both small and large firms, as seen in column (4). The JointTest row at the bottom of the table shows the p-value on the joint significance test of $Exposure_f \times Shock_t$ and $Exposure_f \times Shock_t \times Small_f$ ($H_0 : \hat{\beta}_1 + \hat{\beta}_3 = 0$). Thus, smaller firms have a statistically significant, though smaller in magnitude, drop in their FX credit growth, though the smaller magnitude is not statistically different from the larger effect on the large firms.

Columns (5)-(8) shows the results for peso loans. In Columns (5)-(7), firms with more exposure have a higher loan growth than less exposed firms following the shock. Here, accounting for credit supply shocks does not appear to be as important, as reflected in the

[50] Including the bank-quarter fixed effects reduces the sample size for FX loans because there are many foreign banks that lend only to one firm in the sample, so their observations are wiped out with the bank-quarter fixed effects.

coefficients in columns (6) and (7). The interesting difference comes in column (8), where we see that the large increase in peso borrowing is driven by larger firms, while smaller firms see a mild (though insignificant) decrease in peso loan growth. Thus while all mismatched firms have lower loan growth in FX, only the large firms increase their peso borrowing to compensate. Results are robust to alternate specifications of loan growth and of exposure,[51] adjusting the length of the shock period, and adjusting the cutoff for exporter and small firm designations.[52]

How large are these effects? I use columns (4) and (8) of Table 1 to calculate the estimated effects for small and large firms separately. For small firms, the net impact on their FX loan growth following the shock from the FX exposure is -0.264 and the net impact on their peso loan growth is -0.121. If a small firm increases their FX exposure by 10% of assets (about equivalent to increasing from the median to the 75^{th} percentile), then their FX loan growth will fall by 2.64% and their peso loan growth will fall by 1.21%. For a small firm with 33% of its loans in FX (the pre-shock average), this results in a 1.68% drop in total loan growth. For a large firm, the estimated impact of the shock is -0.691 for FX and 0.899 for peso. A 10% increase in exposure for a large firm results in a drop of 6.91% in their FX loan growth and an increase of 8.99% in their peso loan growth. For a large firm with 56.5% of its loans in FX, these effects will cancel out. The pre-shock average large non-exporting firm had 27% of its loans in FX, which would result in a total increase in loan growth of 4.7%.

To put the 1.68% drop for small firms and 4.7% increase for large firms in perspective, the average loan growth rates in 2008 were 11% and 25% for small and large firms, respectively, while the median rates were 5% and 2.8%, respectively.[53] Thus, for the typical small firm (in terms of loan growth), increasing their initial FX exposure could completely stall their loan growth after the depreciation shock. The increase for large exposed firms is large, more than doubling loan growth for the typical large firm. These effects are thus important to the

[51] See Table A16, which examines exposure measured by short term FX liabilities over assets, standard growth measures, and growth measures that admit entry and exit of firm-bank relationships.

[52] Available upon request.

[53] These numbers for 2011 were 16.8% and 9.5% for small and large average, and -0.2% and 0.8% for small and large median.

outcomes of the firm.

It could be the case that the the FX and peso results for large firms are driven by different sets of firms, rather than the same firms moving from FX to peso. In Table 2, I pool FX and peso loans together in the same regression, and add an interaction with an FX dummy variable to examine the relative difference between FX and peso borrowing for each firm. In this pooled specification, I can include firm-quarter fixed effects in order to compare the relative loan growth of FX vs peso within firm. The regression takes the form:

$$\log(loan^{c}_{f,b,t}) = \alpha_{f,t} + \alpha_{b,t,c} + \delta_0 Exposure_f \times FX_c + \delta_1 Exposure \times Shock_t \times FX_c + \epsilon^{c}_{f,b,t} \quad (4)$$

where c indexes currency (domestic or foreign). While this specification can control for all time-varying firm heterogeneity, it relies on variation only from firms who borrow both in FX and peso. In columns (1) and (2), I include firm fixed effects and bank-quarter-currency fixed effects, the latter to account for different credit supply shocks for each currency, and I add in the firm-quarter fixed effects in columns (3) and (4). These results, while more difficult to interpret with the extra interactions, reveal that there is a significant within firm difference between peso and FX borrowing for large exposed firms following the shock. Note that the difference for small firms (the sum of the coefficients on $Exposure_f \times Shock_t \times FX_c$ and $Exposure_f \times Shock_t \times Small_f \times FX_c$) is close to zero and statistically insignificant, as small firms have declines in both FX and peso growth.

Is the overall effect on loan outcomes positive or negative for large and small firms? Table 3 presents results with FX and peso loans pooled together.[54] Controlling for bank supply shocks in column (1), we see that large exposed firms do have a large and positive impact on their loan growth, whereas small exposed firms have a negative, though not statistically significant, impact. Controlling for credit supply shocks by currency in columns (2) and (3) reveals a significant decline in loan growth for small firms. Thus, it appears that, after controlling for supply shocks, small firms hit with a balance sheet shock indeed appear to hit their borrowing constraint and decrease their overall loan growth.

[54] Note that there are very few firms that borrow from the same bank at the same time in both currencies.

In addition to affecting the net worth of the firm, the exchange rate shock could also impact the firm by affecting the firm's ability to repay short term debt coming due. I examine and compare the impact on borrowing of the firm's short term FX exposure with total FX exposure to attempt to separate the net worth effect from the liquidity effect. These two measures are highly correlated, so results should be interpreted with caution. Short term exposure is defined as the firm's 2008 average of short term FX liabilities minus *total* FX assets, divided by total assets. For my sample of firms, I have data on the maturity composition of FX assets only from 2012 onward. However, examination of the post-2012 data reveals that the average firm holds over 90% of its FX assets as short term assets (e.g. FX deposits, etc.). Thus, I make the assumption that all FX assets are short term, which allows me to construct net short FX exposure prior to the exchange rate shock.

Table 4 reports these results. Comparing just the effect on all firms, columns (1) and (4) illustrate that the variation from the total FX exposure drives the decrease in FX borrowing and increase in peso borrowing, whereas the short exposure is insignificant. Splitting by firm size in columns (2) and (5) indicate that small firms may be more sensitive to their short exposure. Large firms still show the decrease in FX borrowing due to the net worth shock, but those with a large shock to their short term positions increase their FX borrowing. This likely reflects large firms who have short exposure, but are not fully constrained, borrowing relatively more in FX to meet their short term FX obligations. Smaller firms do not appear to have this luxury. While the net effect for small firms is not significant for either total exposure or short exposure, the negative net outcome for FX loans in Table 1 is reflected more in the net coefficient on the short term exposure (-0.916). Column (5) shows the same increase in peso borrowing by large firms as before, driven by their total FX exposure, but smaller firms with higher short term exposure show a decrease in their peso borrowing. Thus, smaller firms appear to be more sensitive to the illiquidity aspect of the balance sheet shock. Columns (3) and (6) present results with just the short term exposure by itself. These results likewise suggest that large firms are not as affected by their short term exposure in the amounts that they borrow, but smaller firms with higher short term FX exposure decrease both their FX and peso borrowing following the exchange rate shock. This element of maturity mismatch and rollover risk may be an important aspect to analyze when accounting for the responses of firms in the lower end of the size distribution to an exchange rate shock.[55]

The mechanism for the effects of the balance sheet shock on loan volume could work through changes in the interest rates charged on firm borrowing. Table 5 presents the baseline results with the log of (1+ the real or nominal interest rate) as the dependent variable.[56] Interest rates are loan weighted within a firm-bank-currency triplet in each period (when aggregating the data to the firm-bank-currency level), and the regressions are weighted by contemporaneous $\log(Loans^c_{f,b,q})$. The regression takes the form:

$$\log(1 + i^c_{f,b,t}) = \alpha_{f,b} + \alpha_{b,t} + \beta_1 Exposure_f \times Shock_t + \beta_2 Small_f \times Shock_t + \beta_3 Exposure_f \times Small_f \times Shock_t + \Phi X_{f,t-1} + \epsilon^c_{f,b,t} \quad (5)$$

where $\alpha_{f,b}$ captures any time invariant variation in interest rates that is specific to a given firm-bank pair. This controls for any preferential or unusual banking relationships that may determine the interest rate. A caveat to this analysis is that interest rates reflect all outstanding loans in the period, not just newly granted loans. The regressions return insignificant results. The coefficients point in the right direction for small firms with high exposure to the shock, who should experience higher interest rates if they are more risky, but we cannot distinguish these effects from 0.[57]

[55] Table A17 in the Appendix considers differences in outcomes by the remaining maturity of the loans. While this measure does not capture maturity at origination, we see that most of the reduction in FX borrowing comes from the remaining maturity short-term FX loans for larger firms. Small exposed firms have a significantly larger decline in their long-term FX borrowing, as compared to large exposed firms. This may indicate that large firms are able to rollover their expiring FX debt with more readily. On the peso, side, most of the increase in loan growth for large firms occurs in long term peso borrowing. This reinforces the result that the maturity dimension matters more for smaller firms, who are unable to obtain more short term FX funding or long term funding in either currency.

[56] Real rates subtract the 1-year expected inflation rate of the peso and add on expected 1-year peso depreciation to FX loans. Both forecast series are from the Bank of Mexico's survey of inflation and exchange rate forecasts.

[57] There may not be enough variation in interest rates (as measured by outstanding loans) to capture these developments. Note that regressions with weaker fixed effects yield similar results.

If there is a change in the interest rate differential, this could affect firm borrowing in FX relative to peso (and thus potentially explain the finding that large exposed firms switch to peso). Table 6 pools the FX and peso loans together, and considers the following regression:

$$\begin{aligned}\log(1+r^c_{f,b,t}) =& \alpha_{f,b} + \alpha_{f,t} + \alpha_{b,t} + \eta_0 FX_c + \eta_1 FX_c \times Shock_t \\ &+ \eta_2 FX_c \times Exposure_f + \eta_3 FX_c \times Shock_t \times Exposure_f + \epsilon^c_{f,b,t}\end{aligned} \tag{6}$$

where r is the real interest rate. In this specification, I can control for all time varying firm and bank characteristics, and time-invariant firm-bank match characteristics that may determine the terms of these loans. In columns (1)-(2), I find a decrease in the differential price of FX vs. peso loans following the depreciation, though this effect is not significantly different for firms who are more exposed following the shock. The significant and negative FX coefficient indicates that there is a premium on the interest rates for peso loans at the individual level, even after controlling for all observable and unobservable time varying characteristics of both firm and bank. This premium is only reduced by 30% following the shock. This confirms the failure of UIP seen at the aggregate level, and suggests that FX loans are still attractive for firms (relative to peso) following the shock if they are able to obtain such a loan.

In column (3), we see that the increase in the real interest rate on FX loans is driven by loans to small firms. That is, firms in the smaller half of the sample face more expensive FX borrowing in real terms following the shock.[58] This is important as it means that a change in the interest rate differential cannot explain why large firms switch to peso borrowing following the shock. Indeed, given that the increase in the FX interest rate is driven mainly by small firms, we would expect that those firms would have a higher propensity to switch to the local currency. Column (4) controls for time-vayring bank-specific factors in each currency via bank-quarter-currency fixed effects. Fully controlling for credit supply shocks in both currencies removes the significance of the effect for small firms and reduces the coefficient by nearly two-thrids. This may be due to soaking up too much variation with

[58] This result is highly significant with weaker sets of fixed effects.

a heavy fixed effect specification, but shocks to bank credit supply in each currency may play more of a role in determining the change in the interest rate differential than does firm-specific risk. Columns (5) and (6) include the full interactions, which are not significant (excepting the coefficient on FX in column (5)).

4.2.1 Potential Threats to Identification

Given my empirical setup, the primary threats to identification are firm characteristics that are correlated with FX mismatch and are affected by macroeconomic changes that occur during the shock period. I test my identification assumption by comparing my interaction of interest, $Exposure_f \times Shock_t$ with competing interactions of $Shock_t$ with other firm characteristics, similarly defined as time-invariant pre-depreciation averages. From the main results, I focus on the overall effect for FX loans and the small vs large split for peso loans. Tables A9 and A10 show these regressions, for FX and peso loans respectively, for six firm characteristics that are correlated with exposure or potentially determine firm outcomes following the depreciation: ratios of exports to sales,[59] cash holdings to assets, sales to assets, net derivatives to liabilities, and leverage (liabilities to assets), as well as firm size (log assets). Exports and size affect the main coefficient of interest the most, but in every case the sign and significance of the coefficient on $Exposure \times Shock_t$ are robust to including these competing interactions.

As noted earlier, firms in some sectors tend to be more exposed to currency shocks than others. It is possible that firms in different sectors are impacted differently during the shock period for other reasons, either due to differences in the change in demand, the change in input costs, or the change in investment opportunities, so the exposure measure could simply be capturing differences in outcomes by sector. In Tables A12 and A13, I explicitly include interactions of $Shock_t$ and $Exposure_f \times Shock_t$ with sector dummies, in order to see if see if the balance sheet shocks differ by sector or if a single sector is driving the results. These regressions include sector dummies one by one, with the column heading indicating

[59] Note that since non-exporters are defined as having their median share of sales to foreigners as less than 15% of total sales, some firms in the non-exporting sample will have some export revenue.

which sector is in the interaction term $Sector_f$. While some of the sectors do appear to be differentially affected during the shock period, none of the interactions appreciably affect the significance or magnitude of the exposure interaction.[60]

Table 7 further tests for robustness to sectoral differences using alternative fixed effects specifications. In columns (1) and (4), I include sector-year fixed effect as a more comprehensive way to account for trends that may affect certain sectors and thus contaminate my identification.[61] Alternatively, it is possible that banks may differentially adjust their credit supply following the shock depending on the sector of the firm. This would violate my identification assumption that firms borrowing from the same bank in the same currency are exposed to the same credit supply shock in each period. Columns (2) and (5) include bank-sector-year fixed effects to account for this possibility. Additionally, there could be unobservable characteristics of each firm-bank match that are correlated with exposure and affect lending outcomes. For instance, higher mismatch firms may match with banks that are more exposed to exchange rate shocks. Columns (3) and (6) address this possibility by including firm-bank fixed effects. In all of these cases, the main results concerning the interaction of $Exposure_f$ and $Shock_t$ are robust

Differences in the effect of exposure between large and small firms could be driven by by some other firm characteristic instead of size. For instance, high leverage could make a firm more vulnerable to a balance sheet shock. Also, many of the large manufacturing firms are exporting firms, while the small manufacturing firms are largely non-exporters. Table A11 examines if these characteristics determine the observed differential behavior between small

[60] The exception is column (6) of Table A13. Firms in the construction sector appear to have larger impacts on their peso borrowing (larger positive for large firms, larger negative for small firms) than firms generally. Nevertheless, the results for construction and non-construction firms point in the same direction. Note that some of the triple and quadruple interactions in Table A13 are missing due to collinearity.

[61] My non-exporter sample largely is not exposed to changes in export revenues associated with the exchange rate change. However, they could be negatively exposed if they import intermediate goods which would become more expensive with the change in terms-of-trade. Exporting firms do a lot of importing (see Blaum (2017) for evidence of this from Mexico), so the exporter sample would be more affected by this issue, but the sector-year fixed effects do capture sector wide changes in import cost over the shock period. For a very limited sample of firms, I compute the share of production costs accounted for by imported inputs. Including this measure as a control captures relevant variation (as indicated by the increase in the within-R^2), but does not change the estimated coefficient. These results are available upon request.

vs. large firms.[62] Columns (1) and (3) compare interactions with a dummy for having pre-2009 leverage (defined as $\frac{Assets}{Equity}$) above the sample median. Leverage appears to generate more noise in the FX regression in column (1), though the coefficients remain sizable and point in the same directions. Still, leverage itself does not appear to explain the observed patterns for either FX or peso loans. Columns (2) and (4) introduce a competing interaction with a manufacturing dummy. Here, the potential selection effect of manufacturing firms being small clearly does not determine or affect the results.

My regression approach follows a difference-in-difference specification. I test the validity of the parallel trends assumption underlying this approach in Tables A14 for loan outcomes. The first two columns in either table highlight that the pre-periods show no significant differences in outcomes by level of exposure leading up to the shock. The second two columns show that the results are robust to the inclusion of firm-specific linear time trends.

Table A18 presents results from a few alternative specifications. First, 42% of loan volume for sample firms originates from cross-border banks. Thus, these changes in loan outcomes may be driven by cross-border banks reacting more strongly to the firm balance sheet shocks, as cross-border banks may differ in their access to FX financing and exposure to the financial crisis. In columns (1) and (3), I restrict my firm-bank sample to just banks resident in Mexico and find that the results are robust. Second, the period following the depreciation was characterized by higher volatility of the exchange rate. Thus, the results could be driven by an increase in volatility and uncertainty about the exchange rate, rather than the actual depreciation shock. Restricting the sample to include just the period after the shock, comparing the immediate aftermath of the depreciation with the later post period, delivers the same results as shown in columns (2) and (5). Lastly, I conduct a placebo test, replacing the original shock variable with a dummy that equals 1 from 2010q3-2011q2, a period in which there were no large exchange rate movements, when firms should not be differentially affected by the exchange rate. This specification delivers the expected null result.

[62]Note that these serve as competing interactions with the small firm dummy, unlike in Tables A12 and A13 where the variables are competing with the exposure measure.

Overall, I find strong evidence for a balance sheet effect, whereby a deterioration in net worth affects firms' ability to borrow. This constraint on borrowing appears to be tighter for loans in FX, and more binding generally on smaller firms. The bite of the binding borrowing constraint on small firms may be amplified if the firm has a larger shock to their short term positions. This is important, as my small firms are still quite large, so the negative effects could be larger still for out of sample firms. My results are further suggestive that liquidity in the domestic currency may be an important factor to offset the negative impact of FX mismatch shocks for larger firms, though the general equilibrium repercussions of the switch from FX to peso borrowing are less well understood.

5 Firm Level Outcomes

When analyzing balance sheet shocks, we are ultimately interested in their effects on real outcomes. Real economic activity does not vary at the loan level, so analysis of real outcomes necessitates working at the firm level. This section presents the empirical approach and results for my firm level analysis. I focus on employment and investment outcomes for the baseline sample of non-exporting firms.

5.1 Identification Strategy

Working at the loan level allows me to control for bank shocks (via bank-time fixed effects) to isolate the impact of firm-level characteristics. When examining firm-level outcomes, controlling for bank shocks would be equally valuable. In order to do so, I construct a control for variation in bank credit supply that varies at the firm level. This is in line with the work of Alfaro et al. (2016); Amiti and Weinstein (in press); Greenstone et al. (2014); Niepmann and Schmidt-Eisenlohr (2017b). I first estimate the following regression at the firm-bank level:[63]

$$\Delta \log(L_{f,b,t}) = \alpha_{f,t} + \alpha_{b,t} + \epsilon_{f,b,t} \tag{7}$$

[63] Note that I have combined FX and peso loans to get the evolution of total loans from the bank.

This regression separates loan growth into bank- and firm-specific factors.[64] Note that if the firm-time fixed effects are not included, the bank-time effects will be biased, as they will attribute all of the time-variation in loan growth to the bank; certain banks may have high loan growth because they are lending to high loan growth firms.

I construct a firm-specific bank shock as the (loan) weighted sum of the estimated bank shocks $\hat{\alpha}_{b,t}$ for each bank that the firm borrows from. Formally,[65]

$$BS_{f,t} = \sum_{b \in B_{f,t}} \left(\frac{L_{f,b,t-1}}{\sum_{b \in B_{f,t}} L_{f,b,t-1}} \hat{\alpha}_{b,t} \right) \tag{8}$$

I then include this variable as a control in the firm level regressions:

$$\log(Y_{f,t}) = \alpha_f + \alpha_t + \gamma_1 Exposure_f \times Shock_t + \gamma_0 BS_{f,t-1} + X_{f,t-1}\theta + e_{f,t} \tag{9}$$

$$\begin{aligned} \log(Y_{f,t}) = \alpha_f + \alpha_t + \gamma_1 Exposure_f \times Shock_t + \gamma_2 Small_f \times Shock_t \\ + \gamma_3 Exposure_f \times Small_f \times Shock_t + \gamma_0 BS_{f,t-1} + X_{f,t-1}\theta + e_{f,t} \end{aligned} \tag{10}$$

where $Y_{f,t}$ is either physical capital, measured as property, plant, and equipment (PPE), or employment, with $\log(Y_{f,t})$ winsorized at 2% to reduce the influence of outliers; α_f is a firm fixed effect; α_t is a time fixed effect; and the other variables and controls are defined as in the firm-bank level regressions. Similar to those regressions, the firm-level regressions compare outcomes for firms with differing levels of exposure following the large depreciation shock.

There is an important econometric issue to address when using the bank shock control. Consider a single period version of Equation 7:

$$\Delta \log(L_{f,b}) = \alpha_f + \alpha_b + \epsilon_{f,b} \tag{11}$$

[64] These effects are computed using the felsdvreg command in STATA (Cornelissen, 2008). See Alfaro et al. (2016) for more discussion on this approach, which extends methodology originally developed in Abowd, Kramarz, and Margolis (1999).

[65] This formulation is similar to the Bartik instrument.

When both firm and bank fixed effects are included, each set of fixed effects will span the whole space. Thus, one individual fixed effect must be omitted due to collinearity, and the remaining fixed effects in this set are then measured relative to the omitted group. This would be true for each period in which we run this regression. If we expand back to the multiple period regression in Equation 7, we see that in each period, one fixed effect group will be omitted, and so the remaining fixed effects will all be estimated relative to the omitted group. Since the effects in each period are measured relative to their own omitted group, the estimates of the effects cannot be compared across time.[66]

This means that my constructed bank shock measure is also not comparable over time. To address this issue, the following proposition will prove useful:

Proposition 5.1. *Time demeaned values of the estimated* $\hat{\alpha}_{f,t}$ *and* $\hat{\alpha}_{b,t}$ *are the same as the time demeaned values of a hypothetical* $\hat{\alpha}^*_{f,t}$ *and* $\hat{\alpha}^*_{b,t}$ *which have all of the fixed effects measured relative to the same benchmark (e.g. 0). Further, the constructed* $BS_{f,t}$*, when time demeaned, has the same value as a time demeaned hypothetical* $BS^*_{f,t}$ *constructed using* $\hat{\alpha}^*_{b,t}$.

Proof: *See Appendix B*

Proposition 5.1 indicates that by including time fixed effects in the firm level regression (and thus time demeaning the data), the coefficient on the bank shock in Equation 9 is exactly the same as it would be if all of the fixed effects were estimated relative to 0 rather than relative to an omitted category. This result is useful generally when using connected datasets (such as credit registry data or bilateral trade data) to construct similar shock estimates for use in collapsed regressions. So long as the appropriate regression specification includes

[66] More generally, the effects are only consistently identified within a connected group of firms and banks. A group is connected if any firm borrows from at least one bank in the group and any bank lends to at least one firm in the group. A group is separate from another group if no firms in the first group borrow from any banks in the second, and no banks in the first group lend to any firms in the second. When you estimate two sets of fixed effects, both sets will span each connected group and so be collinear. Hence, one effect in each group will need to be omitted to avoid the dummy variable trap. Since each connected group has a different omitted effect, the estimates of the fixed effects are all measured relative to different reference points. These effects are therefore consistently estimated and comparable within a connected group, but not necessarily comparable across groups. In the data, around 98% or more of observations in each period are in the same connected group. The handful of observations not in the main group in each period are dropped from this construction.

a time fixed effect,[67] the fixed effect estimates from the matched data can be used in that regression.[68]

5.2 Results

I first examine potential substitution at the firm-level to other sources of funding besides loans (such as bonds and trade credit). These results are presented in Table 8. Columns (1)-(3) present results where the dependent variable is non-bank liabilities (either total, FX, or peso). These results mirror the bank borrowing results: large firms increase their funding, whereas small firms do not. The increase for large firms is driven by their peso borrowing. One specific area of concern is that the large firms may be switching to FX bond debt in order to replace their lost FX bank debt (in addition to using more peso borrowing). Columns (4)-(6) shows that this is not the case. Though not significant, the coefficient on the main interaction is negative for bond debt, particularly FX bond debt, indicating that the effect of the balance sheet shock on bonds is either unchanged or possibly negative.

Table 9 presents my main results at the firm level. Consistent with the firm-bank level results, I find that while there is no measured effect of the balance sheet shock across all firms on average (as found elsewhere in the literature), there is a difference in outcomes for large vs small firms. In columns (1) and (2), I show results for total bank borrowing of these firms. Large exposed firms see an increase in their bank borrowing relative to large, less exposed firms, reflecting the increased access to peso credit, while small exposed firms have a net negative effect, though not statistically significant. In columns (3) and (4), the difference in employment is similar, with exposed large firms seeing a mild increase while small firms do not. Columns (5) and (6) examine growth in physical capital. Here, large exposed firms again see an increase, but smaller exposed firms see a decrease in growth.

While the total effects for small exposed firms measure as a statistical zero for bank credit

[67] Or more generally, a fixed effect that aligns with each connected group.

[68] This does not absolve more general issues associated with using an estimated factor in the regression, such as measurement error. A relatively small sample size makes bootstrapping the errors less feasible, but the results are robust to excluding the bank shock control, so any measurement error in the bank shock does not appear to be biasing the coefficients of interest.

and employment, there is a significant decrease in growth of physical capital for these firms. An increase in exposure of 10% of assets for a small firm would result in a decrease in physical capital growth of 1.14%. For the median small firm, pre-shock capital growth was on the order of 0.2%, so this shock could represent a substantial decline for some firms, or a significant reduction relative to their previous expansion path for others.

These results are again robust to horseraced interactions with other firm characteristics. These results are shown in Tables A19 and A20 for employment and capital respectively. The results are further largely robust to alternative specifications of exposure and growth measurement, shown in the appendix in Table A25, and to interactions with sector dummies, shown in Tables A21 and A22.[69] Thus for smaller firms with a large currency mismatch, balance sheet shocks can have negative real consequences as well as the negative financial consequences documented earlier. This provides corroborating evidence that currency mismatch and balance sheet effects can lead to negative real outcomes via binding borrowing constraints.

Table A23 checks the validity of the difference-in-difference design for real outcomes. The first two columns in either table highlight that the pre-periods show no significant differences in outcomes by level of exposure leading up to the shock. The second two columns examine robustness to the inclusion of firm-specific linear time trends. Investmen outcomes are robust. The employment outcomes in column (3) are no longer significant after including firm specific time trends, nevertheless the coefficients are of approximately the same magnitude as the main specification, or larger.

The 75th percentile firm in terms of FX exposure (for either small or large) experienced a drop in net worth of 3.33% of assets. The median firm (either small or large) experienced a 1.1% drop in net worth. Using the estimates from Table 9, a small firm that experiences a drop in net worth of 1% of assets experiences a decline in physical capital of 0.34%. For

[69] The effects on employment appear to be driven in part by the construction sector. In column (6) of Table A21, balance sheet shocks to large construction firms result in positive outcomes, but balance sheet shocks to small construction firms result in large negative outcomes. The direction of the effect for other sectors remains the same, but is statistically insignificant.

a large firm, a drop in net worth of 1% of assets results in an increase in employment of 0.48% and an increase in physical capital of 0.38%. If FX debt in the economy at large is primarily concentrated among the listed firms, then the aggregate implication is that there is not much of a net effect of the balance sheet shock on aggregate investment, as the smaller firms decrease investment while the larger firms increase investment.[70] However, direct and indirect impacts on firms outside of my sample may be important sources of negative real outcomes. These are briefly discussed in Section 6.

How important is it to capture the firm's full on-balance sheet exposure to FX, rather than relying on more limited measures (e.g. FX debt only)? Table 10 reports coefficients from the investment and employment regressions using alternative measures of FX exposure. Column (1) augments the main measue used in this paper with an estimate of FX hedging. This is done by taking the value of the net derivatives position just after the depreciation (2009q1) and subtracting the net derivatives position just before the depreciation (2008q3). This captures the fact that if firms were using derivatives to hedge the exchange rate shock, the market value of these positions would turn positive (into assets) with the sharp depreciation of the peso (as shown earlier in Figure 5). Although this measure does not fully capture derivatives hedging, comparing columns (1) and (2) suggests that accounting for derivatives usage for these firms does not appreciably alter the estimates.

Column (3) removes FX assets from the measure, as many studies rely on just information about FX liabilities. Here the magnitude for the effect on employment at large firms decreases, while for physical capital the magnitude for both large and small is halved. This suggests that firms holding FX liabilities may often also hold some FX assets, so we would measure a smaller than true effect because we over estimate their exposure. Some studies rely just on one source of debt to get FX exposure, such as loans or bonds. Column (4) uses just FX loans in the numerator of the exposure measure. The measured effects on employment in Panel A are attenuated downwards and all estimates lose significance. The

[70] As shown in Table A15, exporting firms with FX exposure are largely unaffected in their real outcomes, suggesting their positions are fully hedged.

estimates for investment remain similar to those of column (3), still underestimating the impact, but recording a negative net impact for small firms. Column (5) uses only FX bond debt in the numerator of the exposure measure. With just this piece, we lose all significance for the investment regression in Panel B. Panel A on employment, however, shows a large positive (though statistically insignificant) effect for large firms, and a large negative and significant effect on small firms. These results together highight the importance of having a more comprehensive measure of firm FX exposure in order to accurately measure the balance sheet effects of exchange rate shocks.

The result that large firms with a negative balance sheet shock actually have higher growth in terms of debt, employment, and physical capital than less exposed firms has been found previously in the empirical literature, yet is contrary to the standard model. We would expect either a negative effect, if the firm is constrained, or a null effect, if the firm is unconstrained. The positive effect of a balance sheet shock suggests that there may be some other factors at play, although a large variety of observable firm characteristics fail to explain this relationship. The next section discusses implications for theory which could rationalize these findings.

6 Implications for Theory

The evidence presented in this paper is consistent with firms being subject to a constraint on their total borrowing as well as facing a second, tighter constraint on their FX borrowing. These constraints, when binding, change the allocation of credit (differently by currency) and lead to differences in real outcomes. Appendix C presents a simple 3-period model to illustrate how including this second borrowing constraint on foreign currency debt can generate the observed patterns in borrowing following the exchange rate shock. The presence of both borrowing constraints, dependent on net worth or size, is further validated in the data by Figure 7, which plots the bank debt of non-exporting firms in my sample in peso and FX against their size (log assets). As firms get larger, they increase their leverage in peso before increasing their leverage in FX.[71] This is striking as the lower price of FX debt and failure of UIP suggests that risk-neutral firms would desire to do the opposite.

In many models, the constraint on total borrowing that the firm faces can be derived (implicitly or explicitly) from an incentive compatibility constraint in which the firm should not have an incentive to default on their debt (under most realizations of the exchange rate). The additional constraint on FX borrowing reflects the risks faced by the bank. Niepmann and Schmidt-Eisenlohr (2017a) provide evidence that firms that borrow more in FX have a higher probability of defaulting on their loans (both FX and peso) in the event of a depreciation. Further, most collateral backing loans to emerging market firms is denominated in local currency (see Calomiris, Larrain, Liberti, and Sturgess (2017) and Fleisig, Safavian, and de la Peña (2006) for evidence that immovable collateral is frequently required to secure lending in emerging markets). That means that when a loan is made in FX and the exchange rate depreciates, the bank recovers a smaller share of the loan value in the event of default, increasing their downside risk. Thus, the bank has an incentive to limit FX borrowing in addition to limiting total borrowing.[72]

The differential behavior of large vs small firms poses another challenge to existing theory. While standard theory would suggest that a negative balance sheet shock would at best have no effect on the real activity of the firm (if the firm is away from its borrowing constraint), my results show that for very large such firms, they are able to increase their borrowing and investment.[73] The model in the appendix considers selection into FX debt by more productive firms as one possible explanation, as in Salomao and Varela (2016). Another possible explanation is that the exchange rate movement itself changes the opportunity set of large vs small firms. For example, large firms may have their revenues tied to the US dollar via production chains where they serve as suppliers to exporting firms. For

[71] Size based borrowing constraints (as in Gopinath et al. (2017)) match the data better, but are not necessary to generate the qualitative results observed in my analysis.

[72] This incentive may strengthen if the bank faces higher penalties for not repaying its FX creditors as compared to domestic currency creditors.

[73] This result has previously been found explicitly in the empirical literature (e.g. Kim et al. (2015)) and may affect results implicitly in many other papers (as many studies rely on data from listed firms and have shown both positive and negative results).

firms in my sample, the large non-exporting firms with large FX exposure tend to be in services or the construction industry. Thus, this explanation is possible in principle, though less likely in practice for my sample.

General equilibrium effects may thus play an important role to understand the results. Carabarín, de la Garza, and Moreno (2015) find for Mexico that as alternative sources of funding (FX bond markets) open up for these large firms, capital in the banking sector is freed up to lend more to small and medium sized firms. The converse could certainly be the case, where these large firms shift away from their FX borrowing and towards peso borrowing, which crowds out smaller firms. Negative aggregate effects, often documented in the aggregate data following a large depreciation or currency crisis, could occur due to a misallocation of capital, as banks may reallocate resources from risky borrowers to safe (large) borrowers in the event of a negative capital shock. Negative effects could also arise if FX borrowing is pervasive prior to the shock among the small and medium sized firms who are more likely to be constrained in the event of a shock. Even if the large firms are unaffected, the decline in investment by smaller firms together may make a larger impact. General equilibrium effects could also operate through changes in demand during the recession that favor larger firms.Thus, further incorporating firm heterogeneity and currency of borrowing, modeling the joint distribution of FX debt and firm size, into our macroeconomic models will be important to capture the behavior of the economy and the aggregate implications of the balance sheet effects of exchange rate shocks.

7 Conclusion

In this paper, I estimate the effect of balance sheet shocks on firm borrowing and real activity. I construct a unique dataset of listed non-financial firms in Mexico that combines firm balance sheet data, including data on real outcomes, export revenues, and currency exposures, with loan level data for each firm that includes the currency of borrowing as well as the identity of the lending bank. I exploit an exogenous and sudden depreciation episode connected with the financial crisis in the US as an experiment. Using matched firm-bank data, I control for bank credit supply shocks with bank-quarter-currency fixed effects and isolate the impact of pre-existing differences in firm characteristics (e.g. currency mismatch) on responses to the depreciation. I thus directly examine the mechanism of the balance sheet shock (via credit outcomes), and differentiate these effects by currency. I estimate bank credit supply shocks at the firm level, and show how to include this measure as a time-varying control in firm-level regressions. I then examine the effect of the balance sheet shock for the real firm-level outcomes of employment and investment.

I find that non-exporting firms with a higher currency mismatch on their balance sheet have slower loan growth in FX following the depreciation shock. However, large firms with higher FX exposure compensate for this by increasing their peso borrowing, while smaller exposed firms do not. These results are robust to numerous alternative specifications and controls. While the borrowing costs for FX loans relative to peso increase following the shock, compressing the interest rate differential, this was driven by the small firms who did not switch into peso borrowing. FX loans remain cheaper in real terms for all firms, but this result suggests that FX loans were still as attractive as before to large firms in terms of the cost advantage they afford.

At the firm level, I find that total bank borrowing by large non-exporters with a mismatch increases, while smaller non-exporters with a mismatch do not increase the growth of their bank debt. Larger firms consequently see higher growth in their investment and employment, while smaller firms do not see higher employment growth and experience lower investment growth. Together, these results suggest that balance sheet effects can lead to binding borrowing constraints, that these constraints may bind more tightly on FX loans and smaller firms, and that these binding constraints can affect real outcomes.

This paper helps to harmonize and complement existing research by identifying and highlighting the roles of firm size and currency of debt for borrowing constraints. I show that the null or positive impact of FX related balance sheet shocks found in some studies could be due to their focus on large firms that are able to substitute lost FX credit for domestic currency credit after the shock. This suggests that some firms can avoid a binding borrowing constraint after a shock if they are able to switch to local currency credit, but otherwise balance sheet effects can have real impacts on these firms. The stability and liquidity of the domestic banking sector could be a factor for emerging market policy makers to consider when assessing the risk posed by corporate borrowing in foreign currencies. Further, risk assessment should focus on the exposure of small and medium sized firms, as that is where the largest negative real impacts are likely to occur.

An important implication of my results is that the observed movement of the largest firms into the local currency credit market could have spillover effects for smaller firms (especially those not in my sample) by crowding them out of local currency borrowing. The converse result has been found for listed firms in Mexico by Carabarín et al. (2015), who show that as alternative sources of funding (FX bond markets) open up for these large firms, capital in the banking sector is freed up to lend more to small and medium sized firms. Thus, negative effects could occur due to a misallocation of capital from risky to safe borrowers. Negative real effects could also arise if FX borrowing is pervasive prior to the shock among the small and medium sized firms who are more likely to be constrained in the event of a shock. As most existing research relies on large firms for data and analysis of their FX debt, firm level empirical studies may fail to examine the portion of the economy where negative effects might be stronger. A more complete empirical examination the distribution of FX debt among the universe of firms and analysis accounting for general equilibrium channels should be a priority in this line of research.

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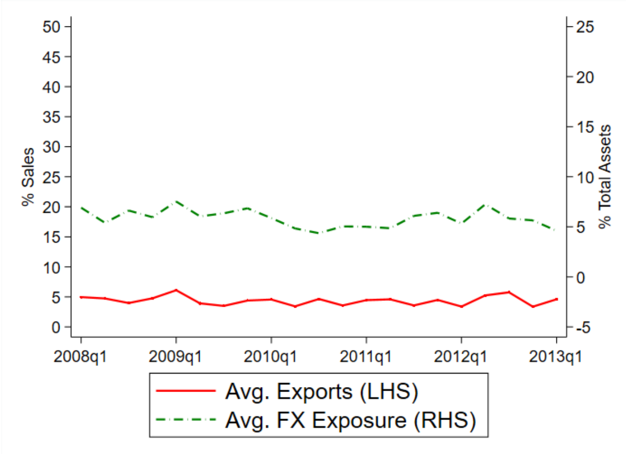
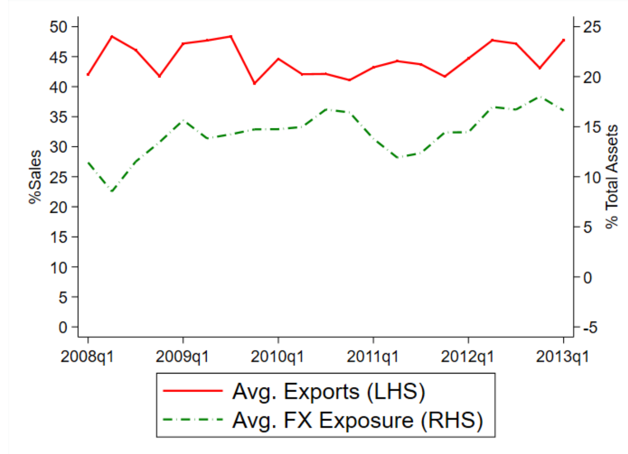
Figure 1: Exports and Exposure



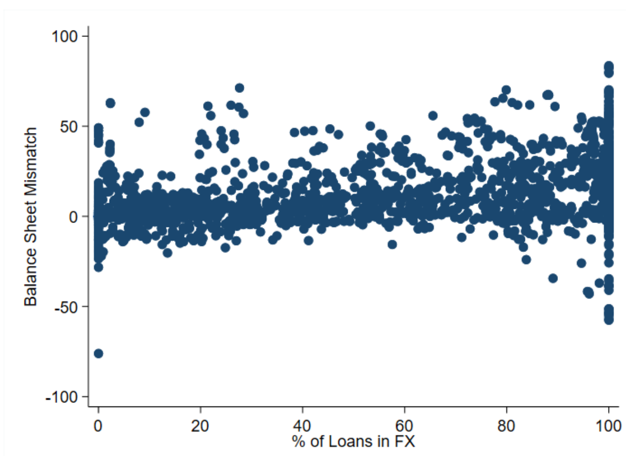
(a) Non-Exporters



(b) Exporters

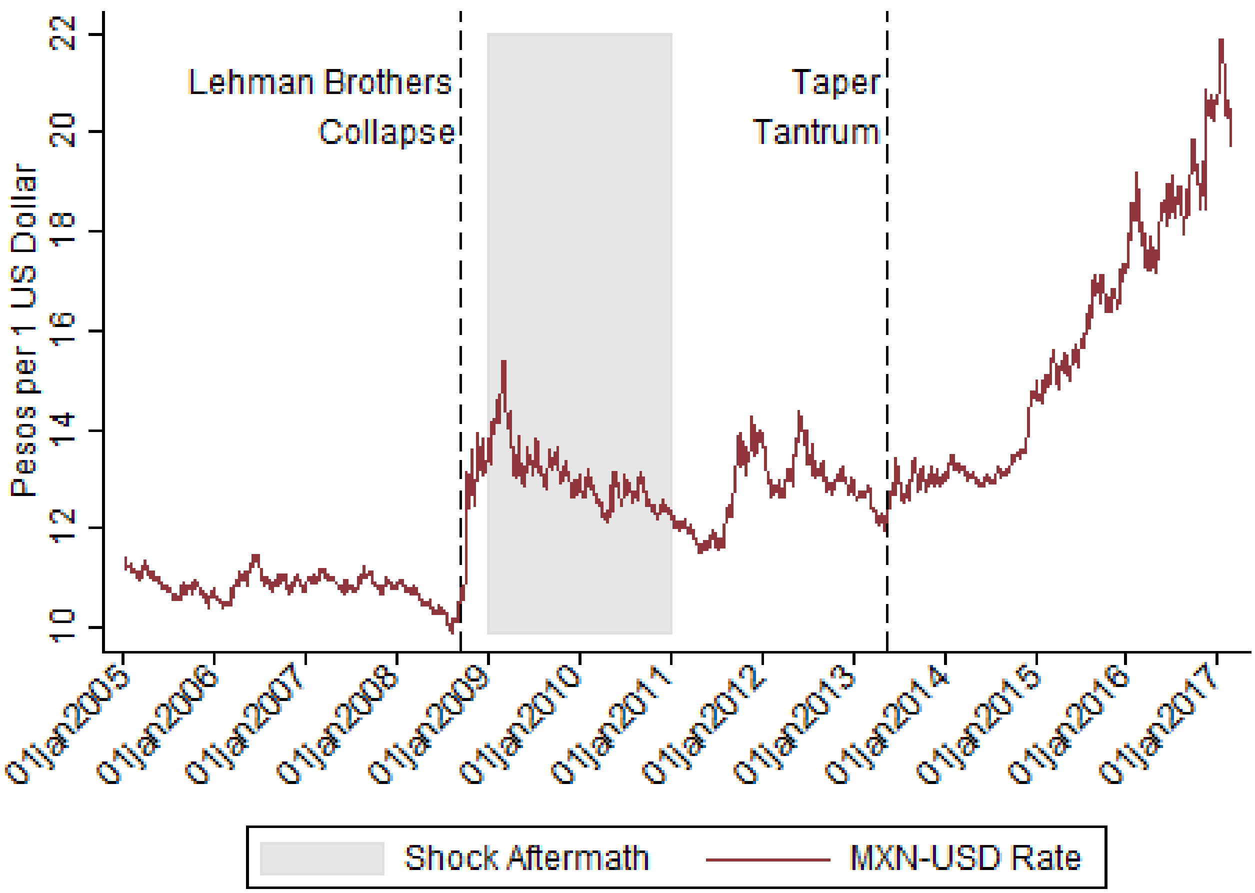
Source: Author's calculations. FX Exposure is (FX Liabilities - FX Assets)/Total Assets, right axis. Exports is share of external sales relative to total sales, left axis. Exporting firms are defined as having the share of external sales to total sales above 15%.

Figure 2: Exposure vs Loan Share



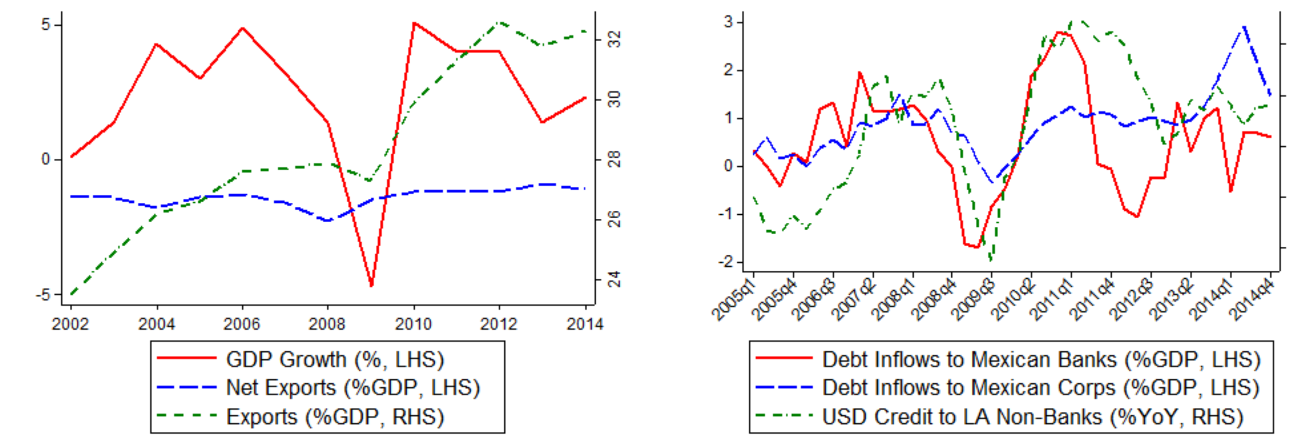
Source: Author's calculations. % of Loans in FX is FX denominated loans divided by total loans. Balance Sheet Mismatch is (FX Liabilities - FX Assets)/Total Assets. 2008q1-2015q2.

Figure 3: US Dollar - Mexican peso Exchange Rate



Source: FRED. Data is daily.

Figure 4: Macroeconomic Trends of Mexico

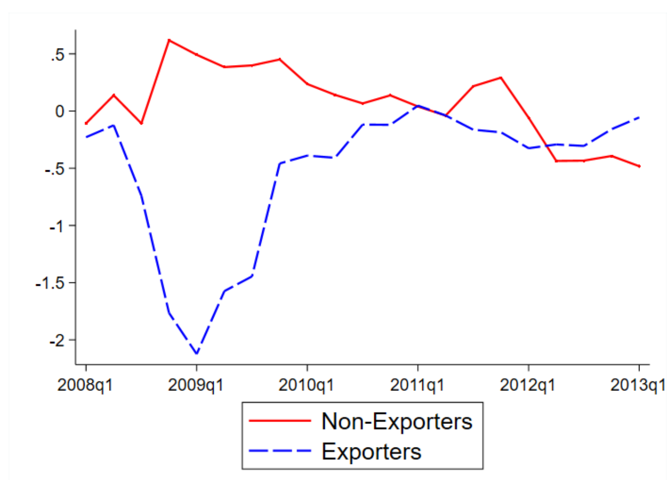


(a) Exports and GDP Growth

(b) Capital Inflows and Dollar Liquidity

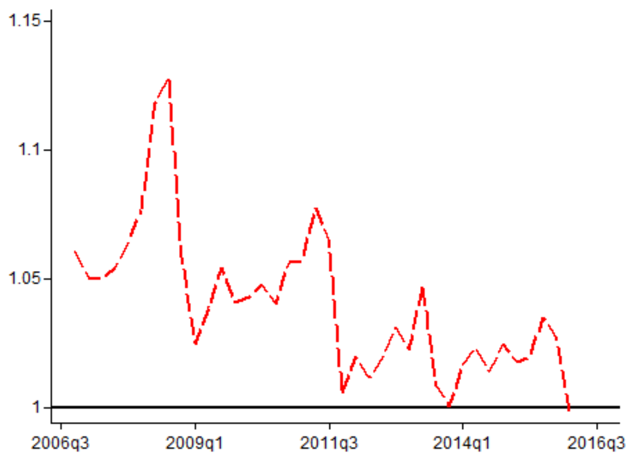
Source: World Bank WDI, Avdjiev et al. (2017), BIS. Debt inflows is defined as portfolio debt inflows (e.g. bonds) plus other investment debt inflows (e.g. loans) capital flows from external creditors to resident banks or non-bank firms. USD credit to LA non-banks is total credit provided to non-bank institutions resident in Latin American countries.

Figure 5: Average Net Derivatives Position to Assets



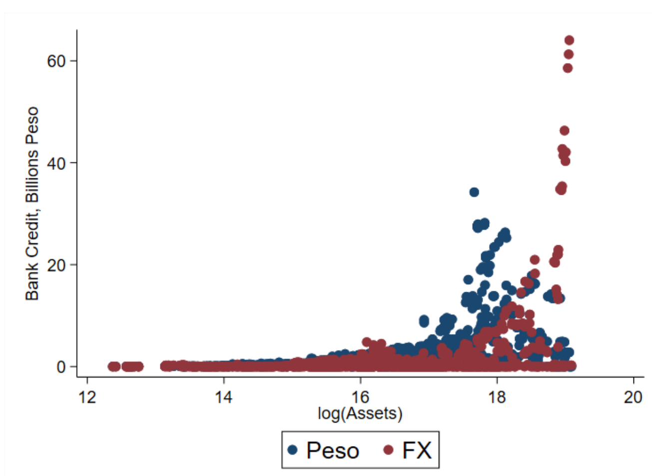
Source: Author's calculations based on on-balance sheet derivatives positions. Figures expressed as percent.

Figure 6: UIP Deviations



Source: Banco de Mexico, FRED. UIP Deviation defined as $(s_t/E[s_{t+1}]) * ((1+r_t)/(1+r_t^*))$, where s_t is the exchange rate expressed as dollars per peso, $E[s_{t+1}]$ is the year ahead expected exchange rate (from survey of professional forecasters), and r and r^* are the the interest rates on 1 year treasury bills for Mexico and the U.S., respectively. All rates are period averages over each quarter.

Figure 7: Bank Debt vs Firm Size



Source: Author's calculations. Non-exportering firms, 2008q1-2013q2

Table 1: Growth in Bank Loans (%), Firm-Bank Level

	FX				Peso			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Shock_t	0.0553	0.0265			-0.0423**	-0.0397		
	(0.0353)	(0.0368)			(0.0210)	(0.0239)		
$\text{Exposure}_f \times \text{Shock}_t$	-0.402***	-0.322***	-0.542***	-0.691***	0.404**	0.464*	0.477*	0.899***
	(0.0825)	(0.103)	(0.108)	(0.209)	(0.196)	(0.256)	(0.250)	(0.279)
$\text{Small}_f \times \text{Shock}_t$				-0.288**				0.0710*
				(0.119)				(0.0389)
$\text{Exposure}_f \times \text{Small}_f \times \text{Shock}_t$				0.427				-1.020***
				(0.270)				(0.299)
Observations	1636	764	764	764	2818	2377	2377	2377
R^2	0.054	0.096	0.475	0.484	0.032	0.034	0.151	0.154
Firms	40	34	34	34	49	47	47	47
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BankQuarterFE	No	No	Yes	Yes	No	No	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
JointTest				0.0505				0.314

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log difference of loans outstanding in FX or Peso at the firm-bank level in each period, winsorized at 1%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Regressions are weighted by the lagged value of log loan. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Growth in Bank Loans (%), Firm-Bank Level - FX vs Peso

	(1)	(2)	(3)	(4)
$\text{Exposure}_f \times \text{Shock}_t$	0.449*	0.837***		
	(0.246)	(0.270)		
$\text{Exposure}_f \times \text{FX}_c$	0.396***	0.787***	0.185	0.542***
	(0.146)	(0.174)	(0.162)	(0.139)
$\text{Exposure}_f \times \text{Shock}_t \times \text{FX}_c$	-0.798***	-1.173***	-0.358*	-0.656***
	(0.260)	(0.255)	(0.206)	(0.238)
$\text{Shock}_t \times \text{Small}_f$		0.0653		
		(0.0397)		
$\text{Exposure}_f \times \text{Shock}_t \times \text{Small}_f$		-0.947***		
		(0.290)		
$\text{Small}_f \times \text{FX}_c$		0.235***		0.219***
		(0.0740)		(0.0642)
$\text{Exposure}_f \times \text{Small}_f \times \text{FX}_c$		-0.927***		-0.784***
		(0.244)		(0.194)
$\text{Shock}_t \times \text{Small}_f \times \text{FX}_c$		-0.281***		-0.275***
		(0.0765)		(0.0766)
$\text{Exposure}_f \times \text{Shock}_t \times \text{Small}_f \times \text{FX}_c$		1.046***		0.752*
		(0.315)		(0.378)
Observations	3142	3142	2964	2964
R^2	0.200	0.204	0.411	0.413
Firms	50	50	47	47
FirmFE	Yes	Yes	-	-
FirmQuarterFE	No	No	Yes	Yes
BankQuarterCurrencyFE	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	-	-

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log difference of loans outstanding at the firm-bank level in each period, winsorized at 1%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. FX is a dummy equal to 1 if the loan is in foreign currency. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Regressions are weighted by the lagged value of log loan. Errors are clustered at the firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Growth in Bank Loans (%), Firm-Bank Level - All Loans

	(1)	(2)	(3)
$\text{Exposure}_f \times \text{Shock}_t$	0.553*	0.529*	0.324*
	(0.275)	(0.272)	(0.187)
$\text{Small}_f \times \text{Shock}_t$	0.0419	0.0348	0.0453
	(0.0375)	(0.0390)	(0.0406)
$\text{Exposure}_f \times \text{Small}_f \times \text{Shock}_t$	-0.724**	-0.789**	-0.565**
	(0.291)	(0.305)	(0.234)
Observations	3413	3142	3112
R^2	0.197	0.200	0.254
Firms	51	50	50
FirmFE	Yes	Yes	-
FirmBankFE	No	No	Yes
BankQuarterFE	Yes	-	-
BankQuarterCurrencyFE	No	Yes	Yes
FirmControls	Yes	Yes	Yes
JointTest	0.121	0.0129	0.0244

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log difference of loans outstanding at the firm-bank level in each period, winsorized at 1%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Regressions are weighted by the lagged value of log loan. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Growth in Bank Loans (%), Firm-Bank Level - Short vs Total FX Exposure

	FX			Peso		
	(1)	(2)	(3)	(4)	(5)	(6)
Exposure$_f$ × Shock$_t$	-0.690**	-1.266***		0.591***	0.894***	
	(0.309)	(0.294)		(0.208)	(0.300)	
Short Exposure$_f$ × Shock$_t$	0.284	1.498***	-0.257	-0.247	-0.00319	0.745
	(0.573)	(0.496)	(0.603)	(0.372)	(0.404)	(0.592)
Small$_f$ × Shock$_t$		-0.436***	-0.239**		0.0562	0.0221
		(0.152)	(0.117)		(0.0438)	(0.0400)
Exposure$_f$ × Small$_f$ × Shock$_t$		1.582**			-0.561	
		(0.619)			(0.392)	
Short Exposure$_f$ × Small$_f$ × Shock$_t$		-2.414**	-0.285		-1.047	-1.462**
		(0.922)	(0.608)		(0.626)	(0.672)
Observations	764	764	764	2284	2284	2284
R^2	0.475	0.488	0.480	0.156	0.159	0.156
Firms	34	34	34	46	46	46
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes
BankQuarterFE	Yes	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes
JointTest		0.518			0.148	
JointTestShort		0.223	0.0248		0.0369	0.0482

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log difference of loans outstanding in FX or Peso at the firm-bank level in each period, winsorized at 1%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Short Exposure is the firm's 2008 average of short term FX liabilities less total FX assets divided by total assets, with 3 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Regressions are weighted by the lagged value of log loan. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. JointTestShort reports the p-value of the F-test that the sum of the coefficients of ShortExposure*Shock and ShortExposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Interest Rates, Firm-Bank Level

	Nominal FX		Real FX		Nominal Peso		Real Peso	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exposure$_f$ $\times$ Shock$_t$	0.00994	-0.00420	0.00989	-0.00366	-0.00277	-0.0121	-0.00276	-0.0120
	(0.0109)	(0.00953)	(0.0112)	(0.0103)	(0.00919)	(0.0138)	(0.00974)	(0.0145)
Shock$_t$ $\times$ Small$_f$		0.00497		0.00453		0.00177		0.00201
		(0.00611)		(0.00632)		(0.00255)		(0.00263)
Exposure$_f$ $\times$ Shock$_t$ $\times$ Small$_f$		0.0194		0.0188		0.0185		0.0182
		(0.0226)		(0.0233)		(0.0194)		(0.0202)
Observations	691	691	691	691	2250	2250	2239	2239
R^2	0.947	0.948	0.973	0.974	0.921	0.921	0.920	0.921
Firms	28	28	28	28	44	44	44	44
FirmBankFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BankQuarterFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
JointTest		0.468		0.481		0.644		0.664

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable in columns (1)-(2) is the log of 1 + the loan weighted nominal interest rate at the firm-bank level in each period. Depedent variable in columns (3)-(4) is the log of the nominal rate, plus the expected Peso depreciation rate for the foreign currency loans, minus expected Peso inflation rate. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. FX is a dummy variable equal to 1 if the loan is denominated in foreign currency. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Regressions are weighted by log loan. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Real Interest Rate Differential, Firm-Bank Level

	(1)	(2)	(3)	(4)	(5)	(6)
FX_c	-0.0530***	-0.0535***	-0.0492***		-0.0484***	
	(0.00424)	(0.00487)	(0.00622)		(0.00686)	
$FX_c \times Shock_t$	0.0132**	0.0141*	0.00547		0.00755	
	(0.00526)	(0.00713)	(0.00828)		(0.0100)	
$FX_c \times Exposure_f$		0.00817			-0.000279	-0.00362
		(0.0228)			(0.0362)	(0.0109)
$FX_c \times Shock_t \times Exposure_f$		-0.0126			-0.0359	0.00926
		(0.0303)			(0.0468)	(0.0187)
$FX_c \times Small_f$			-0.00763	-0.00196	-0.0130	-0.0106
			(0.00807)	(0.00715)	(0.0105)	(0.00809)
$FX_c \times Shock_t \times Small_f$			0.0151*	0.00735	0.0130	0.00532
			(0.00877)	(0.00680)	(0.0118)	(0.00966)
$FX_c \times Exposure_f \times Small_f$					0.0345	0.0473
					(0.0464)	(0.0302)
$FX_c \times Shock_t \times Exposure_f \times Small_f$					0.0368	0.00146
					(0.0549)	(0.0347)
Observations	3616	3222	3616	3278	3222	2946
R^2	0.891	0.881	0.891	0.977	0.882	0.976
Firms	54	45	54	53	45	44
FirmBankFE	Yes	Yes	Yes	Yes	Yes	Yes
BankQuarterFE	Yes	Yes	Yes	-	Yes	-
FirmQuarterFE	Yes	Yes	Yes	Yes	Yes	Yes
BankQuarterCurrencyFE	No	No	No	Yes	No	Yes

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log of 1 + the loan weighted nominal interest rate at the firm-bank level in each period, plus expected Peso depreciation for foreign currency loans, minus expected Peso inflation rate. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. FX is a dummy variable equal to 1 if the loan is denominated in foreign currency. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Regressions are weighted by log loan. Errors are clustered at the firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Growth in Bank Loans (%), Firm-Bank Level, Alternate Fixed Effects

	FX			Peso		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Exposure}_f \times \text{Shock}_t$	-0.479**	-0.780**	-0.552***	0.817**	0.833**	0.717***
	(0.231)	(0.324)	(0.133)	(0.359)	(0.388)	(0.185)
$\text{Small}_f \times \text{Shock}_t$				0.0182	-0.0289	0.0768*
				(0.0442)	(0.0655)	(0.0393)
$\text{Exposure}_f \times \text{Small}_f \times \text{Shock}_t$				-1.145**	-1.117**	-0.821***
				(0.444)	(0.464)	(0.256)
Observations	760	1511	749	2376	2690	2351
R^2	0.500	0.354	0.560	0.165	0.182	0.215
Firms	34	40	33	47	49	47
FirmFE	Yes	Yes	N/A	Yes	Yes	N/A
QuarterFE	N/A	Yes	N/A	N/A	Yes	N/A
SectorYearFE	Yes	N/A	No	Yes	N/A	No
BankQuarterFE	Yes	No	Yes	Yes	No	Yes
BankSectorYearFE	No	Yes	No	No	Yes	No
FirmBankFE	No	No	Yes	No	No	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes
JointTest				0.118	0.115	0.523

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log difference of loans outstanding in FX or Peso at the firm-bank level in each period, winsorized at 1%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Regressions are weighted by the lagged value of log loan. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Growth in Firm Level Non-Bank Financing (%)

	Non-Bank Liabilities			Bond Debt		
	(1) Total	(2) FX	(3) Peso	(4) Total	(5) FX	(6) Peso
$\text{Exposure}_f \times \text{Shock}_t$	0.331**	-0.425	0.814*	-0.179	-0.201	0.249
	(0.161)	(0.285)	(0.405)	(0.303)	(0.147)	(0.479)
$\text{Shock}_t \times \text{Small}_f$	0.0517	-0.167*	0.109*	-0.193**	-0.0321	-0.143
	(0.0365)	(0.0877)	(0.0595)	(0.0771)	(0.0515)	(0.0910)
$\text{Exposure}_f \times \text{Shock}_t \times \text{Small}_f$	-0.482**	0.335	-0.672	0.525	-0.122	0.176
	(0.211)	(0.330)	(0.434)	(0.438)	(0.320)	(0.556)
Observations	844	517	790	837	837	844
R^2	0.217	0.273	0.161	0.082	0.084	0.076
Firms	52	40	47	52	52	52
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes
TimeFE	Yes	Yes	Yes	Yes	Yes	Yes
BankShock	Yes	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes
JointTest	0.292	0.585	0.405	0.296	0.267	0.130

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable in columns (1)-(3) is the log difference of non-bank liabilities outstanding at the firm level in each period, winsorized at 2%. Dependent variable in columns (4)-(6) is the log difference of bond debt at the firm level in each period, winsorized at 2%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Bank shock is a control for credit supply shocks to each firm, as constructed in the text. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Growth in Firm Level Outcomes (%)

	Bank Debt		Employment		PPE	
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Exposure}_f \times \text{Shock}_t$	0.249	0.479**	0.0705	0.161**	0.0336	0.126*
	(0.162)	(0.202)	(0.0474)	(0.0789)	(0.0568)	(0.0650)
$\text{Shock}_t \times \text{Small}_f$		0.0769*		0.00446		0.0148
		(0.0441)		(0.0145)		(0.0110)
$\text{Exposure}_f \times \text{Shock}_t \times \text{Small}_f$		-0.600**		-0.227**		-0.239***
		(0.240)		(0.108)		(0.0825)
Observations	850	850	770	770	792	792
R^2	0.205	0.209	0.158	0.164	0.199	0.207
Firms	52	52	51	51	52	52
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes
TimeFE	Yes	Yes	Yes	Yes	Yes	Yes
BankShock	Yes	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes
JointTest		0.394		0.395		0.0351

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable in columns (1) and (2) is the log difference of bank credit outstanding at the firm level in each period, winsorized at 1%. Dependent variable in columns (3) and (4) is the log difference of employment at the firm level in each period, winsorized at 2%. Dependent variable in columns (5) and (6) is the log difference of physical capital outstanding, measured as property, plant, and equipment, at the firm level in each period, winsorized at 2%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Bank shock is a control for credit supply shocks to each firm, as constructed in the text. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Measures of FX Exposure and Growth in Firm Outcomes (%)

	Panel A: Employment				
Exposure Measure	$\frac{FXL-FXA-FXD}{Assets}$	$\frac{FXL-FXA}{Assets}$	$\frac{FXL}{Assets}$	$\frac{BankFXL}{Assets}$	$\frac{BondFXL}{Assets}$
Exposure$_f$ $\times$ Shock$_t$	0.184**	0.160**	0.105	0.021	0.442
Exposure$_f$ $\times$ Small$_f$ $\times$ Shock$_t$	-0.268**	-0.234**	-0.177**	-0.064	-0.707**
Total Effect (Small)	-0.084	-0.074	-0.072	-0.043	-0.265**
	Panel B: Physical Capital				
Exposure Measure	$\frac{FXL-FXA-FXD}{Assets}$	$\frac{FXL-FXA}{Assets}$	$\frac{FXL}{Assets}$	$\frac{BankFXL}{Assets}$	$\frac{BondFXL}{Assets}$
Exposure$_f$ $\times$ Shock$_t$	0.128*	0.128*	0.079*	0.106	0.081
Exposure$_f$ $\times$ Small$_f$ $\times$ Shock$_t$	-0.253***	-0.249***	-0.140***	-0.179**	-0.28
Total Effect (Small)	-0.125**	-0.121**	-0.061*	-0.073*	-0.199

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable in Panel A is the log difference of employment at the firm level in each period, winsorized at 2%. Dependent variable in Panel B is the log difference of physical capital outstanding, measured as property, plant, and equipment, at the firm level in each period, winsorized at 2%. Exposure variable in column (1) is FX liabilities minus FX assets minus estimated derivatives hedging (as described in the text), divided by total assets; in column 2, FX assets minus FX liabilities, divided by total assets; in column (3), FX liabilities divided by total assets; in column (4), FX loans divded by total assets; in column (5), FX bonds divided by total assets. Exposure variables are all defined as the 2008 average. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. All regressions include firm fixed effects, time fixed effects, and time-varying firm controls consisting of one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Errors are clustered at the firm level. Total Effect (Small) reports the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small, with their estimated significance. All regressions also include Shock*Small. N=765 for PanelA, N=787 for Panel B. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

A Appendix Tables

Table A1: Firms by Category

	Non-Exporters	Exporters	Total
Small	44	20	64
Large	28	32	60
Total	72	52	124

Firms are from the regression sample, which includes just firms with loan data from identifiable banks over 2008q1-2013q1. Exporters are defined as having their median share of external sales to total sales over the sample greater than 15%. Small firms are defined as having their average size (measured by log assets) below the sample median.

Table A2: Firms by Sector

Sector	Number of Firms	Firm-Bank Observations
Construction	14	2106
Energy	1	8
Health	5	294
IT	1	105
Manufacturing	60	7194
Real Estate	6	339
Restaurants	8	669
Retail and Wholesale	11	578
Telecom	12	1313
Transportation	6	464
Total	124	13 070

Firms are from the regression sample, which includes just firms with loan data from identifiable banks over 2008q1-2013q1.

Table A3: Firm-Bank Relationships

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Firms: Multiple Bank Rels.					Banks: Multiple Firm Rels.			
	Firms	Num Firms	Firm Share	Loan Share	Av. No. Rel. per Firm	Banks	Num Banks	Bank Share	Loan Share	Av. No. Rel. per Bank
2008	94	80	0.851	0.995	7.280	221	94	0.425	0.732	3.095
2009	89	81	0.910	0.991	6.831	204	82	0.402	0.797	2.980
2010	94	77	0.819	0.957	6.638	220	84	0.382	0.742	2.836
2011	90	73	0.811	0.955	6.644	202	67	0.331	0.760	2.960
2012	89	77	0.865	0.943	6.798	186	82	0.441	0.876	3.253
2013	87	75	0.862	0.941	6.782	180	82	0.456	0.900	3.278
2014	88	75	0.852	0.936	6.898	191	93	0.487	0.902	3.178

This table presents annual (quarter 4) summary statistics on the frequency of different types of firm-bank relationships within the loan data using end-of-year data for the regression sample. Column (1) lists the number of firm; columns (2)-(4) deal with firms who borrow from multiple banks, listing the number of them, the share of firms, and the share of loans accounted for, respectively; column (5) gives the average number of bank relationships each firm in sample has; column (6) lists the number of banks; columns (7)-(9) deal with banks that lend to multiple firms, listing the number, the share of banks, and the share of loans accounted for, respectively; and column (10) gives the average number of firms each bank lends to in sample.

Table A4: Sample Summary

	Sample Means			Differences		
	Full Sample	Regression Sample	Fixed Effects Sample	Full-Reg	Reg-FE	Full-FE
Firms	74	54	51			
N	2537	1685	1493			
log(Assets)	16.27	16.37	16.50	-0.10^{*}	-0.14^{**}	-0.23^{***}
Liabilities/Assets	53.91	53.24	52.73	0.67	0.51	1.19
Cash/Assets	7.59	6.99	7.21	0.59^{***}	-0.21	0.38
PPE/Assets	39.39	39.03	37.94	0.37	1.09	1.45^{*}
Employment	18.09	16.77	18.68	1.32	-1.92^{*}	-0.60
Output/Assets	20.59	20.02	20.52	0.57	-0.50	0.75
External Sales/Sales	17.61	19.31	20.26	-1.70^{**}	-0.95	-2.65^{***}
FX Exposure	7.86	9.16	9.17	-1.31^{**}	-0.01	-1.31^{**}

Samples as described in the text. N reports the number of firm-time observations. The first 3 data columns are the means for each sample, with all figures expressed in percent, except Employment (measured in thousands of persons) and log(Assets) (where assets are measured in thousands of pesos). PPE is property, plant, and equipment. FX Exposure is defined as (FX Liabilities - FX Assets)/Total Assets. The last 3 data columns are the differences between those means, along with their statistical significance.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A5: Firm-Bank Level Loan Summary

	Obs	Mean	Median	Std. Dev.	Min	Max
Panel A: Non-Exporters, peso Loans						
Volume	3980	0.65	0.20	1.19	0.00	13.90
Interest Rate	3980	11.21	11.75	4.79	0	25.52
Short Term Share	3980	0.54	0.50	0.41	0	1
Panel B: Non-Exporters, FX Loans						
Volume	2040	0.64	0.09	2.57	0.00	43.00
Interest Rate	2039	9.24	8.74	4.75	0	35.43
Short Term Share	2040	0.55	0.49	0.41	0	1
Panel C: Exporters, peso Loans						
Volume	1814	0.75	0.28	1.46	0.00	13.50
Interest Rate	1814	12.62	12.43	3.81	0	30.25
Short Term Share	1814	0.53	0.46	0.43	0	1
Panel D: Exporters, FX Loans						
Volume	5228	1.25	0.16	4.89	0.00	99.00
Interest Rate	5228	9.80	9.05	5.00	0	36.73
Short Term Share	5228	0.51	0.40	0.43	0	1

Loan volume is expressed in billions of pesos. Interest rate is nominal. Short term share is the share of the loan that is due within 1 year divided by the total amount of the loan. The maximum loan volume is expressed in billions of pesos.

Table A6: Correlates with Exposure

Sector	Mean Exposure in 2008	Observations	Variable	Correlation Coefficient
Construction	1.99	35	Assets	0.08^{***}
Health	0.00	16	Employment	-0.03
IT	4.73	1	PPE/Assets	0.11^{***}
Manufacturing	5.71	85	Liabilities/Assets	0.45^{***}
Real Estate	-3.03	16	Profit/Assets	-0.03
Restaurants	0.65	20	Cash/Assets	-0.28^{***}
Retail and Wholesale	2.18	26	Sales/Assets	-0.05
Telecom	14.78	40	Exports/Sales	0.24^{***}
Transportation	3.27	20	Bond Debt/Assets	0.05^{*}
Total	4.78	259	N	1033

Sample is non-exporting firms over 2005-2008. Left side of the table show the average FX exposure in 2008 for each sector. The right side of the table shows the correlation coefficients of various firm characteristics with exposure over 2005-2008. Sample size for correlations is 1033, except for profits where it is 986. t-stat on significance is non-directional. PPE is property, plant, and equipment * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A7: Aggregate Representativeness

Year	Share of GDP	Share of NFC Value Added	Share of Total Credit to Private Non-Financial Sector
2006	9.34	14.73	55.75
2007	9.19	14.42	56.05
2008	12.67	19.77	62.02
2009	14.52	24.41	61.13
2010	11.90	19.64	63.06
2011	10.85	17.49	61.47
2012	8.34	13.19	61.98
2013	7.05	11.31	60.40
2014	6.24	9.96	60.28

Source: World Bank WDI, INEGI, BIS, author's calculations. Total credit is loans + bonds. Value added from my sample calculated as sales - cost of goods sold. Credit to non-financial sector series from BIS is to the private non-financial sector, so PEMEX is excluded from those calculations.

Table A8: Comparability to Other Firms In Mexico

	All Firms	1000 Largest Firms	Listed Firms
Assets	1.62	3930.89	45 588.96
Equipment	0.74	1796.25	29 805.38
Sales	4.09	8846.96	9493.23
Employment	5.44	3344.42	15 807.39
Operating Margin	126.58	135.88	139.17

Source: Mexico 2009 Economic Census, author's calculations. The 1000 largest firms include some financial firms, so those firms are excluded from these numbers resulting in the 921 largest non-financial firms. All firms are similarly adjusted to remove financial firms. All figures are averages. Assets, equipment, and sales are expressed in millions of pesos, employment is expressed in total persons, and operating margin (defined as Operating Income/Sales) is expressed in percent.

Table A9: Growth in FX Loans (%), Firm-Bank Level, Horseraces

	Dependent Variable = $\log(loan^{FX}_{f,b,t})$					
	(1)	(2)	(3)	(4)	(5)	(6)
Horse Variable	Exports	Cash	Derivatives	Size	Leverage	Sales
Exposure$_f$ $\times$ Shock$_t$	-0.399**	-0.592***	-0.549***	-0.487***	-0.557***	-0.565***
	(0.147)	(0.148)	(0.132)	(0.0962)	(0.157)	(0.111)
Horse$_f$ $\times$ Shock$_t$	-0.00355	-0.00282	0.00302	0.0193	0.000405	0.00485
	(0.00375)	(0.00535)	(0.0257)	(0.0251)	(0.00342)	(0.00487)
Observations	764	764	764	764	764	764
R^2	0.476	0.475	0.475	0.476	0.475	0.476
Firms	34	34	34	34	34	34
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes
BankQuarterFE	Yes	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log difference of loans outstanding in FX at the firm-bank level in each period, winsorized at 1%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Horse is the firm characteristic indicated in the column heading. Exports is the 2008 average of the firm's external sales (exports + sales by foreign subsidiaries) over total sales. Cash is the 2008 average of cash to assets, with 2 outlier firms winsorized. Derivatives is the 2008 average of the net derivatives position to liabilities. Size is the 2008 average of log of assets. Leverage is the ratio of liabilities to assets. Sales is the ratio of sales to assets. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Regressions are weighted by the lagged value of log loan. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A10: Growth in peso Loans (%), Firm-Bank Level, Horseraces

	Dependent Variable = $\log(loan^{peso}_{f,b,t})$					
	(1)	(2)	(3)	(4)	(5)	(6)
Horse Variable	Exports	Cash	Derivatives	Size	Leverage	Sales
$\text{Exposure}_f \times \text{Shock}_t$	0.854***	0.998***	0.924***	0.898***	1.103***	0.885***
	(0.279)	(0.267)	(0.277)	(0.293)	(0.238)	(0.266)
$\text{Shock}_t \times \text{Small}_f$	0.0838**	0.264***	0.0610	-0.409	-0.116	0.115
	(0.0384)	(0.0646)	(0.0407)	(1.012)	(0.140)	(0.0845)
$\text{Exposure}_f \times \text{Shock}_t \times \text{Small}_f$	-1.332***	-1.305***	-0.975***	-0.846**	-1.210***	-1.012***
	(0.402)	(0.307)	(0.307)	(0.330)	(0.267)	(0.290)
$\text{Horse}_f \times \text{Shock}_t$	0.00654*	0.00694**	-0.00723	0.00124	-0.00403**	0.00101
	(0.00331)	(0.00283)	(0.0154)	(0.0502)	(0.00165)	(0.00224)
$\text{Horse}_f \times \text{Shock}_t \times \text{Small}_f$	-0.00140	-0.0304***	-0.0841	0.0309	0.00376	-0.00225
	(0.00506)	(0.00949)	(0.0538)	(0.0600)	(0.00288)	(0.00330)
Observations	2377	2377	2377	2377	2377	2377
R^2	0.155	0.157	0.154	0.154	0.156	0.154
Firms	47	47	47	47	47	47
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes
BankQuarterFE	Yes	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes
JointTest	0.134	0.0769	0.691	0.749	0.439	0.314

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log difference of loans outstanding in peso at the firm-bank level in each period, winsorized at 1%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Horse is the firm characteristic indicated in the column heading. Exports is the 2008 average of the firm's external sales (exports + sales by foreign subsidiaries) over total sales. Cash is the 2008 average of cash to assets, with 2 outlier firms winsorized. Derivatives is the 2008 average of the net derivatives position to liabilities. Size is the 2008 average of log of assets. Leverage is the ratio of liabilities to assets. Sales is the ratio of sales to assets. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Regressions are weighted by the lagged value of log loan. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A11: Growth in Bank Loans (%), Firm-Bank Level - Other Firm Characteristics

	FX		Peso	
	(1)	(2)	(3)	(4)
Exposure$_f$ × Shock$_t$	-0.851	-0.723***	0.763*	0.918***
	(0.849)	(0.214)	(0.448)	(0.276)
Shock$_t$ × Small$_f$	-0.322**	-0.212	0.0645	0.0697*
	(0.121)	(0.127)	(0.0471)	(0.0392)
Exposure$_f$ × Shock$_t$ × Small$_f$	0.523*	-0.964	-0.978***	-1.791**
	(0.292)	(0.942)	(0.305)	(0.789)
High Leverage$_f$ × Shock$_t$	-0.0637		-0.0173	
	(0.0994)		(0.0516)	
Exposure$_f$ × High Leverage$_f$ × Shock$_t$	0.175		0.144	
	(0.869)		(0.385)	
Shock$_t$ × Manufacturing		-0.208		0.0644
		(0.182)		(0.0549)
Exposure$_f$ × Shock$_t$ × Manufacturing		1.843		0.578
		(1.123)		(0.782)
Observations	764	764	2377	2377
R^2	0.484	0.486	0.154	0.155
Firms	34	34	47	47
FirmFE	Yes	Yes	Yes	Yes
BankQuarterFE	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes
JointTest	0.688	0.0812	0.518	0.270

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log difference of loans outstanding in FX or Peso at the firm-bank level in each period, winsorized at 1%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. High Leverage is a dummy equal to 1 if the firm's average ratio of assets to equity is above the sample median. Manufacturing is a dummy equal to 1 if the firm is in the manufacturing sector. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Regressions are weighted by the lagged value of log loan. Errors are clustered at the firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A12: Growth in FX Loans (%), Firm-Bank Level - Robustness To Sectors

	Dependent Variable = $\log(loan^{FX}_{f,b,t})$							
Sector Interaction	Telecom		Manufacturing		Construction		Transportation	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exposure$_f$ $\times$ Shock$_t$	-0.581***	-0.577***	-0.364**	-0.561***	-0.428***	-0.424***	-0.576***	-0.575***
	(0.117)	(0.171)	(0.166)	(0.181)	(0.111)	(0.106)	(0.107)	(0.107)
Shock$_t$ $\times$ Sector$_f$	0.0633	0.0677	-0.119	-0.252	0.130*	0.136**	-0.389***	-0.543***
	(0.0778)	(0.114)	(0.114)	(0.192)	(0.0767)	(0.0648)	(0.109)	(0.0802)
Exposure$_f$ $\times$ Shock$_t$ $\times$ Sector$_f$		-0.0180		0.630		-0.113		1.449
		(0.364)		(0.508)		(0.646)		(1.003)
Observations	764	764	764	764	764	764	764	764
R^2	0.475	0.475	0.477	0.478	0.477	0.477	0.478	0.478
Firms	34	34	34	34	34	34	34	34
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BankQuarterFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log difference of loans outstanding in FX or peso at the firm-bank level in each period, winsorized at 1%. Sector is a dummy variable taking a value of one if the firm is in the sector indicated in the column heading. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Regressions are weighted by the lagged value of log loan. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A13: Growth in peso Loans (%), Firm-Bank Level - Robustness To Sectors

	Dependent Variable = $\log(loan^{peso}_{f,b,t})$							
Sector Interaction	Telecom		Manufacturing		Construction		Transportation	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\text{Exposure}_f \times \text{Shock}_t$	0.855**	1.614***	0.934***	0.936***	0.889***	0.417**	0.908***	0.907***
	(0.318)	(0.205)	(0.277)	(0.276)	(0.278)	(0.159)	(0.279)	(0.278)
$\text{Shock}_t \times \text{Small}_f$	0.0784*	0.0966**	0.0754*	0.0912**	0.0836	0.0561	0.0705*	0.0680*
	(0.0403)	(0.0393)	(0.0425)	(0.0437)	(0.0502)	(0.0515)	(0.0400)	(0.0395)
$\text{Exposure}_f \times \text{Shock}_t \times \text{Small}_f$	-0.963***	-1.703***	-1.163***	-2.132**	-1.111***	-0.551**	-1.042***	-0.998***
	(0.334)	(0.218)	(0.360)	(0.841)	(0.308)	(0.228)	(0.300)	(0.298)
$\text{Shock}_t \times \text{Sector}_f$	0.0531	0.125*	0.153***	0.173***	-0.0261	-0.0692	0.0777*	0.0512
	(0.0741)	(0.0675)	(0.0496)	(0.0531)	(0.0537)	(0.0510)	(0.0411)	(0.0402)
$\text{Shock}_t \times \text{Small}_f \times \text{Sector}_f$	0.184*	0.173*	-0.117	-0.169*	-0.0709	0.0300	0.0403	0.251***
	(0.109)	(0.102)	(0.0871)	(0.0993)	(0.0820)	(0.0687)	(0.0947)	(0.0714)
$\text{Exposure}_f \times \text{Shock}_t \times \text{Sector}_f$		-1.283***		1.082		1.308***		-2.501**
		(0.327)		(0.872)		(0.292)		(0.978)
$\text{Exposure}_f \times \text{Shock}_t \times \text{Small}_f \times \text{Sector}_f$						-4.377**		
						(2.164)		
Observations	2377	2377	2377	2377	2377	2377	2377	2377
R^2	0.155	0.157	0.155	0.155	0.155	0.158	0.154	0.155
Firms	47	47	47	47	47	47	47	47
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BankQuarterFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
JointTest	0.370	0.471	0.330	0.153	0.123	0.336	0.275	0.455

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log difference of loans outstanding in FX or peso at the firm-bank level in each period, winsorized at 1%. Sector is a dummy variable taking a value of one if the firm is in the sector indicated in the column heading. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Regressions are weighted by the lagged value of log loan. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A14: Growth in Bank Loans (%), Firm-Bank Level - Difference in Difference Justification

	Pre-Period Differences		Firm Specific Time Trend	
	(1) FX	(2) Peso	(3) FX	(4) Peso
Exposure$_f$ × 2008q3	0.212	0.202		
	(0.327)	(0.560)		
Exposure$_f$ × 2008q4	-0.0298	0.928		
	(0.503)	(0.882)		
2008q3 × Small$_f$		-0.130		
		(0.119)		
2008q4 × Small$_f$		0.0149		
		(0.145)		
Exposure$_f$ × 2008q3 × Small$_f$		-0.583		
		(0.988)		
Exposure$_f$ × 2008q4 × Small$_f$		0.461		
		(2.068)		
Exposure$_f$ × Shock$_t$	-0.521***	1.118**	-0.594***	0.913***
	(0.108)	(0.466)	(0.167)	(0.313)
Shock$_t$ × Small$_f$		0.0661		0.0631
		(0.0481)		(0.0423)
Exposure$_f$ × Shock$_t$ × Small$_f$		-1.177**		-1.003***
		(0.485)		(0.335)
Observations	764	2377	1636	2819
R^2	0.475	0.157	0.815	0.255
Firms	34	47	40	50
FirmFE	Yes	Yes	Yes	Yes
BankQuarterFE	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes
FirmTimeTrend	No	No	Yes	Yes
JointTest		0.691		0.509

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log difference of loans outstanding in FX or Peso at the firm-bank level in each period, winsorized at 1%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Regressions are weighted by the lagged value of log loan. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A15: Growth in Bank Loans (%), Firm-Bank Level - Exporters

	FX			Peso		
	(1)	(2)	(3)	(4)	(5)	(6)
Shock$_t$	-0.0155			-0.0365*		
	(0.0240)			(0.0207)		
Exposure$_f$ $\times$ Shock$_t$	-0.0273	0.00681	0.0217	0.176	0.347**	0.413*
	(0.0679)	(0.0826)	(0.0888)	(0.144)	(0.169)	(0.243)
Small$_f$ $\times$ Shock$_t$			-0.0110			-0.0179
			(0.0975)			(0.104)
Exposure$_f$ $\times$ Small$_f$ $\times$ Shock$_t$			-0.0970			-0.109
			(0.351)			(0.384)
Observations	3853	2271	2271	1485	1162	1162
R^2	0.013	0.387	0.387	0.041	0.261	0.261
Firms	37	36	36	34	34	34
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes
BankQuarterFE	No	Yes	Yes	No	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes
JointTest			0.828			0.351

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log difference of loans outstanding in FX or Peso at the firm-bank level in each period, winsorized at 1%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Regressions are weighted by the lagged value of log loan. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A16: Loan Growth(%), Firm-Bank Level, Alternate Specifications

	$\frac{L-L_{-1}}{L_{-1}}$		$\frac{L-L_{-1}}{0.5*(L+L_{-1})}$	
	(1)	(2)	(3)	(4)
	FX	Peso	FX	Peso
Exposure$_f$ × Shock$_t$	-0.539***	0.941***	-0.417***	0.832***
	(0.128)	(0.257)	(0.116)	(0.260)
Small$_f$ × Shock$_t$		0.102***		0.0696*
		(0.0367)		(0.0356)
Exposure$_f$ × Small$_f$ × Shock$_t$		-0.956***		-0.948***
		(0.296)		(0.277)
Observations	772	2377	911	2681
R^2	0.471	0.162	0.502	0.172
Firms	34	47	34	48
FirmFE	Yes	Yes	Yes	Yes
BankQuarterFE	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes
JointTest		0.926		0.303

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable in columns (1) and (2) is $(L^c_{f,b,t} - L^c_{f,b,t-1})/L^c_{f,b,t-1}$, winsorized at 3% for outliers. Dependent variable in columns (3) and (4) is $(L^c_{f,b,t} - L^c_{f,b,t-1})/(0.5 * (L^c_{f,b,t} + L^c_{f,b,t-1}))$, which admits firm-bank entry and exit, and is bounded by [-2,2]. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Risky is a dummy equal to 1 if the firm is a small firm whose average leverage is above the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Regressions are weighted by the lagged value of log loan. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A17: Growth in Bank Loans by Remaining Maturity (%), Firm-Bank Level

	FX				Peso			
	(1) Short	(2) Short	(3) Long	(4) Long	(5) Short	(6) Short	(7) Long	(8) Long
Exposure$_f$ × Shock$_t$	-0.811***	-0.768*	-0.00147	0.599	0.154	0.129	0.864**	1.326**
	(0.259)	(0.446)	(0.466)	(0.356)	(0.169)	(0.277)	(0.389)	(0.538)
Shock$_t$ × Small$_f$		-0.366***		0.189		-0.0411		0.0524
		(0.112)		(0.153)		(0.0568)		(0.0712)
Exposure$_f$ × Shock$_t$ × Small$_f$		0.316		-1.038***		0.0962		-1.157*
		(0.490)		(0.362)		(0.372)		(0.626)
Observations	560	560	397	397	2002	2002	1422	1422
R^2	0.448	0.457	0.505	0.513	0.150	0.150	0.206	0.208
Firms	28	28	25	25	47	47	42	42
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BankQuarterFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
JointTest		0.0430		0.284		0.333		0.640

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log difference of loans outstanding in FX at the firm-bank level in each period, winsorized at 1%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Risky is a dummy equal to 1 if the firm is a small firm whose average leverage is above the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Regressions are weighted by the lagged value of log loan. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A18: Growth in Bank Loans (%), Firm-Bank Level, Alternate Samples and Placebos

	FX			Peso		
	(1) Sample: Domestic Banks	(2) Sample: 2009q1-2013q1	(3) Placebo: 2010q3-2011q2	(4) Sample: Domestic Banks	(5) Sample: 2009q1-2013q1	(6) Placebo: 2010q3-2011q2
Exposure$_f$ × Shock$_t$	-0.583***	-0.407***	-0.257	0.896***	1.253**	-0.440
	(0.162)	(0.134)	(0.265)	(0.277)	(0.522)	(0.327)
Shock$_t$ × Small$_f$				0.0723*	0.0945**	-0.0158
				(0.0388)	(0.0454)	(0.0454)
Exposure$_f$ × Shock$_t$ × Small$_f$				-1.012***	-1.340**	0.0847
				(0.297)	(0.539)	(0.380)
Observations	493	634	764	2371	2075	2377
R^2	0.492	0.490	0.469	0.154	0.153	0.150
Firms	30	32	34	47	45	47
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes
BankQuarterFE	Yes	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes
JointTest				0.334	0.554	0.169

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log difference of loans outstanding in FX or Peso at the firm-bank level in each period, winsorized at 1%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Regressions are weighted by the lagged value of log loan. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A19: Growth in Employment (%), Horseraces

	Dependent Variable = log($Employment_{f,t}$)					
	(1)	(2)	(3)	(4)	(5)	(6)
Horse Variable	Exports	Cash	Derivatives	Size	Leverage	Sales
$\text{Exposure}_f \times \text{Shock}_t$	0.169*	0.160**	0.179***	0.187***	0.157**	0.158*
	(0.0856)	(0.0790)	(0.0633)	(0.0561)	(0.0737)	(0.0793)
$\text{Shock}_t \times \text{Small}_f$	0.00312	-0.00295	0.00523	-0.444*	-0.00722	0.0252
	(0.0161)	(0.0192)	(0.0148)	(0.247)	(0.0305)	(0.0223)
$\text{Exposure}_f \times \text{Shock}_t \times \text{Small}_f$	-0.403**	-0.223*	-0.240**	-0.217**	-0.242**	-0.235**
	(0.182)	(0.111)	(0.0991)	(0.0959)	(0.112)	(0.103)
$\text{Horse}_f \times \text{Shock}_t$	-0.000872	-0.0000946	-0.00533	-0.0169	0.0000796	-0.000216
	(0.00156)	(0.000789)	(0.00433)	(0.0109)	(0.000357)	(0.000393)
$\text{Horse}_f \times \text{Shock}_t \times \text{Small}_f$	0.00331	0.00143	-0.000358	0.0271*	0.000273	-0.00106
	(0.00244)	(0.00227)	(0.0142)	(0.0150)	(0.000630)	(0.000686)
Observations	770	770	770	770	770	770
R^2	0.166	0.164	0.165	0.166	0.164	0.168
Firms	51	51	51	51	51	51
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes
TimeFE	Yes	Yes	Yes	Yes	Yes	Yes
BankShock	Yes	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes
JointTest	0.139	0.439	0.451	0.705	0.340	0.288

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log difference of employment at the firm level in each period, winsorized at 2%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Horse is the firm characteristic indicated in the column heading. Exports is the 2008 average of the firm's external sales (exports + sales by foreign subsidiaries) over total sales. Cash is the 2008 average of cash to assets, with 2 outlier firms winsorized. Derivatives is the 2008 average of the net derivatives position to liabilities. Size is the 2008 average of log of assets. Leverage is the ratio of liabilities to assets. Sales is the ratio of total sales to assets. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Bank shock is a control for credit supply shocks to each firm, as constructed in the text, lagged one period. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A20: Growth in Physical Capital (%), Horseraces

	Dependent Variable = $\log(PPE_{f,t})$					
	(1)	(2)	(3)	(4)	(5)	(6)
Horse Variable	Exports	Cash	Derivatives	Size	Leverage	Sales
$\text{Exposure}_f \times \text{Shock}_t$	0.125*	0.129*	0.158***	0.143**	0.156**	0.117**
	(0.0652)	(0.0666)	(0.0510)	(0.0578)	(0.0690)	(0.0571)
$\text{Shock}_t \times \text{Small}_f$	0.0160	0.0154	0.0171	-0.126	-0.0222	0.0498**
	(0.0114)	(0.0155)	(0.0102)	(0.190)	(0.0278)	(0.0196)
$\text{Exposure}_f \times \text{Shock}_t \times \text{Small}_f$	-0.330***	-0.241***	-0.274***	-0.272***	-0.285***	-0.244***
	(0.118)	(0.0849)	(0.0750)	(0.0788)	(0.0952)	(0.0729)
$\text{Horse}_f \times \text{Shock}_t$	0.000448	0.000308	-0.00921***	-0.0117	-0.000517	0.000797
	(0.000809)	(0.000586)	(0.00327)	(0.00893)	(0.000353)	(0.000517)
$\text{Horse}_f \times \text{Shock}_t \times \text{Small}_f$	0.000882	0.000137	0.0109	0.00783	0.000803	-0.00183**
	(0.00144)	(0.00194)	(0.00820)	(0.0117)	(0.000663)	(0.000784)
Observations	792	792	792	792	792	792
R^2	0.208	0.207	0.212	0.208	0.209	0.212
Firms	52	52	52	52	52	52
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes
TimeFE	Yes	Yes	Yes	Yes	Yes	Yes
BankShock	Yes	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes
JointTest	0.0282	0.0479	0.0393	0.0216	0.0369	0.0110

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log difference of physical capital outstanding, measured as property, plant, and equipment, at the firm level in each period, winsorized at 2%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Horse is the firm characteristic indicated in the column heading. Exports is the 2008 average of the firm's external sales (exports + sales by foreign subsidiaries) over total sales. Cash is the 2008 average of cash to assets, with 2 outlier firms winsorized. Derivatives is the 2008 average of the net derivatives position to liabilities. Size is the 2008 average of log of assets. Leverage is the ratio of liabilities to assets. Sales is the ratio of total sales to assets. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Bank shock is a control for credit supply shocks to each firm, as constructed in the text, lagged one period. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A21: Growth in Employment (%) - Robustness to Sectors

	Dependent Variable = log($Employment_{f,t}$)							
Sector Interaction	Telecom		Manufacturing		Construction		Transportation	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\text{Exposure}_f \times \text{Shock}_t$	0.405***	0.412*	0.376***	0.379***	0.414***	0.400***	0.393***	0.393***
	(0.115)	(0.215)	(0.0986)	(0.0986)	(0.0870)	(0.0428)	(0.102)	(0.102)
$\text{Shock}_t \times \text{Small}_f$	-0.00101	-0.000992	0.0150	0.0214	-0.00290	-0.00748	0.00208	0.00220
	(0.0214)	(0.0214)	(0.0197)	(0.0221)	(0.0132)	(0.0129)	(0.0206)	(0.0207)
$\text{Exposure}_f \times \text{Shock}_t \times \text{Small}_f$	-0.419**	-0.425*	-0.230	-0.439	-0.367***	-0.268**	-0.413**	-0.417**
	(0.163)	(0.243)	(0.151)	(0.280)	(0.130)	(0.102)	(0.154)	(0.160)
$\text{Shock}_t \times \text{Sector}_f$	-0.0171	-0.0164	-0.0209*	-0.0207*	0.0422	0.0414	0.0127	0.0127
	(0.0239)	(0.0194)	(0.0114)	(0.0115)	(0.0291)	(0.0280)	(0.0121)	(0.0121)
$\text{Shock}_t \times \text{Small}_f \times \text{Sector}_f$	0.0168	0.0166	-0.0540**	-0.0683***	0.0301	0.0708**	-0.00242	-0.00917
	(0.0307)	(0.0298)	(0.0217)	(0.0238)	(0.0436)	(0.0322)	(0.0176)	(0.0265)
$\text{Exposure}_f \times \text{Shock}_t \times \text{Sector}_f$		-0.0145				0.0336		
		(0.222)				(0.174)		
$\text{Exposure}_f \times \text{Shock}_t \times \text{Small}_f \times \text{Sector}_f$				0.298		-1.549**		0.0671
				(0.264)		(0.605)		(0.190)
Observations	517	517	517	517	517	517	517	517
R^2	0.203	0.203	0.216	0.218	0.220	0.229	0.203	0.203
Firms	45	45	45	45	45	45	45	45
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TimeFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BankShock	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
JointTest	0.906	0.907	0.179	0.812	0.628	0.129	0.863	0.844

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log difference of employment at the firm level in each period, winsorized at 2%. Sector is a dummy variable taking a value of 1 if the firm is in the sector indicated in the column heading. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Bank shock is a control for credit supply shocks to each firm, as constructed in the text. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A22: Growth in Physical Capital (%) - Robustness to Sectors

	Dependent Variable = $\log(PPE_{f,t})$							
Sector Interaction	Telecom		Manufacturing		Construction		Transportation	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\text{Exposure}_f \times \text{Shock}_t$	0.213**	0.276*	0.218**	0.219**	0.202***	0.176***	0.220**	0.220**
	(0.0935)	(0.139)	(0.0845)	(0.0851)	(0.0634)	(0.0453)	(0.0864)	(0.0864)
$\text{Shock}_t \times \text{Small}_f$	0.00978	0.0100	0.0167	0.0200	-0.00560	-0.00616	0.0108	0.0109
	(0.0125)	(0.0124)	(0.0129)	(0.0130)	(0.0129)	(0.0126)	(0.0124)	(0.0124)
$\text{Exposure}_f \times \text{Shock}_t \times \text{Small}_f$	-0.257*	-0.319*	-0.208	-0.311	-0.232**	-0.204**	-0.281**	-0.286**
	(0.134)	(0.169)	(0.148)	(0.221)	(0.115)	(0.0993)	(0.129)	(0.137)
$\text{Shock}_t \times \text{Sector}_f$	0.00934	0.0163	0.0195	0.0219*	-0.0316	-0.0319	0.0124	0.0123
	(0.0184)	(0.0171)	(0.0122)	(0.0126)	(0.0213)	(0.0210)	(0.00999)	(0.0100)
$\text{Shock}_t \times \text{Small}_f \times \text{Sector}_f$	0.0342	0.0332	-0.0459*	-0.0555*	0.0573**	0.0582**	0.00943	0.00266
	(0.0216)	(0.0208)	(0.0272)	(0.0298)	(0.0284)	(0.0267)	(0.0160)	(0.0245)
$\text{Exposure}_f \times \text{Shock}_t \times \text{Sector}_f$		-0.138		0.148		0.0539		
		(0.143)		(0.184)		(0.0995)		
$\text{Exposure}_f \times \text{Shock}_t \times \text{Small}_f \times \text{Sector}_f$						-0.0816		0.0675
						(0.596)		(0.164)
Observations	537	537	537	537	537	537	537	537
R^2	0.231	0.232	0.232	0.232	0.235	0.235	0.230	0.230
Firms	46	46	46	46	46	46	46	46
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TimeFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BankShock	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
JointTest	0.622	0.635	0.931	0.618	0.743	0.743	0.499	0.507

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable is the log difference of physical capital outstanding, measured as property, plant, and equipment, at the firm level in each period, winsorized at 2%. Sector is a dummy variable taking a value of 1 if the firm is in the sector indicated in the column heading. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Bank shock is a control for credit supply shocks to each firm, as constructed in the text. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A23: Growth in Firm Level Outcomes (%)

	Pre-Period Differences		Firm Specific Time Trend	
	(1) Emp	(2) PPE	(3) Emp	(4) PPE
Exposure$_f$ × 2008q3	0.000349	-0.0539		
	(0.178)	(0.0600)		
Exposure$_f$ × 2008q4	0.0990	-0.0347		
	(0.0899)	(0.0726)		
2008q3 × Small$_f$	-0.0488	0.0107		
	(0.0305)	(0.0210)		
2008q4 × Small$_f$	0.00145	-0.0173		
	(0.0291)	(0.0282)		
Exposure$_f$ × 2008q3× Small$_f$	-0.00180	-0.0622		
	(0.227)	(0.197)		
Exposure$_f$× 2008q4 × Small$_f$	-0.308	0.149		
	(0.254)	(0.251)		
Exposure$_f$ × Shock$_t$	0.190	0.109	0.296	0.375*
	(0.115)	(0.0731)	(0.220)	(0.214)
Shock$_t$ × Small$_f$	0.00282	0.0147	0.0168	0.0160
	(0.0146)	(0.0119)	(0.0220)	(0.0154)
Exposure$_f$ × Shock$_t$ × Small$_f$	-0.300**	-0.229**	-0.284	-0.593**
	(0.129)	(0.0890)	(0.244)	(0.223)
Observations	768	790	545	567
R^2	0.173	0.208	0.250	0.312
Firms	51	52	47	48
FirmFE	Yes	Yes	Yes	Yes
TimeFE	Yes	Yes	Yes	Yes
BankShock	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes
FirmTimeTrend	No	No	Yes	Yes
JointTest	0.0829	0.0237	0.927	0.00927

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable in columns (1) and (3) is the log difference of employment at the firm level in each period, winsorized at 2%. Dependent variable in columns (2) and (4) is the log difference of physical capital outstanding, measured as property, plant, and equipment, at the firm level in each period, winsorized at 2%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Bank shock is a control for credit supply shocks to each firm, as constructed in the text. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A24: Growth in Firm Level Outcomes (%) - Exporters

	Bank Debt		Employment		PPE	
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Exposure}_f \times \text{Shock}_t$	0.354**	0.207	0.0127	0.0235	0.0148	0.0288
	(0.142)	(0.162)	(0.0263)	(0.0322)	(0.0247)	(0.0243)
$\text{Shock}_t \times \text{Small}_f$		-0.0406		0.0137		0.0137
		(0.0818)		(0.0167)		(0.0169)
$\text{Exposure}_f \times \text{Shock}_t \times \text{Small}_f$		0.487*		-0.0436		-0.0536
		(0.287)		(0.0575)		(0.0585)
Observations	639	639	598	598	600	600
R^2	0.154	0.157	0.183	0.185	0.329	0.331
Firms	38	38	38	38	38	38
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes
TimeFE	Yes	Yes	Yes	Yes	Yes	Yes
BankShock	Yes	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes
JointTest		0.0112		0.681		0.651

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable in columns (1) and (2) is the log difference of bank credit outstanding at the firm level in each period, winsorized at 1%. Dependent variable in columns (3) and (4) is the log difference of employment at the firm level in each period, winsorized at 2%. Dependent variable in columns (5) and (6) is the log difference of physical capital outstanding, measured as property, plant, and equipment, at the firm level in each period, winsorized at 2%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Bank shock is a control for credit supply shocks to each firm, as constructed in the text. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A25: Growth in Firm Level Outcomes (%), Alternate Specifications

	$\Delta\log(E)$		$\frac{E-E_{-1}}{E_{-1}}$		$\Delta\log(PPE)$		$\frac{PPE-PPE_{-1}}{PPE_{-1}}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Short Exposure$_f$ $\times$ Shock$_t$	0.0418	0.209***			0.0683	0.223**		
	(0.0603)	(0.0775)			(0.0875)	(0.108)		
Shock$_t$ $\times$ Small$_f$		-0.0107		0.00371		0.000394		0.0167
		(0.0149)		(0.0145)		(0.00822)		(0.0124)
Short Exposure$_f$ $\times$ Shock$_t$ $\times$ Small$_f$		-0.321***				-0.319**		
		(0.111)				(0.132)		
Exposure$_f$ $\times$ Shock$_t$			0.0776*	0.156**			0.0369	0.140*
			(0.0452)	(0.0769)			(0.0640)	(0.0715)
Exposure$_f$ $\times$ Shock$_t$ $\times$ Small$_f$				-0.197*				-0.266***
				(0.105)				(0.0894)
Observations	770	770	754	754	773	773	792	792
R^2	0.156	0.162	0.148	0.153	0.225	0.233	0.189	0.197
Firms	51	51	51	51	51	51	52	52
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TimeFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BankShock	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FirmControls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
JointTest		0.167		0.586		0.236		0.0278

Sample spans 2008q1-2013q1, Firms reports the number of firms in each regression. Dependent variable in columns (1) and (2) is the log difference of employment at the firm level in each period, winsorized at 2%; in columns (3) and (4) is employment growth $(E - E_{-1})/E_{-1}$ at the firm level in each period, winsorized at 2%; in columns (5) and (6) is the log difference of physical capital outstanding, measured as property, plant, and equipment (PPE), at the firm level in each period, winsorized at 2%.; and in columns (7) and (8) is $(PPE - PPE_{-1})/PPE_{-1}$, winsorized at 2%. Exposure is the firm's average 2008 net FX position to assets, with 2 outlier firms winsorized. Short Exposure is the firm's 2008 average of short term FX liabilities less total FX assets divided by total assets, with 3 outlier firms winsorized. Small is a dummy equal to one if the firm's average size (measured by log assets) is below the sample median. Shock is a dummy variable taking a value of 1 in 2009 and 2010 and 0 otherwise. Bank shock is a control for credit supply shocks to each firm, as constructed in the text, lagged one period. Firm Controls include one quarter lags of firm size (log assets), cash to assets ratio winsorized at 1%, total liabilities to assets ratio winsorized at 2%, bond credit to assets, share of sales to foreigners (including exports and sales by foreign subsidiaries), sales to assets ratio, and net derivatives position to total liabilities winsorized at 3%. Errors are clustered at the firm level. JointTest reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Small is equal to 0. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

B Equivalence of using demeaned estimates of bank shocks

Proof of Proposition 5.1. Rewrite the estimated effect as

$$\hat{\alpha}_{b,t} = \hat{\alpha}^*_{b,t} - \hat{\alpha}^*_{ref,t} \tag{12}$$

Note that the time average of $\hat{\alpha}^*_{ref,t}$ is $\hat{\alpha}^*_{ref,t}$. Thus $\hat{\alpha}_{b,t} - \overline{\hat{\alpha}_t} = \hat{\alpha}^*_{b,t} - \overline{\hat{\alpha}^*_t}$, where $\overline{\hat{\alpha}_t}$ is the time average of $\hat{\alpha}_{b,t}$. By the same logic, $\hat{\alpha}_{f,t} - \overline{\hat{\alpha}^f_t} = \hat{\alpha}^*_{f,t} - \overline{\hat{\alpha}^{f*}_t}$ where $\overline{\hat{\alpha}^f_t}$ is the time average of $\hat{\alpha}_{f,t}$.

Define $L_{f,t-1} = \sum_{b \in B_{f,t}} L_{f,b,t-1}$. Then, by time demeaning $\widehat{BS}_{f,t}$ and substituting in equation 12, we obtain

$$\begin{aligned}
\widehat{BS}_{f,t} - \overline{\widehat{BS}_t} &= \frac{1}{L_{f,t-1}} \sum_{b \in B_{f,t}} (L_{f,b,t-1} \times \hat{\alpha}_{b,t}) - \frac{1}{F_t} \sum_{f; \in F_t} \left(\frac{1}{L_{f,t-1}} \sum_{b \in B_{f,t}} (L_{f,b,t-1} \times \hat{\alpha}_{b,t}) \right) \\
&= \frac{1}{L_{f,t-1}} \sum_{b \in B_{f,t}} (L_{f,b,t-1} \times (\hat{\alpha}^*_{b,t} - \hat{\alpha}^*_{ref,t})) \\
&\quad - \frac{1}{F_t} \sum_{f \in F_t} \left(\frac{1}{L_{f,t-1}} \sum_{b \in B_{f,t}} (L_{f,b,t-1} \times (\hat{\alpha}^*_{b,t} - \hat{\alpha}^*_{ref,t})) \right) \\
&= \frac{1}{L_{f,t-1}} \sum_{b \in B_{f,t}} (L_{f,b,t-1} \times \hat{\alpha}^*_{b,t}) - \frac{\hat{\alpha}^*_{ref,t} \sum_{b \in B_{f,t}} L_{f,b,t-1}}{L_{f,t-1}} \\
&\quad - \frac{1}{F_t} \sum_{f \in F_t} \left(\frac{1}{L_{f,t-1}} \sum_{b \in B_{f,t}} (L_{f,b,t-1} \times \hat{\alpha}^*_{b,t}) - \frac{\hat{\alpha}^*_{ref,t} \sum_{b \in B_{f,t}} L_{f,b,t-1}}{L_{f,t-1}} \right) \\
&= \widehat{BS}^*_{f,t} - \hat{\alpha}^*_{ref,t} - \frac{1}{F_t} \sum_{f \in F_t} \left(\widehat{BS}^*_{f,t} - \hat{\alpha}^*_{ref,t} \right) \\
&= \widehat{BS}^*_{f,t} - \hat{\alpha}^*_{ref,t} - (\overline{\widehat{BS}}^*_t - \hat{\alpha}^*_{ref,t}) \\
&= \widehat{BS}^*_{f,t} - \overline{\widehat{BS}}^*_t
\end{aligned}$$

■

C Model

My results suggest that firms are subject to a constraint on their total borrowing and a second, tighter constraint on their FX borrowing, which gives the balance sheet shocks real impacts. Here, I present a stylized 3 period model which serves to illustrate qualitatively how this mechanism can generate the behavior observed in the empirical results. The model is partial equilibrium in nature to focus on the decisions of the firm.[74]

The key to the model is that firms, in addition to being constrained in their total debt, are subject to a second borrowing constraint specifically on their FX borrowing. These constraints both depend on the net worth of the firm, which in this model is directly related to firm size. This assumption is justified in Figure 7, which plots the bank debt of non-exporting firms in my sample in peso and FX against their size (log assets). As firms get larger, they increase their leverage in peso before increasing their leverage in FX.[75] This is striking as the lower price of FX debt and failure of UIP suggests that firms would desire to do the opposite.

The constraint on total borrowing that the firm faces can be derived from an incentive compatibility constraint, in which the firm should not have the incentive to default on their debt (under most realizations of the exchange rate). The additional constraint on FX borrowing reflects the risks faced by the bank. Niepmann and Schmidt-Eisenlohr (2017a) provide evidence that firms that borrow more in FX have a higher probability of defaulting on their loans (both FX and peso) in the event of a depreciation. Further, most collateral backing loans to firms is denominated in local currency (see Calomiris et al. (2017) and Fleisig et al. (2006) for evidence that immovable collateral is frequently required to secure lending in emerging markets). That means that when a loan is made in FX and the exchange rate depreciates, the bank recovers a smaller share of the loan value in the event of default, increasing their downside risk. Thus, the bank has an incentive to limit FX borrowing in addition to limiting total borrowing.[76]

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[74] I abstract from the maturity mismatch dimension of the balance sheet shock to focus on just the net worth impact and its consequences, as shown in my empirical results.

[75] Size based borrowing constraints (as in Gopinath et al. (2017)) may match the data better, but are not necessary to generate the qualitative results observed in my analysis.

[76] This incentive may strengthen if the bank faces higher penalties for not repaying its FX creditors as compared to domestic peso creditors. In this model, I leave the explicit problem generating this constraint un-modeled.

C.1 General Framework

There are 3 periods $t \in \{0, 1, 2\}$. The economy is populated by firms (or entrepreneurs) who seek to maximize their period 2 wealth. Firms are endowed with initial wealth w_0. Firms are risk neutral and produce using technology $y_t = f(k_t) = zk_t^{\alpha}$.[77] Capital depreciates fully upon use.

The timing works as follows: at $t = 0$, firms inherit their initial wealth (their size) and make borrowing and investment decisions. At the beginning of $t = 1$, a depreciation shock is realized. Firms produce and repay their debt (which may be affected by the depreciation), or default and exit if they are unable to repay, and then use the remaining profits to make borrowing and investment decisions. At the beginning of $t = 2$, uncertainty about the exchange rate is again resolved, firms produce, repay their debt or default, and consume their profits.

Firms can borrow in peso and FX, but the rate of currency depreciation is uncertain, and UIP fails such that FX debt is attractive.[78] UIP failure takes the following form: $E[1+\phi] = \frac{1+r}{1+r^*}\frac{1}{\gamma}$, where $\gamma > 1$ captures the deviation from UIP, $r > r^*$ are the interest rates on local and foreign currency loans, respectively, and ϕ is the rate of depreciation of the local currency. Firms are subject to constraints on their total borrowing and on their FX borrowing.

C.2 Firm's Problem at $t = 1$

The problem is solved recursively. At the end of $t = 1$, firms take as given wealth w_1 and solve the following problem:[79]

$$\max_{d_2, d_2^*} z_2 k_2^{\alpha} - (1+r)d_2 - (1+r^*)E[1+\phi_2]d_2^* \tag{13}$$

s.t.

$$k_2 = w_1 + d_2 + d_2^* \tag{14}$$

[77] I abstract from employment decisions of the firm for simplicity.
[78] UIP failure is shown in the aggregate in Figure 6 and in the microdata at the firm level in Table 6.
[79] This formulation is similar to that in Aghion, Bacchetta, and Banerjee (2001).

$$0 \leq d_2 + d_2^* \leq \kappa_0 w_1 \tag{15}$$

$$0 \leq d_2^* \leq \kappa_1 w_1 \tag{16}$$

where d is peso debt, d^* is FX debt, z is the (potentially firm specific) productivity, and k is investment in physical capital. $\kappa_1 < \kappa_0$, which means that the borrowing constraint on FX loans is tighter than for the firm's overall borrowing. Solving the $t = 1$ problem leads to decision rules $d_2(w_1)$, $d_2^*(w_1)$, and $k_2(w_1)$, which depend on wealth carried intro period 1. Note that the firm maximizes expected period 2 profit, where the only source of uncertainty is the period 2 exchange rate realization.

Recall that $E[1+\phi] = \frac{1+r}{1+r^*}\frac{1}{\gamma}$. Let the CDF of the random variable $1+\phi$ be given by $G(\cdot)$. The solution for the t=1 decision breaks into 6 cases (denoted by cutoffs W_0 to W_4), whose probability depend on w_1 and z_2:

Case 0: $w_1 \leq 0 = W_0$

$Pr(Case0) = 1 - G(\frac{z_1 k_1^\alpha - (1+r)d_1}{(1+r^*)d_1^*})$

$k_2 = 0, d_2^* = 0, d_2 = 0$

$\Pi_2 = 0$

Case 1: $0 < w_1 \leq \frac{\left(\frac{z_2\alpha}{1+r}\right)^{\frac{1}{1-\alpha}}}{1+\kappa_0} = W_1$

$Pr(Case1) = G(\frac{z_1 k_1^\alpha - (1+r)d_1}{(1+r^*)d_1^*}) - G(\frac{z_1 k_1^\alpha - (1+r)d_1 - W_1}{(1+r^*)d_1^*})$

$k_2 = (1+\kappa_0)w_1, d_2^* = \kappa_1 w_1, d_2 = (\kappa_0 - \kappa_1)w_1$

$\Pi_2 = z_2((1+\kappa_0)w_1)^\alpha - (1+r)(\kappa_0-\kappa_1)w_1 - (1+r^*)(1+\phi_2)\kappa_1 w_1$

Case 2: $\frac{\left(\frac{z_2\alpha}{1+r}\right)^{\frac{1}{1-\alpha}}}{1+\kappa_0} \leq w_1 < \frac{\left(\frac{z_2\alpha\gamma}{(1+r)}\right)^{\frac{1}{1-\alpha}}}{1+\kappa_0} = W_2$

$Pr(Case2) = G(\frac{z_1 k_1^\alpha - (1+r)d_1 - W_1}{(1+r^*)d_1^*}) - G(\frac{z_1 k_1^\alpha - (1+r)d_1 - W_2}{(1+r^*)d_1^*})$

$k_2 = \left(\frac{z_2\alpha}{1+r}\right)^{\frac{1}{1-\alpha}}, d_2^* = \kappa_1 w_1, d_2 = \left(\frac{z_2\alpha}{1+r}\right)^{\frac{1}{1-\alpha}} - (1+\kappa_1)w_1$

$\Pi_2 = z_2\left(\frac{z_2\alpha}{1+r}\right)^{\frac{\alpha}{1-\alpha}} - (1+r)\left(\left(\frac{z_2\alpha}{1+r}\right)^{\frac{1}{1-\alpha}} - (1+\kappa_1)w_1\right) - (1+r^*)(1+\phi_2)\kappa_1 w_1$

Case 3: $\frac{\left(\frac{z_2\alpha\gamma}{(1+r)}\right)^{\frac{1}{1-\alpha}}}{1+\kappa_0} \leq w_1 < \frac{\left(\frac{z_2\alpha\gamma}{(1+r)}\right)^{\frac{1}{1-\alpha}}}{1+\kappa_1} = W_3$

$Pr(Case3) = G(\frac{z_1 k_1^\alpha - (1+r)d_1 - W_2}{(1+r^*)d_1^*}) - G(\frac{z_1 k_1^\alpha - (1+r)d_1 - W_3}{(1+r^*)d_1^*})$

$k_2 = (1+\kappa_1)w_1, d_2^* = \kappa^* w_1, d_2 = 0$

$\Pi_2 = z_2((1+\kappa_1)w_1)^\alpha - (1+r^*)(1+\phi_2)\kappa_1 w_1$

Case 4: $\frac{\left(\frac{z_2\alpha\gamma}{(1+r)}\right)^{\frac{1}{1-\alpha}}}{1+\kappa_1} \leq w_1 < \left(\frac{z_2\alpha\gamma}{(1+r)}\right)^{\frac{1}{1-\alpha}} = W_4$

$Pr(Case4) = G(\frac{z_1 k_1^\alpha - (1+r)d_1 - W_3}{(1+r^*)d_1^*}) - G(\frac{z_1 k_1^\alpha - (1+r)d_1 - W_4}{(1+r^*)d_1^*})$

$k_2 = (\frac{z_2\alpha\gamma}{1+r})^{\frac{1}{1-\alpha}}$, $d_2^* = (\frac{z_2\alpha\gamma}{1+r})^{\frac{1}{1-\alpha}} - w_1$, $d_2 = 0$

$\Pi_2 = z_2\left(\frac{z_2\alpha\gamma}{1+r}\right)^{\frac{\alpha}{1-\alpha}} - (1+r^*)(1+\phi_2)\left(\left(\frac{z_2\alpha\gamma}{1+r}\right)^{\frac{1}{1-\alpha}} - w_1\right)$

Case 5: $\left(\frac{z_2\alpha\gamma}{(1+r)}\right)^{\frac{1}{1-\alpha}} \leq w_1$

$Pr(Case5) = G(\frac{z_1 k_1^\alpha - (1+r)d_1 - W_4}{(1+r^*)d_1^*})$

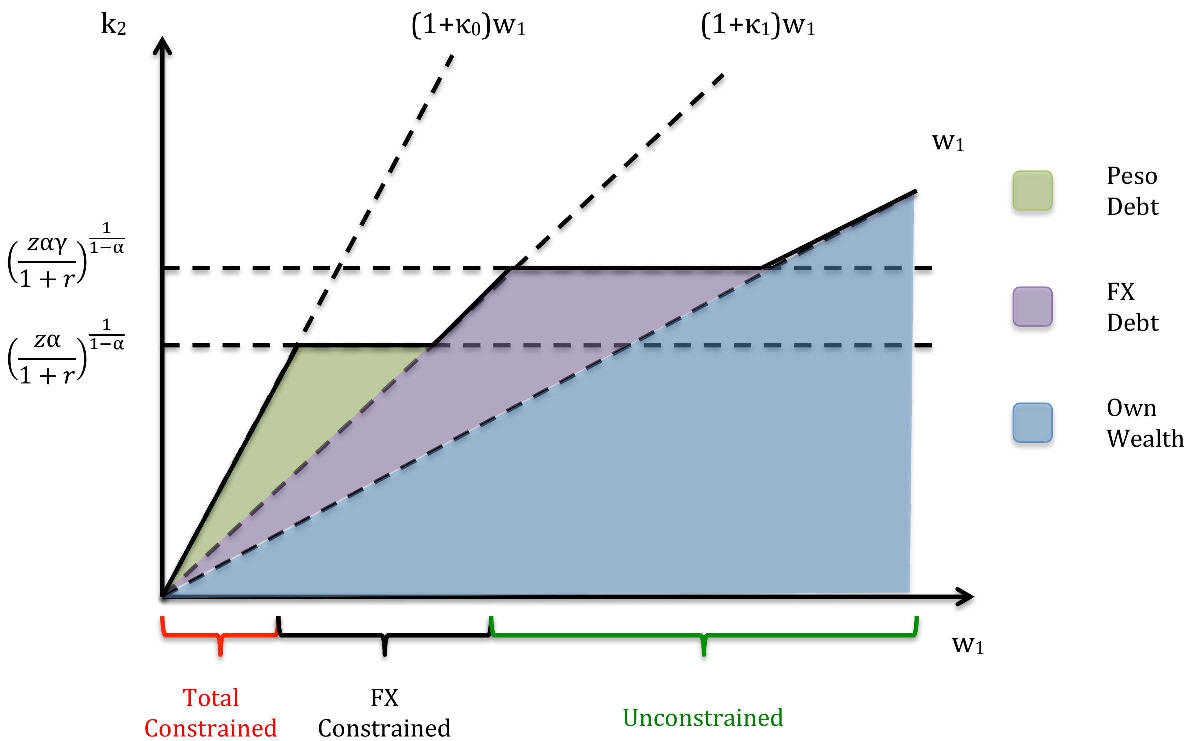
$k_2 = w_1$, $d_2^* = 0$, $d_2 = 0$

$\Pi_2 = z_2 w_1^\alpha$

Figure C1 illustrates the relationship between wealth w_1 and investment k_2. The different cases are determined by which constraints are binding and the funding source (peso, FX, or own wealth) with which the marginal unit of investment is financed. Starting from 0 in Figure C1, as a firm increases in w_1, investment k_2 increases since higher wealth relaxes the total borrowing constraint. While the marginal debt is denominated in pesos, the optimal investment level is $(\frac{z\alpha}{1+r})^{\frac{1}{1-\alpha}}$. Once wealth is sufficiently large, the firm can make this level of investment, so investment is flat though FX debt increases with increasing wealth, which relaxes the FX borrowing constraint. Once the marginal unit of debt switches to FX, the optimal level of investment increases to $(\frac{z\alpha\gamma}{1+r})^{\frac{1}{1-\alpha}}$, so firms increase FX debt with increasing wealth (which relaxes their FX debt constraint). Once wealth is sufficiently large, the firm makes the new optimal level of investment. When the marginal unit of investment is purchased solely with wealth, then investment increases one-for-one with wealth.

The purpose of this model is to rationalize the patterns of borrowing and investment outcomes for small firms and large firms after a balance sheet shock. Small firms are constrained in their total borrowing, while large firms may be constrained only in their FX borrowing. Therefore, I focus my analysis on the first two cases, given by wealth cutoffs W_1 and W_2 corresponding to the first increasing slope and flat segment of the investment curve

Figure C1: Size and Investment



in Figure C1.[80,81]

For illustration, consider two firms that have the same initial wealth w_0 and investment k_1, but for random reasons differ in terms of the FX share of initial debt $\frac{d_1^*}{d_1+d_1^*}$.[82] A large depreciation will lead to a larger decrease in w_1 for the more exposed firm. Proposition C.1 summarizes the response of borrowing and investment to a shock to w_1 for firms in the first two cases.

Proposition C.1. *If $0 < w_1 \leq W_1$, then a negative shock to w_1 results in lower FX debt, peso debt, and investment. That is, $\frac{\partial d_2^*}{\partial w_1} > 0$, $\frac{\partial d_2}{\partial w_1} > 0$, and $\frac{\partial k_2}{\partial w_1} > 0$.*

If $W_1 < w_1 \leq W_2$, then a negative shock to w_1 (such that w_1 remains above the lower threshold) results in lower FX debt, higher peso debt, higher total debt, and unchanged investment. That is,

80 Note, however, that the pattern from the other cases matches the data plotted in Figure 7: as the firm gets bigger, the firm levers up in peso, decreases total borrowing while shifting to FX debt, then levers up in FX debt, and finally decreases bank debt as firm size becomes extremely large.

81 There is also a case 0, where firms default in period 1 and exit, and so does not involve any decisions for period 2.

82 The depreciation is quite unexpected, so this assumption could be justified that small and random differences may generate differences in exposure orthogonal to other firm characteristics.

$\frac{\partial d_2^*}{\partial w_1} > 0$, $\frac{\partial d_2}{\partial w_1} < 0$, $\frac{\partial(d_2+d_2^*)}{\partial w_1} < 0$, *and* $\frac{\partial k_2}{\partial w_1} = 0$

Proof:

Proof of Proposition C.1. If $0 < w_1 \leq W_1$, the constrained optimal debt and investment choices are $d_2^* = \kappa_1 w_1$, $d_2 = (\kappa_0 - \kappa_1)w_1$, and $k_2 = (1+\kappa_0)w_1$. It follows that $\frac{\partial d_2^*}{\partial w_1} = \kappa_1 > 0$, $\frac{\partial d_2}{\partial w_1} = (\kappa_0 - \kappa_1) > 0$, and $\frac{\partial k_2}{\partial w_1} = 1 + \kappa_0 > 0$. Hence, a negative shock to w_1 leads to lower FX debt, peso debt, and investment.

If $W_1 < w_1 \leq W_2$, the semi-constrained optimal debt and investment choices are $d_2^* = \kappa_1 w_1$, $d_2 = \left(\frac{z_2\alpha}{1+r}\right)^{\frac{1}{1-\alpha}} - (1+\kappa_1)w_1$, $d_2 + d_2^* = \left(\frac{z_2\alpha}{1+r}\right)^{\frac{1}{1-\alpha}} - w_1$, and $k_2 = \left(\frac{z_2\alpha}{1+r}\right)^{\frac{1}{1-\alpha}}$. It then follows that $\frac{\partial d_2^*}{\partial w_1} = \kappa_1 > 0$, $\frac{\partial d_2}{\partial w_1} = -(1+\kappa_1) < 0$, $\frac{\partial(d_2+d_2^*)}{\partial w_1} = -1 < 0$, and $\frac{\partial k_2}{\partial w_1} = 0$. Hence, a negative shock to w_1 which leaves $w_1 > W_1$, results in lower FX debt, higher peso debt, higher total debt, and unchanged investment. ■

The intuition for the first case is straightforward: the firm is constrained in their borrowing, and a negative shock to net worth causes that constraint to bind more tightly, so the firm must borrow and invest less. The intuition for the second case is as follows: the firm is constrained in their FX debt, so the negative shock forces them to reduce their FX debt. They remain unconstrained in their total debt. So, the firm makes up for the lost wealth and lost FX debt with an increase in peso debt. The increase in peso debt is thus larger than the decrease in FX debt, so total debt rises.

This matches most of my key empirical results shown in Table 1 and Table 9. However, the model does not explain why large exposed non-exporters have higher investment and employment following the shock, rather than unchanged real outcomes.[83] Further, I have assumed firms of the same size randomly have different levels of FX mismatch. If I relax this assumption, firms of the same size would choose exactly the same exposure in period 0. To address these two issues, I allow firms to differ from each other in terms of their period

[83]This is also found empirically elsewhere in the literature. See for example Kim et al. (2015).

1 and 2 productivity (z_1, z_2).[84] I next describe the firm's period 0 problem and the role of productivity in determining FX exposure and real outcomes.

C.3 Firm's Problem at $t = 0$

At $t = 0$, firms solve the following problem, taking the decision rules $d_2(w_1, z_1, z_2)$, $d_2^*(w_1, z_1, z_2)$, and $k_2(w_1, z_1, z_2)$ and initial wealth w_0 as given:

$$\max_{d_1, d_1^*} E[z_2 k_2(w_1, z_1, z_2)^\alpha - (1+r)d_2(w_1, z_1, z_2) - (1+r^*)(1+\phi_2)d_2^*(w_1, z_1, z_2)] \tag{17}$$

s.t.

$$w_1 = z_1 k_1^\alpha - (1+r)d_1 - (1+r^*)E[1+\phi_1]d_1^* \tag{18}$$

$$k_1 = w_0 + d_1 + d_1^* \tag{19}$$

$$d_1 + d_1^* \leq \kappa_0 w_0 \tag{20}$$

$$d_1^* \leq \kappa_1 w_0 \tag{21}$$

(z_1, z_2) are known at $t = 0$. The solution for d_1 and d_1^* depends on the distribution of $1 + \phi$ and may not have a closed form depending on the functional form of the CDF, $G(\cdot)$.

Using the probabilities of being in case and the expected profit from each case derived earlier, we can express the period 0 decision as maximizing the expected period 2 profit, given w_0, and subject to the budget constraint and borrowing constraints.

$$\max_{d_1, d_1^*} \sum_{i=0}^{5} Pr(Case_i | z_2) * \Pi_2^i(w_1, z_2) \tag{22}$$

s.t. the same set of constraints

Differences in productivity have a couple of key effects that can generate the patterns observed in the empirical analysis. The first concerns the cross-sectional difference in firm productivity, highlighted by Proposition C.2

[84] This need not be the only way to generate these results, but it is useful as a simple extension to the model. Note that the main empirical results that exposed firms decrease FX borrowing, exposed small firms decrease investment, and large exposed firms increase peso (and total) borrowing, do not require this additional assumption of differences in future productivity.

Proposition C.2. *For a given initial wealth w_0, firms that are more productive in period 1 borrow more in FX in period 0 than firms that are less productive in period 1: $\frac{\partial d_1^*}{\partial z_1} \geq 0$.*

Proof:

Proof of Proposition C.2. The proof proceeds in several steps: First, I show that $E_1[Pi_2]$ is strictly increasing in w_1, $\forall\, w_1 > 0$:

Case 1: $\frac{\partial E_1[\Pi_2]}{\partial w_1} = \alpha z_2((1+\kappa_0)w_1)^{\alpha-1}(1+\kappa_0) - (1+r)(\kappa_0 - \kappa_1 \frac{\gamma-1}{\gamma}) > 0 \;\forall\, w_1 \in (0, W_1)$

Case 2: $\frac{\partial E_1[\Pi_2]}{\partial w_1} = (1+r)(1+\kappa_1 \frac{\gamma-1}{\gamma}) > 0$

Case 3: $\frac{\partial E_1[\Pi_2]}{\partial w_1} = \alpha z_2((1+\kappa_1)w_1)^{\alpha-1}(1+\kappa_1) - \kappa_1 \frac{1+r}{\gamma} > 0 \;\forall\, w_1 \in (W_2, W_3)$

Case 4: $\frac{\partial E_1[\Pi_2]}{\partial w_1} = \frac{1+r}{\gamma} > 0$

Case 5: $\frac{\partial E_1[\Pi_2]}{\partial w_1} = \alpha z_2 w_1^{\alpha-1} > 0$

Thus, maximizing $E_1[\Pi_2]$ requires maximizing $E_0[w_1]$, accounting for the probability of default.

Next, I show that $E_0[w_1]$ is increasing in FX debt, holding k_1 (and thus $d_1 + d_1^*$) constant and thresholds W_i constant:

$\frac{\partial E_0[w_1]}{\partial d_1^*}|_{W_i=\bar{W}_i,(k_1=\bar{k})} = (1+r)\frac{\gamma-1}{\gamma} > 0$

Next, I show that the default probability is increasing in d_1^*, again holding investment constant:

$\frac{\partial Pr(w_1<W_0)}{\partial d_1^*}|_{k_1=\bar{k}} = G'(\cdot)\frac{z_1 k_1^{\alpha} - (1+r)(k_1-w_0)}{(1+r^*)(d_1^*)^2} > 0$ for all values of debt $d_1 + d_1^*$ such that the firm does not default with probability 1 (prevented by borrowing constraint).

Lastly, I show that the default probability is increasing in z_1:

$\frac{\partial Pr(w_1<W_0)}{\partial z_1} = \frac{k_1^{\alpha}}{(1+r^*)d_1^*} > 0$

This implies that with a higher z_1, the firm could increase their share of FX debt while maintaining their original default probability and thus have higher expected wealth w_1 and then higher expected period 2 profits Π_2. So, $\frac{\partial d_1^*}{\partial z_1} > 0$

■

The intuition is that higher d_1^* increases your probability of being constrained, but higher z_1 decreases your probability of being constrained or defaulting. So, firms that have higher

z_1 can borrow more in the cheaper currency while maintaining an equal or lower probability of default than firms with lower z_1.[85] This mechanism is modeled more fully in Salomao and Varela (2016), which presents a model of firm dynamics that generates more productive firms selecting into FX borrowing. They confirm this prediction with data for firms in Hungary.[86]

The second effect of productivity differences concerns the increase in productivity over time. Increased future productivity increases the optimal scale of current investment. If the firm is unconstrained in period 1 and future productivity is higher than current productivity ($z_2 > z_1$), the firm will increase investment k_2 up to the new optimal level. Note that, all things equal, the probability of being constrained increases with higher future productivity as the optimal investment size gets larger, requiring more debt: $\frac{\partial Pr(w_1 < W_i)}{\partial z_2} > 0 \ \forall \ i \in \{0, 1, 2, 3, 4\}$, where W_i's are the cutoffs for the different cases of the solution, detailed above. Higher future productivity decreases your probability of default.

Combining the cross-sectional and dynamic differences in productivity generates the desired results. Firms with higher productivity in period 1 select into FX debt in period 0, but if there is a negative balance sheet shock in period 1, only the firms who initially had more wealth will be unconstrained. These unconstrained firms will be able to increase their investment k_2 up to a higher optimal level, relative to firms who are less productive in period 1 (and so chose less FX exposure). I assume that $Corr(z_1, \frac{z_2}{z_1}) > 0$, so that currently more productive firms are also more likely to have productive future investment opportunities. Formally, I consider two types of firms: unproductive firms who have productivity $\bar{z}$ in both periods, and productive firms who have productivity z_1 and z_2 such that $\bar{z} < z_1 < z_2$.[87]

[85] Since borrowing decisions made in period 0 affect how binding constraints will be for period 1 borrowing decisions, the FX borrowing constraint may be slack in period 0 for lower productivity firms.

[86] In my data, large non-exporting firms with higher income and more productive capacity (higher levels of physical capital) tend to have larger FX mismatches. However, I do not have data on hours worked or wage bill, so I cannot compute standard measures of total factor productivity directly. While exposed firms tend to have higher absolute income and higher levels of physical capital, those characteristics do not explain the positive results for exposed large firms following the depreciation. Thus, modeling this as an unobserved future opportunity is appropriate and is one possibility that rationalizes the fact found here, and elsewhere in the literature, that large exposed firms sometimes do better following a depreciation.

[87] The results are similar if firms differ in their initial productivity z_1, while all firms face the same productivity growth rate: $z_2 = (1 + g_z)z_1$.

Proposition C.3 gives the conditions whereby a firm with increasing productivity would choose a higher proportion of their debt in FX:

Proposition C.3. *Let $\bar{z}$ be the productivity level of unproductive firms in both periods and z_1, z_2 be the productivity of highly productive firms, such that $\bar{z} < z_1 < z_2$. Then $d_1^*(w_0, z_1, z_2) \geq d_1^*(w_0, \bar{z}, \bar{z})$ when $\frac{z_2^{\frac{1}{1-\alpha}} - \bar{z}^{\frac{1}{1-\alpha}}}{z_1 - \bar{z}} < X_1 k_1^{\alpha}$, for a given constant X_1.*

Proof:

Proof of Proposition C.3. From Proposition C.2, we know that the probability of default in period 1 does not depend on z_2 and is decreasing in z_1. For the remaining thresholds, it is sufficient to find conditions for W_4 such that $Pr(w_1 < W_4 | z_1, z_2) < Pr(w_1 < W_4 | \bar{z})$:

$$\frac{\bar{z}k_1^{\alpha} - (1+r)d_1 - W_4(\bar{z})}{(1+r^*)d_1^*} < \frac{z_1 k_1^{\alpha} - (1+r)d_1 - W_4(z_2)}{(1+r^*)d_1^*}$$

$$W_4(z_2) - W_4(\bar{z}) < k_1^{\alpha}(z_1 - \bar{z})$$

$$\left(z_2^{\frac{1}{1-\alpha}} - \bar{z}^{\frac{1}{1-\alpha}}\right)\left(\frac{\alpha\gamma}{1+r}\right)^{\frac{1}{1-\alpha}} < k_1^{\alpha}(z_1 - \bar{z})$$

$$\frac{z_2^{\frac{1}{1-\alpha}} - \bar{z}^{\frac{1}{1-\alpha}}}{z_1 - \bar{z}} < X_1 k_1^{\alpha}$$

where $X_4 = \left(\frac{1+r}{\alpha\gamma}\right)^{\frac{1}{1-\alpha}}$. Note that for the other thresholds, the constant is, $X_1 = (1 + \kappa_0)\left(\frac{1+r}{\alpha}\right)^{\frac{1}{1-\alpha}}$ $X_2 = (1+\kappa_0)\left(\frac{1+r}{\alpha\gamma}\right)^{\frac{1}{1-\alpha}}$, and $X_3 = (1+\kappa_1)\left(\frac{1+r}{\alpha\gamma}\right)^{\frac{1}{1-\alpha}}$, so $X_4 < X_3 < X_2 < X_1$.

Assuming this condition holds, then $Pr(w_1 < W_i | z_1, z_2) < Pr(w_1 < W_i | \bar{z}) \; \forall \, i \in \{1, 2, 3, 4\}$. From the logic in the proof to Proposition C.2, this implies that $d_1^*(w_0, z_1, z_2) > d_1^*(w_0, \bar{z}, \bar{z})$.

∎

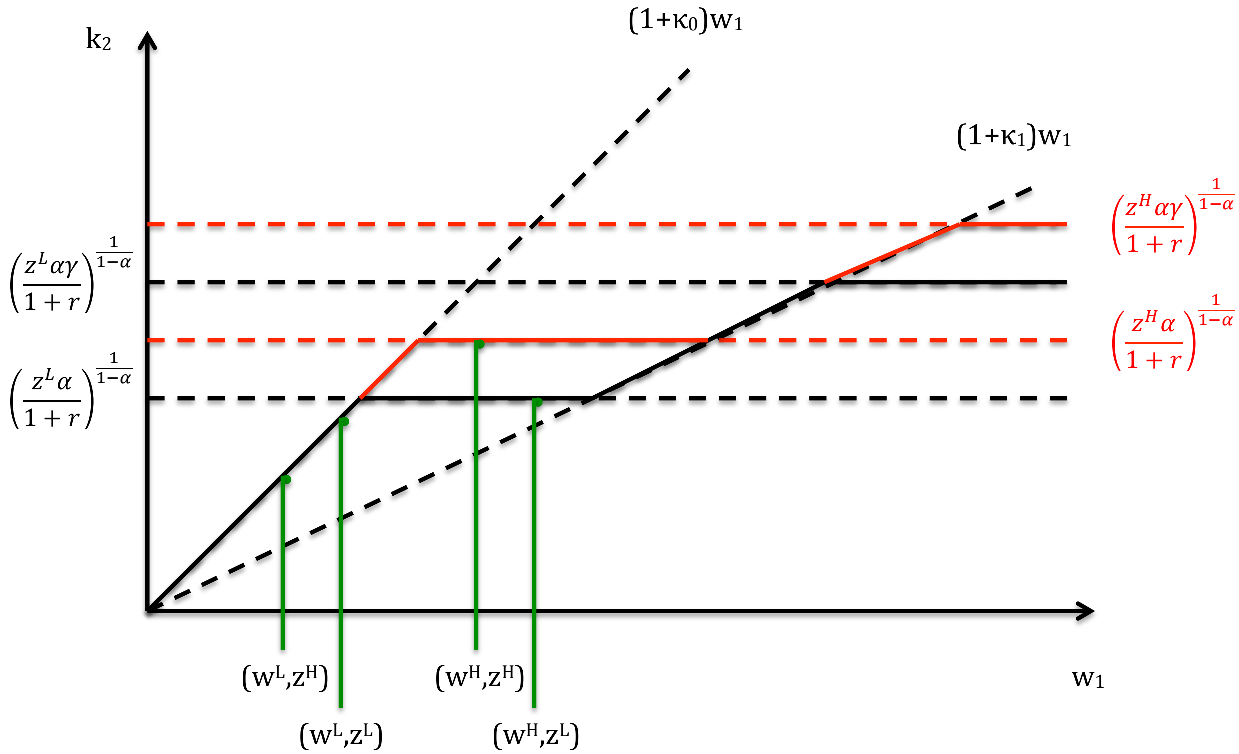
This condition implies that the increase in z_2 over z_1 cannot be too large, or the firm will avoid FX debt in period 0 because their constraint (for the higher level of investment) would be more likely to bind in period 1. Under these conditions, highly productive firms will borrow more in FX in period 0. Thus, the result in the data that large exposed firms do better following the depreciation can be explained in the model by selection into exposure in period 0 by firms with higher current productivity and increasing future productivity (that is, they have productive future investments to make). These firms borrow more in FX initially and experience a large balance sheet shock. Highly productive but small firms (in terms of initial wealth w_0, which implies smaller k_1) are constrained as before, while larger firms are unconstrained, and so they can increase their investment up to the new optimal level.

For illustration, suppose that the realized depreciation is large enough that the productive firms (who borrow more in FX in period 0) end up with lower w_1 than unproductive firms of the same initial w_0.[88] This is not necessary, but serves as a useful demonstration that these results are not due to more productive firms making more money in period 1 than their less productive counterparts. The effects on period 1 decisions are illustrated in Figure C2. Consider 4 firms with high or low productivity and high or low initial wealth: $\{(w^H, z^H)$, (w^H, z^L), (w^L, z^H), $(w^L, z^L)\}$. For firms with lower initial wealth, the drop in net worth that the productive firms experience (given their higher FX exposure) leads to lower borrowing and investment, relative to less exposed firms, due to the binding borrowing constraint. For large (high wealth) firms, the negative shock to net worth leaves them in the unconstrained range, and so they are able to increase borrowing and investment up to the new optimal level k_2, but decrease FX borrowing and increase peso borrowing to do so. Thus, comparing exposed firms to less exposed firms of the same w_0 size following the shock, the large firms invest more but the small firms invest less.

While productivity differences with selection into FX exposure is a plausible explanation for the increase in real outcomes for more exposed large firms, one important caveat with the preceeding discussion is that these differences imply that more productive large firms would increase their real activity regardless of the exchange rate shock. This would violate the parallel trends assumption in the empirical section. Thus, while the proposed model may be a useful framework, especially for understanding the reallocation of debt by currency (which does not require the assumptions about productivity differences), other

[88] This occurs when $(1+\phi) > \frac{k_1^{\alpha} - (1+r)\frac{\partial d_1}{\partial z_1}}{(1+r^*)\frac{\partial d_1^*}{\partial z_1}}$.

Figure C2: Size and Investment: Difference by Productivity



explanations are important to pursue.

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