

WHAT HINDERS INVESTMENT IN THE AFTERMATH OF FINANCIAL CRISES: INSOLVENT FIRMS OR ILLIQUID BANKS?

Sebnem Kalemli-Ozcan, Herman Kamil, and Carolina Villegas-Sanchez*

Abstract—We quantify the effects of lending and balance sheet channels on corporate investment during large devaluations. We find that if currency crises are accompanied by banking crises, domestic exporters holding unhedged foreign currency debt decrease investment while foreign exporters with better access to credit increase investment despite their unhedged foreign currency debt. We do not find such a differential effect under pure currency crises. Using firm-bank matched data during the global financial crisis, we show that both domestic and foreign-owned firms experienced a decline in bank credit from affected banks; however, foreign-owned firms substituted the lost credit.

I. Introduction

A central debate in finance and macroeconomics is whether financial frictions operate mostly through the bank lending channel, the firm balance sheet channel, or both in transforming financial crises into recessions. Quantifying the effects of both channels on corporate investment simultaneously has proven difficult. This is the task we undertake in this paper. A key advantage of our approach is that we employ a unique data set that allows us to separately account for the ability of firms to borrow based on their net worth (balance sheet channel) and the ability of banks to lend (the supply of credit/lending channel). Based on this strategy, we simultaneously measure the relative importance of the lending and balance sheet channels for corporate investment.

We use the experience of Latin American countries that experienced a range of financial crises during the period 1990 to 2005. These often involved a currency crisis and a twin crisis episode, where prior to the currency crash, the banking system collapsed, as shown by Kaminsky and Reinhart (1999) and Reinhart and Rogoff (2013a). Both types of financial crises—currency and twin—feature the depreciation or devaluation of the currency and therefore, a willingness of exporting firms to invest and exploit competitiveness effects via a depreciated currency. Hence, a currency crisis constitutes a positive shock to credit demand. The two types of crises differ in the supply of credit by local banks: the lending channel is more relevant during twin crises when the

credit supply contracts relatively more than in the case of currency crises. On the negative side, large devaluations or depreciations also affect a firm's debt burden and net worth. We expect firms with high dollar debt and unhedged instruments (such as export revenue, derivatives or dollar assets) to decrease investment due to the negative shock to their collateral resulting from the balance sheet weakness caused by the depreciated currency (balance sheet channel). Only exporting firms with sufficient dollar-denominated streams of income can compensate changes in the value of foreign currency-denominated debt.

We study four episodes of currency crises (Mexico 1995, Argentina 2002, Brazil 1999 and 2002) using a triple difference-in-difference methodology. Two of these episodes were twin crises because they were combined with a banking crisis: Mexico 1994 and Argentina 2001. To obtain firm-level measures of insolvency and liquidity over time, we hand-collected a unique panel database with annual accounting information for the whole universe of listed nonfinancial companies in these Latin American countries, spanning the period from 1990 to 2005. We define an insolvent firm as a high-leverage firm with holdings of short-term foreign currency-denominated debt that are not matched by a dollar-denominated stream of income.¹ These firms are naturally more likely to experience a decline in net worth in the aftermath of large exchange rate devaluations. Aguiar (2005) shows that firms with heavy exposure to short-term foreign currency debt before the Mexican crisis decreased investment relative to firms with lower dollar debt exposure. Bleakley and Cowan (2008) report the opposite result, whereby firms holding dollar debt invest more during exchange rate depreciations. They argue that firms match the currency composition of their liabilities with that of their income streams or assets, avoiding insolvency during a currency depreciation. Hence, we ensure that our insolvent firms have unhedged foreign currency debt.

We measure the liquidity shock first at the country level by focusing on twin crisis episodes that are characterized by a general scarcity of credit in the year prior to the currency crisis for all firms. Second, we use foreign ownership (FDI and portfolio equity investment) as our preferred firm-level measure of access to liquidity. Desai, Foley, and Forbes (2008) investigate the response of sales, assets, and capital expenditures of U.S. multinational affiliates and domestic firms in the aftermath of a variety of financial crises in 25 emerging market countries and find that foreign affiliates outperform their local counterparts across these performance measures. Their interpretation is that local firms are financially constrained

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* Kalemli-Ozcan: University of Maryland, CEPR, and NBER; Kamil: Ministry of Finance, Uruguay; Villegas-Sanchez: ESADE–Universitat Ramon Llull.

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¹ This is based on Allen et al. (2002).

due to their limited access to finance.² Hence, we use foreign ownership as our access to finance measure. We test this assumption using firm-bank matched data from Mexico and show that when exposed to the same bank-level liquidity shock, foreign-owned firms, as opposed to domestic firms, are able to substitute credit across banks.

Our main specification regresses firm-level investment on a triple interaction of foreign ownership \times unhedged foreign currency debt \times post, where foreign ownership captures the differential access to finance during a banking versus currency crisis and hence the lending channel. The unhedged foreign currency debt captures the balance sheet weakness and hence the balance sheet channel, and the term *post* refers to the period of devaluation. We estimate this specification in a sample of exporters. We show that, conditional on their balance sheet weakness, foreign-owned exporters invest relatively more than domestic exporters only during twin crises. There is no difference in investment rates between these groups during currency crises, although domestic exporters with unhedged foreign currency debt become risky borrowers under both types of crises. The fact that investment rates are higher for foreign-owned exporters only during one type of crisis also excludes many other explanations, such as the possibility of foreign-owned exporters' switching destination markets. It must be the case that only foreign-owned exporters with high levels of unhedged dollar debt, and only during twin crises, switch destination markets (and hence there must be a differential demand shock for foreign-owned exporters with high unhedged dollar debt during a twin crisis). We undertake a series of robustness checks that help to corroborate our interpretation.

During twin crises, domestic exporters suffer a negative liquidity shock from their bank and hence are unable to roll over short-term debt and exploit growth opportunities. Their investment is 10 percentage points lower than that of foreign-owned exporters when both groups hold similar levels of dollar debt, mostly unhedged. This is a sizable difference between the groups because the average firm in our twin crises countries decreased investment by 20 percentage points during such crises. The average domestic exporter decreased investment by 13 percentage points, whereas the average foreign-owned exporter increased investment by 7 percentage points. Our results point to the key role of illiquidity rather than insolvency as the main source of financial constraint that hinders investment. This does not mean that insolvency due to balance sheet weakness is not important but rather that the availability of credit in the presence of good investment opportunities can overcome short-term balance sheet vulnerability.

Our key contribution relative to past studies reporting the better performance of foreign-owned firms during a variety of crises is that we document the exact mechanism by which financial crises intensify financing constraints. We narrow

the possible set of financial constraints and quantify their effects during financial crises. It is possible that foreign-owned exporters have more resilient balance sheets based on matching dollar income. In simple terms, foreigners might be better at managing their balance sheet exposures. In any of these cases, foreign-owned exporters will enjoy higher net worth and be considered solvent firms in the aftermath of large devaluations. This creates a selection problem and makes it impossible to differentiate whether the better performance of foreign-owned exporters during financial crises is due to better access to liquidity or higher net worth. The strength of our data set lies precisely in observing the foreign currency denomination of the debt together with the foreign ownership status of the firm to account for this bias.

Our key identifying assumption is that conditional on holding unhedged dollar debt prior to the crisis, access to credit is the only difference between foreign-owned and domestic exporters that explains differences in investment rates. As it is possible that foreign-owned exporters differ from domestic exporters in many dimensions other than access to credit, we control for all such differences by including foreign-year fixed effects in all specifications. These fixed effects will absorb time-varying differences before and after the shock in investment rates and determinants of these rates between foreign-owned and domestic exporters. The permanent differences between foreign-owned and domestic exporters will also be absorbed by the foreign-year fixed effects, such as the higher asset tangibility of foreigners, as these fixed effects include foreign dummies by construction. We use sector-year fixed effects to control for changes in sectors over time in terms of their need for external financing and all other supply and demand shocks that are common to all firms within an industry. If access to credit in some sectors is less stringent exactly at the moment of the crisis and foreigners happen to be in those sectors in advance, using foreign-year dummies will fully control for such selection at the moment of the crisis at both the firm and sector level.³ Finally, the multicountry panel dimension of our data allows us to condition on many country-specific policy changes and other macroeconomic shocks through the use of country-year fixed effects, such as valuation effects and country-specific trends.

Why is the access to finance difference between foreign-owned and domestic exporters not absorbed by foreign-year fixed effects? It is probable that there is a difference in access to finance between these groups even during normal times, and this is indeed absorbed by the foreign-year fixed effects. What is not absorbed by these fixed effects is the difference in access to finance between the foreign-owned and domestic exporters who hold high levels of unhedged dollar debt at the time of the twin crisis (and not a currency crisis). Hence, we interpret this result in terms of the bank lending channel

²Desai, Foley, and Hines (2004) show how multinational affiliates use internal capital markets in financially underdeveloped markets.

³Note that we define foreign ownership based on predetermined values three years prior to the crisis; therefore, foreign dummies do not vary over time.

because there is no difference between these two groups when there is no banking crisis.

A final caveat is that we treat balance sheet and lending channel shocks asymmetrically: we have a firm-level measure of the balance sheet shock but not a firm-level measure of the lending shock. So far, we proxied the lending channel with a firm-level access to finance measure, that is, foreign ownership. The literature has shown that the most straightforward way to identify the lending channel is to investigate the behavior of firms borrowing from multiple banks, as in Khwaja and Mian (2008) for Pakistan; Jimenez et al. (2012) for Spain; Amiti and Weinstein (2011) for Japan; and Paravisini et al. (2014) for Peru. The last part of our paper uses firm-bank matched data from Mexico and follows this literature to identify the lending channel. This will help us to test our assumption of foreign ownership being a measure of access to finance. As we have the foreign-owned firm and domestic firm borrowing from the same bank, they will be exposed to the same credit supply shock. We then assess whether domestic and foreign-owned firms have different abilities to substitute for the lost credit and find that only foreign-owned firms had the ability to substitute creditors. This finding justifies our assumption of foreign ownership being an “access to finance” measure during twin crises periods when credit is tight.

We proceed as follows. Section II reviews the literature. Section III presents the methodology. Section IV describes the data. Section V presents the analysis. Section VI undertakes an analysis using a firm-bank-level matched data set. Section VII concludes.

II. Literature

Our paper is related to several strands of the literature. Beginning with the work of Peek and Rosengren (1997), several papers have studied whether bank supply shocks halt credit provision in the domestic economy—for example, Kashyap and Stein (2000), Khwaja and Mian (2008), Paravisini et al. (2014), Schnabl (2012), and Jimenez et al. (2012). We are interested in the real effects of credit shocks. Some studies examine the effects of a supply shock to banks on real aggregate economic activity; however, most of these papers use cross-sectional aggregate variation and produce mixed results. Kashyap, Lamont, and Stein (1994) use U.S. manufacturing firms’ inventory investment data and emphasize the importance of separating the “lending story” from the “collateral story”; however, the cross-sectional nature of their data set does not allow them to do so. Kashyap, Stein, and Wilcox (1993) highlight the change in the firms’ composition of financing when firms switched to commercial paper issuance from bank lending as a result of tighter credit conditions. A recent version of this early idea is the work by Adrian, Colla, and Shin (2012), which criticizes the use of aggregate flow-of-funds data and includes an analysis using microlevel data on loan and bond issuance, revealing

an increase in bond financing when there is a reduction in bank loan supply.

The evidence on firm-level real outcomes is sparse. Two papers using microlevel data with better identification techniques attempt to link credit shocks to firm-level exports, finding sizable effects. Paravisini et al. (2014) investigate the effect of the 2008 crisis on Peruvian exporters, and Amiti and Weinstein (2011) investigate the effect of financial shocks on exporters via trade finance using a bank-firm matched data set from Japan. On investment, Amiti and Weinstein (2013) employ the same data set to show that movements in the bank loan supply net of borrower characteristics and general credit conditions have large impacts on aggregate loan supply and investment. Duchin, Ozbas, and Sensoy (2010) investigate the effect of the 2008 crisis on the corporate investment of U.S. listed firms. Their paper shows that firms with more collateral decrease investment less, which is consistent with one of the main results in our paper, indicating that firms that suffer from balance sheet weakness decrease investment relatively more.⁴ Acharya et al. (2014) investigate the effects of a shock to GIIPS banks on investment for firms that borrow from GIIPS banks.

None of these papers focus on separating the lending channel from the balance sheet channel and providing estimates for each channel.

III. Identification

Our identification strategy is based on a triple differences-in-differences specification. The key justification for doing so is its ability to control for all of the time-varying differences between domestic and foreign-owned exporters through the use of foreign-year effects. We focus on the sample of exporting firms because these firms are more likely to experience a positive shock to credit demand as a result of their increased competitiveness due to a depreciated currency. The triple differences-in-differences specification, by interacting foreign ownership with balance sheet weakness and a time dummy that separates the period before and after depreciation and another dummy that separates the period before and after the twin crisis (depreciation plus banking crisis), will deliver different investment rates of foreign-owned and domestic firms after the depreciation conditional on the fact that both sets of firms have the same balance sheet weakness. Such weakness is captured by the share of unhedged short-term dollar liabilities.

The identifying assumption is that conditional on having a similar balance sheet exposure prior to the crisis, foreign-owned and domestic firms do not differ in any other dimension that is correlated with the difference in their investment rates, before and after the crisis. The only difference between foreign-owned and domestic exporters, both holding unhedged dollar debt when entering the crisis, is

⁴ A similar paper to Duchin et al. (2010) is the work by Almeida et al. (2012), in which the investment outcomes of firms that differ in their long-term debt maturity structure were compared during the 2008 financial crisis.

the difference in their access to finance before and after the crisis.

We estimate:

$$\begin{aligned}
 y_{i,c,j,t} = & \beta_1 \text{Foreign}_{i,c,j} \times \text{ShortDollarDebt}_{i,c,j} \\
 & \times \text{Post}^{\text{currency},t} + \beta_2 \text{ShortDollarDebt}_{i,c,j} \\
 & \times \text{Post}^{\text{currency},t} + \beta_3 \text{Foreign}_{i,c,j} \\
 & \times \text{ShortDollarDebt}_{i,c,j} \times \text{Post}^{\text{twin},t} \\
 & + \beta_4 \text{ShortDollarDebt}_{i,c,j} \times \text{Post}^{\text{twin},t} \\
 & + \gamma_{FO,t} + \phi_{j,t} + \varphi_{c,t} + \alpha_i + \xi_{i,c,j,t}, \quad (1)
 \end{aligned}$$

where $y_{i,c,j,t}$ refers to investment of firm i in country c in sector j at time t .

Foreign is a dummy variable that takes a value of 1 if the company is foreign owned and 0 otherwise. This variable is based on the percentage of the firm's capital stock held by foreigners (see section IV for a description of the data). *ShortDollarDebt* equals 1 if short-term dollar debt holdings are higher than the median of the distribution of this variable among firms holding such debt. While using dummy variables might restrict variation, for example, in terms of the amount of foreign investment in these firms' capital stock, we still prefer the dummy variables for two reasons. First, given our triple interaction specification, indicator variables make the interpretation of the coefficients straightforward by clearly identifying the groups of interest. Second, to avoid concerns regarding selection into becoming a foreign-owned firm or a high-dollar debt holder as a consequence of the crisis, both *Foreign* and *ShortDollarDebt* are predetermined variables based on the values of the corresponding variables three years prior to the crisis.

$\text{Post}^{\text{twin}}$ is a dummy variable that takes a value of 1 in the year of the twin crisis and one year after. The corresponding initial depreciation year is 2002 for Argentina and 1995 for Mexico; in both countries, a banking crisis had begun just one year prior to the beginning of the currency crisis. $\text{Post}^{\text{currency}}$ is a dummy variable that takes a value of 1 in the year of the currency crisis and one year after, meaning that the initial depreciation year is 1999 or 2002 in Brazil (Brazil experienced two different currency crises in a relatively short period of time). (See section IVA for a description of the crisis episodes.)

We include $\phi_{j,t}$ that controls for sector-year fixed effects and $\varphi_{c,t}$ that captures country-year fixed effects, $\gamma_{FO,t}$ are the foreign-year fixed effects, α_i are firm-specific effects, and $\xi_{i,c,j,t}$ is the error term.⁵ By using firm fixed effects, we will be identifying solely on the basis of firm changes over time. Therefore, because *Foreign* and *ShortDollarDebt* are predetermined variables that do not vary over time, we cannot identify their main effect, which is absorbed by the firm fixed effects. The same is true for the interaction of the two. Country-year and sector-year effects will absorb the effects

of any other macroeconomic and industry-level shock. Most important, the foreign-year fixed effects will control for all of the time-varying differences between foreign-owned and domestic companies.

The interpretation of the coefficients in equation (1) is as follows: β_2 is the effect of holding dollar debt after the currency crisis only for the sample of domestic exporting firms. Similarly, β_1 captures the investment behavior of foreign-owned exporting companies holding dollar debt relative to those domestic-owned exporting companies with dollar debt after the currency crisis. β_4 and β_3 capture similar effects after the twin crisis.

If there is no balance sheet mismatch (when dollar debt is hedged) on the part of both foreign-owned and domestic firms, we expect β_2 in equation (1) to be insignificant because domestic exporting firms that hold dollar debt should not perform differently than do foreign-owned exporting firms with dollar debt, provided that we have foreign-year fixed effects in the regression controlling for all other differences between foreign-owned and domestic firms. Alternatively, if there is a balance sheet mismatch, then both sets of exporters will suffer from weak balance sheets, again leading to an insignificant coefficient because there will not be any difference in the performance of the two types of firms. The possibility of domestic exporters matching their liability dollarization, while foreign-owned exporters do not (or vice versa), that plagued previous studies is completely accounted for by our triple specification, where we explicitly include the possibility of mismatch.

Hence, β_1 compared to β_2 and β_3 compared to β_4 is the incremental effect on investment of being a foreign-owned company among exporting firms holding unhedged dollar debt. If $\beta_3 > \beta_4$ (i.e., foreign-owned exporting firms holding dollar debt outperform domestic exporters holding dollar debt), we interpret this as the access-to-finance effect or evidence for the liquidity channel. This interpretation will be strengthened by β_1 not being statistically different from β_2 during a currency crisis, as domestic banks can still provide credit and the access-to-finance effect should be mitigated (see section IVA and figure A.3 in the online appendix for a lengthier discussion of this point).

IV. Data and Background on the Crises

The empirical analysis draws on a unique database with accounting information for the entire universe of publicly traded companies in three Latin American countries, spanning the period from 1990 to 2005.⁶ The countries covered

⁶Section B.1 in the online appendix provides a detailed description of the data provider and the coverage of the sample. Table A.1 shows the market capitalization of the countries in the analysis, together with that of Spain, Germany, and the United States for comparison. Table A.2 shows the average number of listed firms during the period and compares to official sources and reports exit rates and the average number of years. Note that the comparison to official sources is not one-to-one because the World Development Indicators refer to all listed companies while we work with nonfinancial listed companies.

⁵Note that the Post dummy is captured in the country-year fixed effects as other time dummies.

are Argentina, Brazil, and Mexico.⁷ A distinct feature of this data set is that together with firm-level investment, it contains detailed information on the currency and maturity composition of firms' balance sheets, the breakdown of sales into domestic and export revenues, firms' foreign ownership structure, and other measures of access to international markets, such as corporate bond issuances abroad at the transaction level.

The original data set does not provide information on firm-level ownership, and therefore, we undertake a very detailed process to construct a continuous measure of foreign ownership for each firm in our sample. Our indicator of foreign ownership is based on precise dates of ownership changes, the share of the firm's capital stock held by foreigners, and the nationality of the parent and global ultimate parent (see section C in the online appendix for a full description). As a result, the foreign ownership measure can take any value between 0 and 100 and represents the percentage of capital owned by foreign investors at a given point in time. Figure A.1 in the online appendix shows the evolution of average foreign ownership over time in our sample in a balanced panel. Many Latin American countries underwent massive privatization processes during the 1990s. Therefore, as expected, foreign ownership has grown steadily over time. Most of our firms are domestic, and hence the distribution of foreign ownership has a high concentration of firms around 0, where 70% of the firms are domestic, as shown in panel a of figure A.2 in the online appendix.⁸ Panel b in figure A.2 shows that among firms with positive foreign ownership, 40% of the observations are between 85% and 100% foreign owned. Hence, foreign investors prefer to have a controlling stake in general (or to engage in FDI with fully owned subsidiaries). These distributions are similar across countries.

A. *The Crisis Episodes*

Table A.3 in the online appendix shows the currency crisis and banking crisis episodes for our countries together with percent changes in macroaggregates before, during, and after the crisis episodes. All of the percent changes in table A.3 are two-year averages. As in Desai et al. (2008), we identify a currency crisis in a given year if the real exchange rate depreciated by more than 25% with respect to the previous year. We identify four currency crisis episodes in our sample:

⁷ See the data appendix and Kamil (2009) for a detailed description of the data set and sources. The original data set was collected for Argentina, Brazil, Chile, Colombia, Mexico, and Peru; however, only Argentina, Brazil, and Mexico experienced currency crises during this period, and therefore we limit the analysis to these three countries. According to Desai et al. (2008), Peru also experienced a currency crisis in 1993; unfortunately, our data for Peru begin only in 1994, and because we cannot conduct a before-and-after analysis, we do not include Peru in the analysis.

⁸ We choose 2000 as an intermediate year, but similar figures are obtained using any other year.

Mexico (1995), Brazil (1999), Brazil (2002), and Argentina (2002).⁹

Following Reinhart and Rogoff (2013b), we identify the following banking crises: Argentina (1995), and (2001), Brazil (1995), and Mexico (1994). Reinhart and Rogoff (2013b) base their classification of banking crises on two types of events. First, they focus on bank runs that led to the closure, merging, or takeover by the public sector of one or more financial institutions. Second, in the absence of bank runs, a banking crisis involves the closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions) that marks the beginning of a string of similar outcomes for other financial institutions.¹⁰

Table A.3 shows that with the exception of Argentina, the countries we consider exhibited similar rates of GDP growth, investment, and trade balance prior to the crisis. During the crisis and in its aftermath, experiences differ from country to country, showing the importance of including country-year fixed effects. A common feature of recovery in all countries is the increase in investment and exports, leading to positive trade balance growth.

A critical assumption for our study is that banks are illiquid during only twin crises, not currency crises. Note that our results do not rest on the very strict form of this assumption. We only need banks to be relatively more illiquid during twin crises relative to during currency crises. Since the seminal work of Kaminsky and Reinhart (1999), an extensive literature has highlighted the role of a troubled banking sector that transforms a currency crisis into a twin crisis. This is especially relevant for emerging markets, where stock and bond markets are less developed and banks are the main source of credit. Therefore, bank illiquidity entails a halt in domestic credit provision. Banks can also be insolvent if they

⁹ All four episodes imply a considerable depreciation of the real exchange rate: the two episodes in Brazil amounted to a 34% depreciation, while Mexico witnessed a 47% depreciation, and Argentina one of 96%. Note that Mexico abandoned the peg on December 20, 1994, and we are interested in the effects of such depreciation on investment; therefore, we set the beginning of the currency crisis in 1995. To avoid misclassification of companies based on values prior to the crisis, all predetermined variables in Mexico are based on information provided in the years 1991, 1992, and 1993.

¹⁰ For example, Argentina (2001) and Mexico (1994) were precipitated by different events. In Argentina, a bank run began in March 2001, due to a lack of public confidence in government policy actions. There was strong opposition from the public to the new fiscal austerity package sent to the Congress and the amendment to the convertibility law (change in parity from being pegged to the dollar to being pegged to a basket composed of the U.S. dollar and euro), as described in Laeven and Valencia (2008). As a result of the bank run, partial withdrawal restrictions were imposed (*corralito*) and fixed-term deposits (CDs) were reprogrammed to stop outflows from banks (*corralon*). In Mexico, the 1994 banking crisis had different origins. Until 1991, banks were nationalized. With the privatization process in 1991–1992, investors with scarce previous experience in banking seeking to quickly recover their investment extended large amounts of loans without proper credit risk analysis. This behavior, together with the stagnation of real estate prices and the increase in U.S. real interest rates, eroded banks' balance sheets. In 1994, 9 of 34 commercial banks were subject to intervention, and 11 banks participated in the loan/purchase recapitalization program. These nine banks accounted for 19% of the assets in the financial system.

have a balance sheet mismatch of their own. For our purposes of focusing on the real effects of the crisis, where the investment decision is made by the firm, the key factor is whether banks can provide liquidity to firms regardless of whether they are themselves illiquid or insolvent. The extensive literature on the bank lending channel also provides evidence on the causal link between a negative shock to banks and the credit provision to firms in a developing country context, as reviewed in the related literature section. The relevant factor for our analysis is that all the banking crises predate the currency crises and were not due to firm bankruptcy. If banks become insolvent under a currency crisis and halt domestic credit provision as much as in the case of a twin crisis, then our firm-level access to finance measure—foreign ownership—should not have differential explanatory power between the types of crises—that is, domestic firms should perform worse than foreign-owned firms under both types of crises.

Figure A.3 in the online appendix demonstrates the case in point and shows that countries that experienced a twin crisis (Argentina and Mexico) witnessed a significant decline in domestic credit provision beginning in the year prior to the currency crisis, whereas this was not the case in Brazil, which experienced two currency crisis episodes. Figure A.3 shows local banks' credit to the private sector (as a percentage of GDP). The top panel shows the case of Mexico and Argentina. In Mexico, the banking crisis of 1994 was followed by a currency crisis in 1995. Domestic credit as a percentage of GDP declined sharply, corresponding to a 40% decline in credit provision to the private sector between 1994 and 1996. In Argentina, the decline in credit as a percentage of GDP was approximately 50% between 2001 and 2003. The lower panel represents Brazil, which did not suffer from a collapse in bank lending during the currency crises of 1999 and 2002.¹¹

B. Descriptive Statistics

Table A.4 in the online appendix reports the percentage of observations by type of firm, averaged over the sample period. Foreign is a dummy that takes a value of 1 if the company is majority owned (more than 50%) by a foreign investor and 0 otherwise. Brazil and Mexico show a similar percentage of foreign-owned observations (on average,

10%), while in Argentina, 40% of the firms are foreign owned according to this definition. If we were to focus on the subsample of firms with some foreign ownership, nearly 45% of Mexican firms with some foreign ownership are majority owned, and in the case of Argentina, 67% of foreign-owned companies are majority owned. Another important variable in the analysis is export status. Approximately 58% of the observations report some export revenue, but only 35% of the total observations report a ratio of export revenue to sales greater than 1%, captured by the *HighExporter* variable.

We measure dollar liabilities as the ratio of total dollar liabilities to total liabilities and short-term dollar liabilities as the ratio of short-term dollar liabilities to total short-term liabilities.¹² Of the sample, 85% report some positive debt holding denominated in foreign currency, while only 56% of the sample report positive dollar assets. Note that although this table cannot inform us of the extent of dollar assets, the percentage of observations reporting dollar assets is remarkably higher in Argentina and Mexico than in Brazil, and we will take this into account during our robustness exercises.¹³

Table A.5 in the online appendix reports the main summary statistics.¹⁴ Our measure of investment is the change in the stocks of property, plant and equipment from $t - 1$ to t net of depreciation normalized by assets in $t - 1$. This is a commonly used measure in the literature. It is the accounting value of the outstanding stock of physical assets. This investment-to-asset ratio is winsorized at the lower and upper 1% level at the country level to control for outliers before it is used in the regressions. The measure might be sensitive to valuation effects, and hence the aim of normalizing with assets is to control for the firm-specific valuation changes that will arise due to differencing the capital stock. Firm fixed effects help to minimize the effects of accounting bias in the value of capital stock. Finally, country-year fixed effects will account for any changes in the valuation effects that are common to all firms operating in the same country.

On average, firms hold 29% of their short-term debt in foreign currency, while exporters hold higher average values of their debt in foreign currency (42%). Bond and equity issuance abroad is limited, at 3% to 4%, and loan issuance abroad is close to 6% to 8%. Online appendix table A.6 shows the corresponding correlations.

What is crucial for this study is the variation in dollar debt holdings across different types of firms. Table 1 shows that, on average, exporters hold more dollar debt

¹¹ Note that the beginning of the 1990s was a turbulent period in Brazil. Inflation was rampant, peaking at 82.4% in March 1990. A new government designed a stabilization program, Plano Real, intended to reduce the fiscal deficit and introduced a new currency. During the 1980s, banks acted as intermediaries for public sector debt and benefited from high inflation and indexation. To avoid reducing their profits once inflation was reduced, banks initially expanded credit (mostly through consumer and commercial loans). Although the new currency reduced inflation, it could not prevent the banking crisis of the mid-1990s. According to Reinhart and Rogoff (2013a), in 1994, 17 small banks were liquidated, 3 private banks were subject to intervention, and 8 state banks were placed under administration. The Central Bank intervened in or placed under temporary administration 43 financial institutions. Private banks returned to profitability in 1998, but public banks did not begin to recover until 1999.

¹² Short-term liabilities refer to outstanding debt that must be paid within twelve months.

¹³ In the case of Mexico, the sample of firms with available information on dollar assets declines to half, and hence it is not fully comparable.

¹⁴ The cleaning procedure outlined in the appendix leaves us with complete information for an unbalanced panel of 7,255 firm-year observations, which consist of 933 firms with an average of approximately 7.7 years each. Data on investment and additional controls included subsequently in the estimation leave us with a sample of 4,548 observations, or 660 firms. Note that some of our main regressions are based on a sample of 2,016 observations, or 252 firms. This is the subsample of exporting firms.

TABLE 1.—DOLLAR DEBT BY FIRM TYPE

	Non-HighExporter		Exporter	
	Mean	Median	Mean	Median
Argentina	0.489	0.509	0.541	0.611
Brazil	0.133	0.021	0.308	0.268
Mexico	0.250	0.161	0.554	0.596
Total	0.233	0.130	0.481	0.512
Test mean difference (<i>p</i> -value)	-0.254	(0.000)		
	Domestic		Foreign	
	Mean	Median	Mean	Median
Argentina	0.482	0.504	0.526	0.557
Brazil	0.165	0.040	0.137	0.040
Mexico	0.363	0.328	0.320	0.296
Total	0.295	0.218	0.276	0.195
Test mean difference (<i>p</i> -value)	0.019	(0.191)		
	Domestic HighExporter		Foreign HighExporter	
	Mean	Median	Mean	Median
Argentina	0.507	0.589	0.591	0.626
Brazil	0.308	0.265	0.309	0.307
Mexico	0.566	0.609	0.412	0.439
Total	0.488	0.518	0.417	0.453
Test mean difference (<i>p</i> -value)	0.071	(0.016)		

The table reports the mean and median of the variable *ShortDollarDebt* in the sample of firms with available investment information. *ShortDollarDebt* is the ratio of short-term (less than twelve months) dollar-denominated liabilities to short-term debt. *HighExporter* is a dummy variable that takes the value of 1 if the firm reports an exports-to-sales ratio of more than 1% and 0 otherwise. *Foreign* is a dummy variable that takes the value of 1 if the firm is more than 50% owned.

than do nonexporting firms. However, what is important for our differences-in-differences methodology is the difference between foreign-owned and domestic exporters, which seem to hold similar average ratios of short-term debt denominated in foreign currency. In Mexico, the difference between foreign-owned and domestic exporters is slightly higher; however, this difference is not statistically significant in the period prior to the crisis.¹⁵

There are certain institutional differences across countries with respect to firms' ability to borrow in foreign currency from local banks. In Argentina and Mexico, firms can borrow in dollars from domestic banks. In the case of Brazil, however, most of companies' foreign currency borrowing is obtained abroad (whether bond issuances, bank loans, or trade credit). This is because, in Brazil, financial dollarization is severely restricted: on-shore foreign currency deposits are banned, and private banks cannot lend in dollars. In Brazil, firms that want to borrow in foreign currency domestically can do so only through the state development bank (BNDES) under stringent conditions. Only exporters can borrow easily from BNDES by pledging foreign currency revenue as collateral against dollar debt. As we will focus on exporters throughout our analysis, the concern that domestic firms in Brazil could hold significantly less foreign currency-denominated debt than foreign-owned firms do is less troublesome. In fact, as is clear from the previous table

1, this is not the case. In addition, foreign currency borrowing by domestic firms in Brazil is nonnegligible and amounts to 30% of short-term liabilities, which is in line with the 40% figure for Mexico.¹⁶

V. Empirical Analysis

A. Benchmark Results

Our aim is to compare firms with similar balance sheet exposures that differ only in their foreign ownership status. Conditional on the balance sheet channel, the lending channel implies that foreign-owned firms should invest more than domestic firms only during twin crises (when bank liquidity constraints are more pronounced) but that no significant differences should be present during currency crises.

We proceed to estimate our main specification presented in equation (1) on the sample of exporting firms. To define the exporter sample, we use a predetermined export dummy. Although changes from nonexporter to exporter status at the time of the crisis were relatively limited in our sample and accounted for 4% of the exporting observations, we nevertheless define an exporter as a firm that reported export revenues during the three years prior to the crisis.¹⁷ To address selection concerns, we also use predetermined dummy variables to measure the exposure

¹⁵ On average, prior to the crisis, domestic exporters held 58% of their short-term debt denominated in dollars while foreign-owned exporters held 50%, and this difference is not statistically significant. See also table A.9 in the online appendix for further robustness checks regarding different trends in dollar debt holdings between the two groups of interest prior to the crisis.

¹⁶ Compared to other countries in the region, Brazil's foreign currency borrowing is similar to that in Chile (29%) and considerably higher than that observed in Colombia, where there are also, as in Brazil, controls on foreign currency borrowing (10%).

¹⁷ In the case of Argentina, we refer to the years 1998, 1999, and 2000; for Brazil 1996, 1997, and 1998; and for Mexico 1991, 1992, and 1993.

of the firm to short-term dollar liabilities¹⁸ and foreign ownership.¹⁹ There is the possibility that productive firms were bought out by foreigners during the crisis. Aguiar and Gopinath (2005) show that foreign investors buy inferior firms at fire-sale prices. Note that this mechanism will work against our result; nevertheless, we define foreign status as a dummy based on the ownership status of the firm three years prior to the crisis.²⁰

Table 2 reports our main results. Column 1 shows that foreign-owned exporting companies holding dollar debt increase investment during twin crises relative to domestic firms holding dollar debt. On the contrary, during currency crises, there is no significant difference between the investment behavior of foreign-owned and domestic exporters (see column 2). Column 3 presents the full specification that accounts simultaneously for twin and currency crises and corroborates the results reported in columns 1 and 2. As shown in table A.12 in the appendix, these results are not driven by entry into and exit from the sample and are robust to considering a continuous sample of firms (i.e., firms that we observe from the beginning of the sample to the last year of the crisis: Mexico 1990–1996 and Argentina and Brazil 1993–2003).

To account for the relative importance of holding dollar debt in the overall indebtedness of the company and to control for international access to credit other than that secured through foreign ownership, we proceed as follows. First, holding dollar debt might not be an issue for investment if the firm is not leveraged; therefore, all specifications include the ratio of total liabilities to total assets lagged by one period. Second, we use data from Dealogic Bondware and Loanware to include measures of access to international markets: a BondAbroad dummy that takes a value of 1 in the year the firm issues a corporate bond abroad, an InternationalLoan dummy that takes a value of 1 in the year the firm issues a syndicated loan abroad, and an EquityAbroad dummy that takes a value of 1 in the year the firm issues stock abroad (either as ADR or GDR, whether in the United States or another stock market). Although these measures are good proxies for external sources of financing during tranquil times, we believe that these measures will be relatively weak during financially turbulent times. As argued by the sudden stop literature, markets shy from emerging markets during such times (see, Mendoza and Calvo, 2000, and Reinhart and Reinhart, 2008). Indeed, these measures are insignificant in all specifications. We thus rely on foreign ownership as the

main arm's-length source of financing for foreign affiliates located in emerging markets, especially during financial crises.²¹

In column 3, foreign-owned exporters holding dollar debt increase investment relative to domestic exporters holding dollar debt during twin crises. However, foreign-owned exporters holding dollar debt do not behave significantly differently from domestic exporters with dollar debt during currency crises. In addition, in column 2, according to the *F*-test at the end of the table, the total effect of dollar debt is not significant during the currency crisis years. The results in column 3 indicate that domestic exporters with high levels of the short-term dollar debt ratio at the time of a crisis exhibited an average investment ratio that is 10 percentage points lower than that of foreign-owned exporters with high levels of short-term dollar debt.

We next turn to analyze the robustness of our results.

B. Additional Controls

The results in table 2 indicate that controlling for firm balance sheet weakness, during a twin crisis, foreign-owned exporters increase investment relative to domestic exporters. Table 3 presents a series of robustness checks based on additional controls.

One of our key assumptions is that firms in countries that experienced a twin crisis cannot finance investment or working capital through banks at the time of the crisis. Several studies have highlighted the dependence of firms on the local banking system in Latin America, such as Demircuc-Kunt and Levine (2001). We add the variable bank debt to total liabilities to control for this effect in column 1. Statistics on this variable indicate that 20% of total liabilities correspond to short-term bank debt and that exporters seem to exhibit only a slightly higher dependence on short-term bank debt at 22%. Highly bank-indebted firms tend to invest less, and there is no differential effect during the crisis periods; the crucial point is that our main result is not affected.

We have emphasized the role of hard-currency-denominated income as the main channel to avoid balance sheet mismatches, but other factors can contribute to improving firms' solvency. The potential negative effect of foreign-denominated short-term liabilities on firms' balance sheets during crises can be mitigated by significant holdings of foreign currency-denominated assets. Column 2 shows that our results are robust to controlling for dollar assets as a share of total assets during crises; higher dollar asset holdings on the part of foreign-owned exporters is not the main channel explaining their relatively better performance. In column 3, we explore another channel that could explain

¹⁸ *ShortDollarDebt* is a dummy that equals 1 if the firm had a ratio of short-term dollar debt to short-term debt greater than 32% at any time during the three years prior to the crisis. The 32% figure corresponds to the median of the distribution of firms holding short-term dollar debt.

¹⁹ As we are estimating a triple interaction model, to correctly identify the groups of interest, we opt to define foreign-owned companies according to a dummy that equals 1 if the company is more than 50% owned by a foreign investor in the three years prior to the crisis and 0 otherwise.

²⁰ There are 23 cases in which a domestic firm changed ownership status to majority foreign owned at the time of the devaluation in the total sample; in the exporter subsample, there are only 6 of such cases.

²¹ Argentina Renault is a case in point. In 2001, the parent firm contributed \$300 million to ensure the survival of its affiliate. In January 2003, it received an additional \$160 million from its parent, Renault, to accommodate its bank creditors. The company lost \$71 million in 2003 and ended the year with debt of approximately \$276 million. However, during the first half of 2004, the company made a small profit.

TABLE 2.—DIFFERENTIAL RESPONSE OF FOREIGN EXPORTERS HOLDING DOLLAR DEBT DURING CRISES

Dependent Variable: Investment Sample: Argentina, Mexico, and Brazil	(1)	(2)	(3)
$ShortDollarDebt \times Foreign \times Post^{twin}$	0.092** (0.04)		0.089** (0.04)
$ShortDollarDebt \times Post^{twin}$	-0.100** (0.03)		-0.100** (0.03)
$ShortDollarDebt \times Foreign \times Post^{currency}$		-0.047 (0.03)	-0.023 (0.03)
$ShortDollarDebt \times Post^{currency}$		0.016 (0.02)	0.016 (0.02)
<i>BondAbroad</i>	0.022 (0.02)	0.024 (0.02)	0.022 (0.02)
<i>InternationalLoan</i>	0.013 (0.01)	0.012 (0.01)	0.013 (0.01)
<i>EquityAbroad</i>	0.003 (0.02)	0.001 (0.02)	0.004 (0.02)
<i>Leverage</i>	-0.115*** (0.03)	-0.113*** (0.03)	-0.115*** (0.03)
Observations	2,016	2,016	2,016
Firm FE	Yes	Yes	Yes
Country-year FE	Yes	Yes	Yes
Sector-year FE	Yes	Yes	Yes
Foreign-year FE	Yes	Yes	Yes
F-test: ShortDollarDebt	0.001	0.387	0.008

Sample of HighExporter. The dependent variable is investment normalized by total lagged assets. $Post^{twin}$ is a dummy variable that takes the value of 1 in the year of the twin crisis and one year after; the starting depreciation year is 2002 for Argentina and 1995 for Mexico. $Post^{currency}$ is a dummy variable that takes the value of 1 in the year of the currency crisis and one year after; the starting depreciation year is 1999 and 2002 in Brazil. $ShortDollarDebt$ is a predetermined variable that takes the value of 1 if the ratio of short-term dollar-denominated liabilities to total short-term liabilities is higher than median value in the sample of firms holding short-term dollar debt and 0 otherwise. Control variables: *Leverage* is the ratio of total liabilities to total assets; *BondAbroad* is a dummy that takes the value of 1 in the year the firm issues a corporate bond abroad; *InternationalLoan* is a dummy that takes the value of 1 in the year the firm issues syndicated loans abroad; *EquityAbroad* is a dummy that takes the value of 1 in the year the firm issues equity abroad. All control variables are lagged one period. Standard errors are clustered at the firm-year level. Significant at *10%, **5%, ***1%.

our main results outside an access to credit interpretation: cash holdings. The increase in debt service via the inflated dollar-denominated debt would not entail a deteriorated balance sheet if firms held enough cash. Our main results are not affected, and foreign-owned companies have significantly different cash holdings only during currency crises.

All of the above specifications control for other forms of access to international markets. In column 4, we also test what happens to these other forms of international access to finance at the time of the crisis. Becker and Ivashina (2014) find strong evidence of substitution from loans to bonds at times when bank credit is tight; therefore, if firms could substitute bank credit for corporate bonds at the time of the crisis, we should observe no effect on investment. The results in column 4 show that issuing loans and equity abroad at the time of the crisis seems to be negatively correlated with investment. Some of these issuances might be to service debt rather than to undertake new investment projects. What is interesting is that the size of the interaction coefficients decreases, which might indicate that foreign-owned firms have access to external and internal funding during twin crises.

C. Alternative Explanations

We have argued that the difference in investment patterns between foreign-owned and domestic exporters during twin crises is due to differences in access to liquidity, which we corroborate by the lack of similar findings during currency crises. In this section, we explore potential

alternative explanations for access to credit. It is important to note that all specifications include foreign-year fixed effects and therefore control for systematic differences between foreign-owned and domestic firms. Alternatives to the access-to-credit explanation have to explain differences between foreign-owned exporters holding unhedged dollar debt ratios and domestic exporters *holding unhedged dollar debt ratios*.

It is not straightforward to find alternative explanations to the access to finance reasoning because the alternative explanations would have to apply both to foreign-owned and domestic exporters and to foreign-owned and domestic exporters with high levels of unhedged dollar debt. For example, foreign-owned exporters can have better connections or information about international markets; they can export more than domestic exporters to developed countries that are less affected by the crisis²² or foreign-owned exporters can rely less than domestic exporters on imported

²² Paravisini et al. (2014) show that estimates based on comparing the outcomes of foreign-owned firms and domestic firms might be biased if the crisis had a heterogeneous impact across exporters with multiple destinations. If foreign-owned and domestic exporters have clear-cut differentiated markets (i.e., developed countries' versus emerging countries' destination markets), the foreign-year fixed effects account for such heterogeneity in destination markets. Therefore, the heterogeneity in destination markets could only bias our estimates if foreign-owned exporters holding unhedged dollar debt export to very different markets than domestic exporters holding unhedged dollar debt. It is reassuring that our twin crises results are based on the experience of Mexico, where both foreign-owned and domestic exporters direct over 90% of their exports to a single market, the United States (see figure A.5 in the appendix). We explore this issue more in table A.7.

TABLE 3.—DIFFERENTIAL RESPONSE OF FOREIGNER EXPORTERS HOLDING DOLLAR DEBT: ROBUSTNESS

Dependent Variable: Investment Sample: Argentina, Mexico, and Brazil				
Robustness Measure	(1) BankCredit	(2) DollarAsset	(3) Cash	(4) PostCrisis
<i>ShortDollarDebt</i> × <i>Foreign</i> × <i>Post</i> ^{twin}	0.089** (0.04)	0.101** (0.04)	0.095** (0.04)	0.071** (0.04)
<i>ShortDollarDebt</i> × <i>Post</i> ^{twin}	-0.104** (0.03)	-0.086** (0.03)	-0.101** (0.03)	-0.082** (0.03)
<i>BankCreditShare</i>	-0.061** (0.02)			
<i>BankCreditShare</i> × <i>Post</i> ^{twin}	0.031 (0.05)			
<i>DollarAssets</i> × <i>Foreign</i> × <i>Post</i> ^{twin}		-0.036 (0.06)		
<i>DollarAssets</i> × <i>Post</i> ^{twin}		0.015 (0.03)		
<i>Cash</i> × <i>Foreign</i> × <i>Post</i> ^{twin}			0.017 (0.06)	
<i>Cash</i> × <i>Post</i> ^{twin}			-0.037 (0.03)	
<i>BondAbroad</i> × <i>Post</i> ^{twin}				-0.012 (0.10)
<i>InternationalLoan</i> × <i>Post</i> ^{twin}				-0.104** (0.04)
<i>EquityAbroad</i> × <i>Post</i> ^{twin}				-0.135* (0.07)
<i>Leverage</i> × <i>Post</i> ^{twin}				0.063 (0.07)
<i>BondAbroad</i>	X	X	X	X
<i>InternationalLoan</i>	X	X	X	X
<i>EquityAbroad</i>	X	X	X	X
<i>Leverage</i>	X	X	X	X
Observations	1,950	1,912	1,933	2,016
Firm FE	Yes	Yes	Yes	Yes
Country-year FE	Yes	Yes	Yes	Yes
Sector-year FE	Yes	Yes	Yes	Yes
Foreign-year FE	Yes	Yes	Yes	Yes

Sample of HighExporter. The dependent variable is investment normalized by total lagged assets. *Post*^{twin} is a dummy variable that takes the value of 1 in the year of the twin crisis and one year after; the starting depreciation year is 2002 for Argentina and 1995 for Mexico. *Post*^{currency} is a dummy variable that takes the value of 1 in the year of the currency crisis and one year after; the starting depreciation year is 1999 and 2002 in Brazil. *ShortDollarDebt* is a predetermined variable that takes the value of 1 if the ratio of short-term dollar-denominated liabilities to total short-term liabilities is higher than the median value of the distribution of firms holding short-term dollar debt and 0 otherwise. *BankCreditShare* is the ratio of short-term bank credit to total liabilities. *DollarAssets* is a predetermined variable that takes the value of 1 if the firm held any dollar-denominated assets in the three years prior to the crisis. *Cash* is a predetermined dummy variable that takes the value of 1 if the ratio of cash to total assets is higher than the 75th percentile distribution value and 0 otherwise. Control variables: *Leverage* is the ratio of total liabilities to total assets; *BondAbroad* is a dummy that takes the value of one in the year the firm issues a corporate bond abroad; *InternationalLoan* is a dummy that takes the value of 1 in the year the firm issues syndicated loans abroad; *EquityAbroad* is a dummy that takes the value of 1 in the year the firm issues equity abroad. All control variables are lagged one period. Standard errors are clustered at the firm-year level. Significant at *10%, **5%, ***1%.

intermediate inputs.²³ All of these explanations refer to differences between foreign-owned and domestic exporters, which we account for with the inclusion of foreign-year fixed effects. Note that, a priori, none of these explanations is specific to differences between foreign-owned exporters and domestic exporters with dollar debt.²⁴

One possibility that the foreign-year fixed effects cannot rule out is that among firms holding above-median-dollar debt ratios, foreign-owned companies are larger exporters and therefore can outperform domestic exporters with lower export shares. Table A.7 in the online appendix shows that

²³ The depreciation increases the relative price of imports, which could explain the relatively worse performance of domestic exporters if they are more dependent on imported materials.

²⁴ Foreign affiliates import most of their intermediate inputs from the parent company at a lower price or through different trade credit instruments. This will be in line with our thinking that during crises, parent companies provide either direct credit to foreign-owned affiliates or indirect credit through cheaper intermediate inputs or trade credit.

differences in foreign market exposure cannot explain the increase in investment by foreign-owned companies after the crisis. To proxy for the extent of foreign market exposure, we take the average of the firm exports-to-sales ratio for the three years prior to the crisis. First, we show in column 1 that in the sample of exporting firms holding high-dollar debt ratios, large domestic exporters decrease investment relative to large foreign-owned exporters; however, greater foreign exposure by foreign-owned companies is not a significant determinant of investment. Therefore, the increase in investment identified in our main results cannot be explained by a higher export orientation of foreign-owned companies, which also hold high levels of dollar debt. Column 2 shows very similar results in the total sample of exporters, and finally, column 3 shows that the decrease in investment by large domestic exporters is explained primarily by these exporters' dollar debt holdings. After accounting for differences in foreign market exposure, foreign-owned firms

increase investment relative to domestic exporters holding dollar debt during twin crises, as our prior results indicate.

D. Investment Trends Prior to the Crisis

How different are investment trends for foreign-owned firms with liability dollarization? Although foreign-year effects control for all of the time-varying differences between foreign-owned exporters and domestic exporters, they do not account for differences between foreign-owned exporters and domestic exporters with dollar debt. One of the main identifying assumptions underlying the triple difference-in-difference strategy is that both foreign-owned and domestic exporters holding dollar debt had similar investment trends prior to the crisis. We are working with a relatively homogeneous sample of firms; they are all listed, with nonnegligible export revenue and substantial dollar debt holdings. In addition, the regressions control for a host of other observable characteristics such as the leverage ratio, access to international markets, sector-year fixed effects, and country-year fixed effects. Therefore, we expect similar investment trends prior to the crisis. In table A.8 in the online appendix, we conduct a placebo test using years prior to 1995 as the crisis years and cannot find systematic differences in investment rates between foreign-owned and domestic firms holding above-median-dollar debt in any year prior to the crisis.

E. Are Dollar Debt Holdings Exogenous?

Our results are based on the assumption that firms across countries freely choose the percentage of their short-term debt that is denominated in foreign currency. We do not want our results to be driven by differences in dollar debt practices across countries. As we have explained, most Brazilian companies' foreign currency borrowing is obtained abroad (whether bond issuances or bank loans). Exporters can, however, borrow from the BNDES in foreign currency. In fact, table 1 shows that although lower than the Argentinean and Mexican levels, short-term dollar debt in Brazil represents on average 30% of short-term debt. Most important, most of the variation in short-term dollar debt is observed within the sample of exporters (i.e., nonexporting companies do not hold significant amounts of dollar debt), our sample of interest given that they are the firms representing an investment opportunity. Although the median domestic exporter in Brazil holds lower levels of dollar debt than does its foreign-owned counterpart, the same is true for Argentinean domestic exporters, and this does not seem to be something specific to Brazil.

Finally, it is also possible that both foreign-owned and domestic firms reduce their dollar liabilities in anticipation of the crisis and that it is possible that foreign-owned exporters predict currency crisis more accurately. This can explain the no-difference result between foreign-owned and domestic exporting firms in the case of currency crises. Table A.9 in the online appendix shows that there were no systematic

differences in dollar debt holdings among foreign-owned and domestic exporters prior to the crisis in each of the countries of interest.

VI. Firm-Bank Level Credit Supply Shock

Thus far, we have used two variables to measure a credit supply shock: the country-level banking crisis, assuming all banks are hit by a supply shock, and the other based on the firm-level distinction between foreign and domestic ownership. We assume that foreign-owned firms will be less affected by a domestic banking crisis than domestic firms, and hence, they will experience a relatively lower credit supply shock. None of these variables will measure the firm's idiosyncratic bank supply shock, and therefore our measure for the lending channel may not be accurate. In the first part of the paper, we held that foreign ownership is a good proxy for access to credit during crises, and we have ruled out various alternative explanations. Now we provide further evidence that substantiates this point. We provide evidence indicating that foreign-owned firms are less sensitive than domestic firms to the credit supply channel.

In this section, we employ a new data set from Mexico to measure the firm-specific bank supply shock. The data set is similar to the credit registry data in that we know the loan amount of each firm from each bank (where the bank can be a domestic Mexican bank or a foreign-owned bank). In fact, the data set provides all sources of financing for a firm, not necessarily only banks, and financial institutions other than banks are also recorded. The advantage of the data set is to have a firm-specific measure of the bank supply shock and, hence, to provide an exact measure of the bank lending channel. As we have multiple firms (foreign and domestic) borrowing from the same bank, we can trace the differential effect of a bank-specific shock on foreign-owned and domestic firms. The main disadvantage is that the data set is only for Mexico during the recent period of 2005 to 2012, and therefore we will capture the global financial crisis as the source of the bank credit supply shock instead of Mexico's own peso crisis as we did in the previous section. The second disadvantage is that supply and demand for credit do not move in opposite directions given the lack of a large depreciation.

This section studies the potentially differential response of foreign-owned and domestic firms to a bank credit supply shock. To proxy the bank credit supply shock, we use bank-level variation and test whether banks with headquarters in developed countries reduced credit more than domestic (Mexican) or emerging market banks. The recent financial crisis originated in September 2008 in the United States and soon expanded to European countries. Hence, credit provided by local banks to the private sector in Mexico did not experience a major change during this period (see figure A.4 in the appendix). We expect firms that were more dependent on U.S. and European ("Western") banks to face a

lower credit supply relative to firms borrowing from Mexican banks.²⁵

The identification strategy follows Khwaja and Mian (2008) and Jimenez et al. (2012), where firms borrowing from multiple banks, as in the former, eliminate the influence of the firm-specific characteristics and controlling for firm-year fixed effects in all specifications, as in the latter, eliminates the time-varying changes in the demand for credit. We estimate the following equation:

$$\log(C_{i,b,t}) = \beta_1 \text{WesternBank}_{i,b} + \beta_2 (\text{WesternBank}_{i,b} \times \text{Post}_t) + \alpha_{i,t} + \delta_b + u_{i,b,t} \quad (2)$$

where $C_{i,b,t}$ denotes loans from bank b to firm i at time t ; Post_t is a dummy variable that takes a value of 1 in the year 2009 and thereafter.²⁶ $\text{WesternBank}_{i,b}$ is a predetermined dummy variable that takes a value of 1 if firm i borrowed from a Western bank b one year prior to the beginning of the crisis (year 2007).²⁷ The firm-time dummies $\alpha_{i,t}$ absorb all changes in credit demand by the firm, including all other noncredit shocks to the firm, including common shocks to all firms at time t , and δ_b accounts for changes in credit supply that are bank specific and do not vary over time (i.e., certain banks might have more lenient policies than others).

The results from estimating equation (2) are presented in table A.10 in the online appendix. Column 1 shows that, on average, Western banks provide higher credit than do Mexican or other emerging market banks during “normal” times.²⁸ However, the negative interaction term indicates that Western banks decreased credit during the recent global financial crisis. It could be that the decline in credit by foreign banks is not the result of lower liquidity on the part of banks but rather lower demand on the part of firms given the uncertain conditions. Controlling for firm-year fixed effects rules out this possibility. Similarly, including bank fixed effects guarantees that the results are not driven by average differences across banks. Most important, beginning in column 2, all specifications control for firm-bank-specific effects, δ_{ib} , that control for potential special firm-bank relationships that do not vary over time. Columns 3 and 4 show that both foreign-owned and domestic firms are subject to the credit supply channel. All firms borrowing from Western banks prior to

the crisis experienced a decrease in bank credit from those banks.

Columns 5 to 8 explore potential differences in credit patterns according to maturity. In general, comparing the short-term and the long-term results, it is clear that most of the decline in total bank credit was due to a decline in short-term bank credit. Both foreign-owned and domestic firms experienced a similar decline in short-term bank credit, while domestic firms experienced a sharper decline in long-term bank credit from Western banks.

The results in table A.10 indicate that firms that borrowed from Western banks prior to the crisis experienced a decrease in bank credit from these banks during the crisis years. However, the total bank credit of a firm does not necessarily need to decrease if firms manage to substitute bank credit across banks. We are interested in analyzing whether firms that were highly exposed to foreign bank credit prior to the crisis experienced a higher decrease in overall bank credit relative to firms that were less dependent on foreign bank credit prior to the crisis. To explore this possibility, we estimate the following regression:

$$\log(C_{i,t}) = \beta_0 + \beta_1 (\text{BankCredit}_i^{\text{WB}} \times \text{Post}_t) + \alpha_i + \delta_t + u_{i,t}, \quad (3)$$

where $C_{i,t}$ denotes the total bank credit of firm i at time t (summing the credit from all banks); Post_t is a dummy variable that takes a value of 1 in the years 2009, 2010, 2011, and 2012. We define the variable $\text{BankCredit}_i^{\text{WB}}$ as the share of Western bank credit in total bank credit in year 2007:

$$\text{BankCredit}_i^{\text{WB}} = \frac{\sum_i C_{i,b} \times \text{WesternBank}_{i,b}}{\sum_i C_{i,b}}$$

Given the different results obtained for short-term and long-term bank-specific credit in table A.10, we also explore the possibility that there are differences in total short-term and long-term bank credit at the firm level depending on how exposed firms are to short-term foreign bank credit or long-term foreign bank credit in 2007 prior to the crisis:

$$\begin{aligned} \text{STBankCredit}_i^{\text{WB}} &= \frac{\sum_i \text{STC}_{i,b} \times \text{WesternBank}_{i,b}}{\sum_i \text{STC}_{i,b}} \\ &\quad \text{STC}_{i,b} : \text{short-term bank credit} \\ \text{LTBankCredit}_i^{\text{WB}} &= \frac{\sum_i \text{LTC}_{i,b} \times \text{WesternBank}_{i,b}}{\sum_i \text{LTC}_{i,b}} \\ &\quad \text{LTC}_{i,b} : \text{long-term bank credit.} \end{aligned}$$

Table 4 presents the main results. We are interested in the differential impact of the credit supply channel on domestic and foreign-owned firms. Columns 1 and 2 show that domestic firms are more exposed to the credit channel than are foreign-owned firms. The total bank credit of foreign-owned firms heavily borrowing from Western banks prior to the crisis did not change in the crisis years, suggesting that foreign-owned firms managed to substitute for the decrease

²⁵ We use *banks* for brevity, but, all financial institutions granting credit to these firms are recorded.

²⁶ We have data available for the period 2005 to 2012, and we drop the year 2008 from the analysis because some of the balance sheet items refer to only the first three quarters of 2008.

²⁷ We define Western banks as those with an ultimate owner headquartered in Austria, Belgium, Switzerland, Germany, Spain, Finland, France, the United Kingdom, Ireland, Italy, the Netherlands, Norway, Sweden, Portugal, Canada, Japan, and the United States.

²⁸ Note that we identify over 400 financial institutions granting credit to firms operating in Mexico. There are only approximately 40 banks registered in Mexico. The difference in the number of observations comes from considering all financial institutions operating in Mexico (not only banks), and hence export development agencies or mortgage financial institutions are also considered, and many of these companies borrow from banks operating abroad.

TABLE 4.—TRANSMISSION OF CREDIT SHOCKS BY FOREIGN BANKS—FIRM-LEVEL CREDIT

Dependent Variable: $\log(C_{i,t} + 1)$	Total Credit		Short-Term		Long-Term	
	DO (1)	FO (2)	DO (3)	FO (4)	DO (5)	FO (6)
$BankCredit^{WB} \times Post$	-0.643** (0.288)	0.763 (0.531)				
$STBankCredit^{WB} \times Post$			-1.403*** (0.414)	-0.928 (0.714)		
$LTBankCredit^{WB} \times Post$					-0.617 (0.463)	-0.355 (0.868)
Observations	478	144	478	144	478	144
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Firm-year	Firm-year	Firm-year	Firm-year	Firm-year	Firm-year

The dependent variable $\log(C_{i,t} + 1)$ is the log of bank debt from bank of firm i at time t plus 1. Columns 1 and 2 refer to total bank credit, columns 3 and 4 include short-term bank credit, and columns 5 and 6 explore long-term bank credit. *FO* refers to the sample of foreign-owned firms, and *DO* refers to the sample of domestic firms. $BankCredit^{WB}$ is the share of foreign bank credit to total bank credit in 2007. $STBankCredit^{WB}$ is the share of foreign short-term bank credit to short-term bank credit in 2007. $LTBankCredit^{WB}$ is the share of foreign long-term bank credit to long-term bank credit in 2007. Columns 2, 4, and 6 present results for the subsample of predetermined foreign-owned firms (those firms that were foreign owned in 2007) while columns 1, 3, and 5 do so for the subsample of domestic firms. Standard errors clustered at the firm-year level are in parentheses. Significant at *10%, **5%, ***1%.

in credit by Western banks. Conversely, domestic firms with high dependence on foreign bank credit prior to the crisis experienced a decline in overall bank credit. Comparing columns 3 and 5, it becomes apparent that most of the decline in total bank credit was driven by lower short-term lending.

It is now clear from tables 4 and A.10 that foreign-owned firms are less sensitive to the bank credit channel, supporting the evidence presented in the first part of the paper. There, we showed that in the face of a country-wide credit supply shock, foreign-owned firms, as opposed to domestic firms, increased investment rates. The firm-bank matched data in this section allow us to confirm that in addition, given a bank-specific supply shock, foreign-owned firms are better able to substitute credit across banks and therefore are less exposed to credit supply shocks.

VII. Conclusion

We exploit a unique quasi-natural experiment, the experience of Latin American countries with a plethora of financial crises during 1990 to 2005, to disentangle and quantify the effects of the lending channel and the balance sheet channel on corporate investment.

A currency crisis constitutes a positive credit demand shock for exporting firms. These firms may want to increase investment to export more through a competitive devaluation; however, they may not be able to do so if they are credit constrained. In this setting, credit constraints can take different forms. First, the depreciated currency is a negative shock to the firms' collateral in the presence of currency and maturity mismatches, compromising firms' solvency. Second, even if firms do not become credit constrained due to the devaluation and they enjoy strong balance sheets, they might nevertheless not exploit the investment opportunity resulting from a depreciated currency if, simultaneously, there is a credit crunch in the economy due to a banking crisis. Emerging market firms heavily rely on their local banks

for external financing and experience a severe contraction in liquidity during banking crises.

To separate the collateral hypothesis from the liquidity hypothesis, we compare firms with similar net worth at the onset of a financial crisis that differ in their ability to overcome the liquidity crunch experienced by local banks. We condition on balance sheet weakness, and then we study the sensitivity of investment by foreign-owned and domestic exporters to the negative credit supply shock that occurs during a banking crisis, where we expect the former group to be less credit constrained. We test this assumption using firm-bank matched data from Mexico. Our identification strategy is a triple differences-in-differences approach, where we interact foreign ownership with balance sheet weakness before and after both twin and currency crises. This strategy allow us to control for all possible time-varying differences between foreign-owned and domestic exporters by saturating the regression with a full set of foreign-year fixed effects.

We find no difference in the investment behavior of foreign-owned exporters relative to domestic exporters under a currency crisis. This means that they both use the investment opportunity regardless of their balance sheet weakness. If the currency crisis occurs simultaneously with a banking crisis, however, foreign-owned exporters perform significantly better. They increase investment ratios by 7%, and domestic exporters decrease investment by 13%. Overall, our results suggest that the key factor hindering investment in the aftermath of financial crises is illiquidity.

Some caveats are in order. The focus of this paper is on exporting firms that the trade literature extensively shows are of higher quality than other firms in the corporate sector. Therefore, the results presented here cannot be generalized to the full economy. The results indicate that currency mismatches are especially detrimental for local firms with no investment opportunities. Future research needs to focus on the full set of firms, where the balance sheet channel will clearly be very important for firms operating in the nontradable sector.

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